City of Austin | Austin Water
P.O. Box 1088 Austin, TX 78767
AustinWater.org

City of Austin – Austin Water SWIFT Loan Application
Direct Reuse Project 51041
May 11, 2016 Submittal to TWDB (with revisions as noted)

Note: Austin's Direct Reuse SWIFT loan application consists of 8 separate construction projects to upgrade and expand Austin's reclaimed water system. See Project 51042 (Austin's Smart Meter SWIFT loan application) for attachments that are applicable to both loan applications, such as the City of Austin's bond counsel contract, financial advisor contract, and documents pertaining to City of Austin finances.

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Texas Water
Development Board
P.O. Box 13231, Austin, Texas 78711-3231

APPLICATION FOR FINANCIAL ASSISTANCE

FOR WATER AND WASTEWATER INFRASTRUCTURE PROJECTS

This application is comprehensive, covering all loan and grant assistance applications for water and wastewater infrastructure financing through the various Texas Water Development Board (TWDB) programs. The format of the application is intended to expedite the review process for both the applicant and TWDB staff. This application can be used by political subdivisions, including water supply corporations.

Please submit one double-sided original and one indexed, electronic copy, via electronic storage media such as CD or flash drive using MS Word, Excel and/or Adobe Acrobat.

Please submit your application to**:**

Texas Water Development Board
Water Supply and Infrastructure-Regional Water Planning and Development
P O Box 13231
1700 N. Congress Avenue, 5th Floor
Austin, Texas 78711-3231
(78701 for courier deliveries)

A complete application consists of all of the applicable information and forms requested in this document. When preparing this application please review the Application and all Guidance and Forms, listed at the end.

For more information, please contact your Regional Project Implementation Team at:

http://www.twdb.texas.gov/financial/programs/swift/regional_project_teams.asp

Thank you.

TWDB Use Only

Name of Applicant: ________________________

Date application received: ______________

Date administratively complete: ________________

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Part A: General Information

1. The legal authority under which the applicant was created and operates.
   - a) ☐ TYPE A GENERAL-LAW MUNICIPALITY (Texas Local Gov't Code Sec. 5.001)
   - b) ☐ TYPE B GENERAL-LAW MUNICIPALITY (Texas Local Gov't Code Sec. 5.002)
   - c) ☐ TYPE C GENERAL-LAW MUNICIPALITY (Texas Local Gov't Code Sec. 5.003)
   - d) X HOME-RULE MUNICIPALITY (Texas Local Gov't Code Sec. 5.004)
   - e) ☐ SPECIAL-LAW MUNICIPALITY (Texas Local Gov't Code Sec. 5.005)
   - f) ☐ NONPROFIT ORGANIZATION (Business Organization Code Chapter 22)
   - g) ☐ NONPROFIT WATER SUPPLY OR SEWER SERVICE CORP. (Texas Water Code Chapter 67)
   - h) ☐ ALL DISTRICTS (Texas Water Code Chapter 49)
   - i) ☐ OTHER (attach)

2. Applicant Name and Contact Information:

Name:	City of Austin
County:	Travis County
Physical Address:	Austin Water, c/o Heather Cooke 625 E. 10th Street, Suite 300, Austin, Texas 78701
Mailing Address:	Austin Water, c/o Heather Cooke 625 E. 10th Street, Suite 300, Austin, Texas 78701
Phone:	512-972-0083
Fax:	512-974-3504
Website:	http://austintexas.gov/

3. Brief description of the project: A series of projects to improve the filter capacity of Austin Water's two major wastewater treatment plants and expand Austin's reclaimed water system infrastructure

4. Applicant's Officers and Members:

Name	**Office Held**
Steve Adler	Mayor
Ora Houston	Council Member – District 1
Delia Garza	Council Member – District 2
Sabino "Pio" Renteria	Council Member – District 3
Gregorio "Greg" Casar	Council Member – District 4
Ann Kitchen	Council Member – District 5
Don Zimmerman	Council Member – District 6
Leslie Pool	Council Member – District 7
Ellen Troxclair	Council Member – District 8
Kathie Tovo	Council Member – District 9
Sheri Gallo	Council Member – District 10

5. Applicant's **primary contact person** for day-to-day project implementation.

Name:	Heather Cooke
Title:	Legislative Coordinator
Address:	Austin Water, 625 E. 10th Street, Suite 300, Austin, Texas 78701
Phone:	512-972-0083
Fax and Email:	512-974-3504, heather.cooke@austintexas.gov

6. Applicant's Consultants (Attach copies of all draft and/or executed contracts for consultant services to be used by the Applicant in applying for financial assistance or constructing the proposed project.):

a) Applicant Engineer N/A ☐

Firm Name:	City of Austin, Austin Water
Contact:	Chris Chen, P.E.
Address:	625 E. 10th Street, Suite 800, Austin, Texas 78701
Phone:	512-972-0240
Fax:	512-974-3504
Email:	chris.chen@austintexas.gov

b) Bond Counsel N/A ☐

Firm Name:	McCall, Parkhurst, & Horton, LLP
Contact:	Jeff Leuschel
Address:	717 North Harwood, Suite 900, Dallas, Texas 75201
Phone:	214-754-9234
Fax:	214-754-9250
Email:	jleuschel@mphlegal.com

c) Financial Advisor N/A ☐

Firm Name:	Public Financial Management (PFM)
Contact:	Dennis Waley
Address:	221 W. 6th Street, Suite 1900, Austin, Texas 78701
Phone:	512-614-5323
Fax:	512-472-0932
Email:	waleyd@pfm.com

d) Certified Public Accountant (or other appropriate rep) N/A X

Firm Name:	
Contact:	
Address:	
Phone:	
Fax:	
Email:	

e) Legal Counsel (if other than Bond Counsel) N/A X

Firm Name:	
Contact:	
Address:	
Phone:	
Fax:	
Email:	

f) Any other consultant representing the Applicant before the Board N/A X

Firm Name:	
Contact:	
Address:	
Phone:	
Fax:	
Email:	

7. List the counties within the Applicant's service area. Travis, Williamson, Hays

8. Identify the Applicant's total service area population: 948,441 (2016 retail water population)

9. Applicant is requesting funding from which programs? Check all that apply.

		PROGRAM	AMOUNT REQUESTED
a)	☐	Drinking Water State Revolving Fund (DWSRF)	$ _____
b)	☐	Clean Water State Revolving Fund (CWSRF)	$ _____
c)	☐	Texas Water Development Fund (DFund)	$ _____
d)	☐	State Participation	$ _____
e)	☐	Rural Water Assistance Fund (RWAF)	$ _____
f)	X	State Water Implementation Fund for Texas (SWIFT)	$ 86,980,456
g)	☐	Economically Distressed Areas Program (EDAP)	$ _____
h)	☐	If other please explain: _____	$ _____

10. Other Funding Sources: Provide a list of any other funding source(s) being utilized to complete the project, including Applicant's local contribution, if any, or commitments applied for and/or received from any other funding agency for this project or any aspect of this project. **Provide commitment letters if available. Additional funding sources must be included within the Project Budget (TWDB-1201).**

Funding Source	Type of Funds (Loan/Grant)	Amount ($)	Date Applied for Funding	Anticipated or Funding Secured Date
None				
Total Funding from All Sources		$		

Comments: __________

11. Applicant is requesting funding for which phase(s)? Check all that apply.

X Planning
☐ Acquisition
X Design
X Construction

12. Is Applicant requesting funding to refinance existing debt?
X Yes If yes, attach a copy of the document securing the debt to be refinanced. **Attached document (<u>see Austin's Smart Meter SWIFT application</u>)**
☐ No

Part B: Legal Information

13. Cite the legal authority under which the Applicant can issue the proposed debt including the authority to make a proposed pledge of revenues. <u>The City of Austin is a "home-rule" city operating under a home-rule charter, adopted pursuant to Section 5 of Article XI of the Texas Constitution</u>

14. What type of pledge will be used to repay the proposed debt?
X Systems Revenue
☐ Taxes
☐ Combination of systems revenues and taxes
☐ Other (Contract Revenue, etc.)

15. Provide the full legal name of the security for the proposed debt issue(s). <u>City of Austin, Texas (Travis, Williamson and Hays Counties) Water and Wastewater System</u>

16. Describe the pledge being offered and any existing rate covenants. <u>The pledge being offered is systems revenues of Austin Water (the City of Austin's municipally owned water and wastewater utility). The system's revenues are generated by providing retail and wholesale water and wastewater services.</u>

17. Attach the resolution from the governing body requesting financial assistance.
TWDB-0201A (<u>http://www.twdb.texas.gov/financial/instructions/)</u>
X **Attached Resolution**

18. Attach the Application Affidavit
TWDB-0201 (<u>http://www.twdb.texas.gov/financial/instructions/</u>)
X **Attached Applicant Affidavit**

19. Attach the Certificate of Secretary
TWDB-201B (<u>http://www.twdb.texas.gov/financial/instructions/</u>)
X **Attached Certificate of Secretary**

20. Is the applicant a Water Supply Corporation (WSC)?
☐ Yes If yes, attach each of the following:
  - ☐ **Articles of Incorporation**
  - ☐ **Certificate of Incorporation from the Texas Secretary of State evidencing that the current Articles of Incorporation are on file with the Secretary**
  - ☐ **By-laws and any amendments**
  - ☐ **Certificate of Status from the Texas Secretary of State (i.e. Certificate of Existence)**
  - ☐ **Certificate of Account Status from the Texas Comptroller of Public Accounts (certifies that the WSC is exempt from the franchise tax and that the WSC is in good standing)**.

X No

21. Is the applicant proposing to issue revenue bonds?

X Yes If yes, attach copies of the most recent resolution/ordinance(s) authorizing any outstanding parity debt. This is essential to insure outstanding bond covenants are consistent with covenants that might be required for TWDB financing.

Attached resolution/ordinance(s)

(See Austin's Smart Meter SWIFT application)

☐ No

22. Does the applicant possess a Certificate of Convenience and Necessity (CCN)?

X Yes If yes, attach a copy of the CCN and service area map showing the areas the applicant is allowed to provide water or wastewater services.

Attached CCN and service area map

(See Austin's Smart Meter SWIFT application)

☐ No If no, indicate the status of the CCN. ___________

☐ N/A

23. Has the applicant been the subject of any enforcement action by the Texas Commission on Environmental Quality (TCEQ), the Environmental Protection Agency (EPA), or any other entity within the past three years?

X Yes If yes, attach a brief description of every enforcement action within the past three years and action(s) to address requirements.

Attached (See Austin's Smart Meter SWIFT application)

☐ No

24. Are any facilities to be constructed or the area to be served within the service are of a municipality or other public utility?

☐ Yes If yes, has the applicant obtained an affidavit stating that the utility does not object to the construction and operation of the services and facilities in its service area?

☐ If yes, attach a copy of the affidavit.

☐ **Attached affidavit**

☐ If no, provide an explanation as to why not. ___________

X No

25. If the assistance requested is more than $500,000 a Water Conservation Plan (WCP) is required. The WCP cannot be more than **FIVE** years old and must have been adopted by the applicant. Has the applicant adopted a Board-approved WCP? (Check one and attach requested information, if any.)

X Yes Enter date of Applicant's WCP adoption: April 17, 2014

☐ No If no, attach a copy of a draft Water Conservation Plan and Drought Contingency Plan prepared in accordance with the TWDB WCP Checklist (http://www.twdb.state.tx.us/financial/instructions/doc/TWDB-1968.pdf)

☐ **Attached Draft WCP and Drought Contingency Plan**

☐ **Attached Utility Profile TWDB-1965**

http://www.twdb.state.tx.us/financial/instructions/doc/TWDB-1965.pdf

☐ N/A (Request is $500,000 or less per Water Code §§ 15.106(c), 17.125(c), 17.277(c), and 17.857(c))

<u>Note:</u> If the applicant will utilize the project financed by the TWDB to furnish services to another entity that in turn will furnish services to the ultimate consumer, the requirements for the WCP may be met through contractual agreements between the applicant and the other entity providing for establishment of a water conservation plan. The provision requiring a WCP shall be included in the contract at the earliest of: the original execution, renewal or substantial amendment of that contract, or by other appropriate measures.

26. Does the applicant provide retail water services?
  - X Yes — If yes, has the applicant already submitted to the TWDB the annual water use survey of groundwater and surface water for the last **<u>THREE</u>** years?
    - X Yes
    - ☐ No — If no, please download survey forms and attach a copy of the completed water use surveys to the application. http://www.twdb.texas.gov/waterplanning/waterusesurvey/index.asp
      - ☐ **Attached Water Use Survey**
  - ☐ No

27. Is the applicant a retail public utility that provides potable water?
  - X Yes — If yes, has the applicant already submitted the most recently required water loss audit to the TWDB?
    - X Yes
    - ☐ No — If no, and if applying for a water supply project, please complete the online TWDB Water Audit worksheet found at http://www.twdb.texas.gov/conservation/resources/waterloss-resources.asp and attach a copy to the application.
      - ☐ **Attached TWDB Water Audit worksheet**
  - ☐ No

28. Does the Applicant provide wastewater services?
  - X Yes
  - ☐ No

Part C: Financial Information

Regional or wholesale providers, complete questions 29-31.
Retail providers, complete questions 32-34.

29. List top **TEN** customers of the system by annual usage in gallons and percentage of total usage, including whether any are in bankruptcy.

Customer Name	Annual Usage (gal)	Percent of Usage	Bankruptcy (Y/N)
Travis County WCID # 10	700,063,528	30.61%	N
Wells Branch MUD	419,511,800	18.34%	N
North Austin MUD #1	286,883,853	12.54%	N
Northtown MUD	265,251,944	11.60%	N
Shady Hollow MUD	141,815,800	6.20%	N
Aqua Utilities Inc	122,330,100	5.35%	N
City Of Rollingwood	104,364,000	4.56%	N
City Of Sunset Valley	100,994,300	4.42%	N
Creedmoor Maha Water Supply Corp.	77,949,100	3.41%	N
Lost Creek MUD	37,020,200	1.62%	N

Comments: Percent of Usage is based on total usage of wholesale customers only

30. List the top TEN customers of the system by gross revenues and percent of total revenues, including whether any are in bankruptcy

Customer Name	Annual Revenue($)	Percent of Revenue	Bankruptcy (Y/N)
Travis County WCID # 10	2,872,107	30.73%	N
Wells Branch MUD	1,653,752	17.69%	N
North Austin MUD #1	1,159,353	12.40%	N
Northtown MUD	1,018,292	10.90%	N
Shady Hollow MUD	628,066	6.72%	N
Aqua Utilities Inc	526,464	5.16%	N
City Of Rollingwood	482,343	5.63%	N
City Of Sunset Valley	423,361	4.53%	N
Creedmoor Maha Water Supply Corp.	300,410	3.21%	N
Lost Creek MUD	155,442	1.66%	N

Comments: Percent of Revenue is based on total revenue of wholesale customers only

31. Provide a summary of the wholesale contracts with customers

Contract Type	Minimum annual amount	Usage fee per 1,000 gallons	Annual Operations and Maintenance	Annual Capital Costs	Annual Debt Service	Other

Please see Austin's Smart Meter SWIFT application for attachment labeled Part C, Question 31 Wholesale Contracts Summary

32. List top **TEN** customers of the water and/or wastewater system by annual revenue with corresponding usage and percentage of total use, including whether any are in bankruptcy.

a. **WATER**

Customer Name	Annual Usage (gal)	Percent of Total Water Revenue	Bankruptcy (Y/N)
Samsung Austin Semiconductors	1,558,196,400	3.43%	N
University Of Texas	732,563,300	1.94%	N
Freescale	708,784,000	1.43%	N
Austin Independent School District	311,702,200	0.94%	N
Spansion	299,685,900	0.64%	N
Texas Facilities Commission	207,220,700	0.58%	N
St Davids Healthcare LLP	133,147,900	0.36%	N
Seton Healthcare	132,731,700	0.36%	N
Travis County	128,946,800	0.36%	N
Flextronics America, LLC	95,336,500	0.25%	N

Comments: Top ten retail customers by entity; Percent of Total Water Revenue includes all retail sales (commercial and residential)

b. **WASTEWATER**

Customer Name	Annual Usage (gal)	Percent of Total Wastewater Revenue	Bankruptcy (Y/N)
Samsung Austin Semiconductors	1,190,953,300	3.85%	N
Freescale	467,060,900	1.66%	N
University Of Texas	381,598,400	1.46%	N
Austin Independent School District	227,758,500	0.88%	N
Spansion	194,657,872	0.64%	N
Texas Facilities Commission	138,337,900	0.53%	N
Hospira Inc	116,782,300	0.45%	N

Travis County	112,029,000	0.43%	N
Seton Healthcare	106,463,500	0.41%	N
St Davids Healthcare LLP	94,466,500	0.36%	N

Comments: Top ten retail customers by entity; Percent of Total Wastewater Revenue includes all retail sales (commercial and residential)

33. Current Average Residential Usage and Rate Information

Service	Date of Last Rate Increase	Avg. Monthly Usage (gallons) (1)	Avg. Monthly Bill ($) (2)	Avg. Monthly Increase Per Customer($) (3)	Projected Monthly Increase Necessary ($) (4)
Water	11/01/15	5,700	36.20	5.53	2.52
Wastewater	11/01/15	4,000	37.58	1.06	2.40

(1) Estimated average residential usage from FY15 used in setting current (FY16) rates
(2) Estimated average residential bill from FY15
(3) Estimated average residential bill increase seen from FY14 bill to FY15 bill
(4) Estimated average residential bill increase seen from FY15 bill to current (FY16) bill

Comments:
Estimated average annualized residential bill for Water: FY14 $30.67; FY15 $36.20; FY16 $38.72
Estimated average annualized residential bill for Wastewater: FY14 $36.52; FY15 $37.58; FY16 $39.98

34. Provide the number of customers for each of the past five years.

Year	Number of **Water** Customers	**Number of Wastewater Customers**
2011	211,833	**199,005**
2012	213,036	**200,759**
2013	215,955	**202,693**
2014	216,969	**204,378**
2015	221,579	**209,291**
Comments	Monthly average number of customers	**Average Wastewater customer accounts**

Comments: **Items in red were provided to TWDB on 5/16/2016**

All applicants complete questions 35-51 of the financial section, as applicable.

35. Disclose all issues that may affect the project or the applicant's ability to issue and/or repay debt (such as anticipated lawsuits, judgments, bankruptcies, major customer closings, etc.).
None

36. Has the applicant ever defaulted on any debt?
☐ Yes If yes, disclose all circumstances surrounding prior default(s). ___________
X No
Comment: Neither the City of Austin nor Austin Water has defaulted on debt

37. Does the applicant have taxing authority?

X Yes

☐ No

Comment: Austin Water does not have taxing authority, but the City of Austin does have ad-valorem taxing authority

38. Provide the last five-years of data showing total taxable assessed valuation including net ad valorem taxes levied, corresponding tax rate (detailing debt service and general purposes), and tax collection rate.

Fiscal Year Ending	Net Taxable Assessed Value ($)	Tax Rate	General Fund	Interest & Sinking Fund	Tax Levy $	Percentage Current Collections	Percentage Total Collections
20							
20							
20							
20							
20							

Please see Austin's Smart Meter SWIFT application for attached chart, labeled Part C, Question 38
Property Appraised Value

Comments: ___________

39. Attach the last five-years of tax assessed values delineated by Classification (Residential, Commercial and Industrial). **If applicant does not have taxing authority, provide the assessed values of the county.**

a) X **2015 attached**
b) X **2014 attached**
c) X **2013 attached**
d) X **2012 attached**
e) X **2011 attached**

Please see Austin's Smart Meter SWIFT application for attached chart, labeled Part C, Question 39
Assessed Property Value by Class

40. Attach the direct and overlapping tax rate table:

X **Attached tax rate table**

41. Provide the current top **TEN** taxpayers showing percentage of ownership to total assessed valuation. State if any are in bankruptcy and explain anticipated prospective impacts in the Comments blank, below. If any of these have changed in the past three years, please provide information on the changes to the top ten.

Taxpayer Name	Assessed Value	Percent of Total	Bankruptcy (Y/N)
Samsung Austin Semiconductor LLC	2,479,597,057	2.51%	N
Parkway San Jacinto Center, LLC	747,257,757	0.76%	N
Columbia/St Davids Health Care	475,554,898	0.48%	N
Circuit of the Americas LLC	289,137,087	0.29%	N
IBM Corporation	240,508,129	0.24%	N
IMT Capital II Riata LP	236,598,167	0.24%	N
Freescale Semiconductor Inc	230,339,094	0.23%	N
HEB Grocery Company LP	222,663,057	0.23%	N
Shopping Center at Gateway LP	219,840,252	0.22%	N
Riata Holdings LP	203,117,049	0.21%	N

Comments: See attached tables for data on top ten taxpayers over the past three years since some changes have occurred among this top ten group

42. Provide the maximum tax rate permitted by law per $100 of property value. $2.50

43. Does the applicant collect sales tax?

X Yes Provide the sales tax collection history for the past five years.

Fiscal Year Ending	Total Collections (in millions)
2011	$148.78
2012	$162.92
2013	$173.90
2014	$187.25
2015	$201.61

The City of Austin collects sales tax, but Austin Water does not.

☐ No

44. Indicate the tax status of the proposed loan?

X Tax-Exempt

☐ Taxable

45. Proforma **(Select one of the four listed below) Please be sure the proforma reflects the schedule requested, including multi-phased funding options.**

a. System revenues are anticipated to be used to repay the proposed debt. Attach a proforma indicating the following information for each year the debt is outstanding:
   - X projected gross revenues
   - X operating and maintenance expenditures
   - X outstanding and proposed debt service requirements
   - X net revenues available for debt service and coverage of current and proposed debt paid from revenues

b. Taxes are anticipated to be used to repay the proposed debt. Attach a pro forma indicating the following information for each year the debt is outstanding:
   - ☐ outstanding and proposed debt service requirements
   - ☐ the tax rate necessary to repay current and proposed debt paid from taxes
   - ☐ list the assumed collection rate and tax base used to prepare the schedule

c. Combination of system revenues and taxes to be used to repay the proposed debt. Attach a pro forma indicating the following information for each year the debt is outstanding:
   - ☐ projected gross revenues, operating and maintenance expenditures, net revenues available for debt service
   - ☐ outstanding and proposed debt service requirements
   - ☐ the tax rate necessary to pay the current and proposed debt
   - ☐ list the assumed collection rate and tax base used to prepare the schedule

d. Another type of pledge will be used to repay the proposed debt. Attach a pro forma with information for each year the debt is outstanding, which includes projected revenues, annual expenditures, outstanding debt requirements, and revenues available for debt service.

☐ Attached

46. Attach a **FIVE** year comparative system operating statement (not condensed) including audited prior years and an unaudited year-to-date statement. Unaudited year-to-date statement must reflect the financial status for a period not exceeding the latest six months.

☐ **Attached Operating Statement. (see Austin's Smart Meter SWIFT application)**

47. Attach **ONE** copy of an annual audit of financial statements, including the management letter, for the preceding fiscal year prepared by a certified public accountant or firm of accountants and, if the last annual audit was more than 6 months ago, then, provide interim financial information.

☐ **Attached Annual Audit (see Austin's Smart Meter SWIFT application)**
☐ **Attached Management Letter**
☐ **If applicable, attached interim financial information**

48. Does the applicant have any outstanding debt? (Check all that apply)

X Yes, General obligation debt (issued by the City, not Austin Water)
X Yes, Revenue debt
X Yes, Authorized but unissued debt (City Council approved our Series 2016 issuance on April 21, 2016. We expect to sell the bonds on May 10 and close on the bond sale on June 1, 2016.
☐ No

49. Attach a listing of total outstanding debt and identify the debt holder. Segregate by type (General Obligation or Revenue) and present a consolidated schedule for each, showing total annual requirements. Note any authorized but unissued debt.

a. General Obligation Debt:
X Yes
☐ **Attached schedule. The schedule should also identify the debt holder. (see Austin's Smart Meter SWIFT application)**
☐ No

b. Revenue:
X Yes
☐ **Attached schedule. The schedule should also identify the debt holder. (see Austin's Smart Meter SWIFT application)**
☐ No

c. Authorized by Unissued Debt:
X Yes
☐ **Attached schedule. The schedule should also identify the debt holder. (Schedule not yet available)**
☐ No

50. List the ten largest employers of the Applicant's service area:

Name	Number of Employees
Texas State Government	39,499
The University of Texas at Austin	23,131
Dell Computer Corporation	13,000

City of Austin	12,977
Federal Government	11,800
Austin Independent School District	11,478
HEB	11,277
Seton Healthcare Network	10,945
St. David's Healthcare Partnership	8,369
IBM Corporation	6,000

Comments (example, any anticipated changes to the tax base, employers etc.) ___________

51. Provide any current bond ratings with date received.

	Standard & Poor's	Date Received	Moody's	Date Received	Fitch	Date Received
G.O.	AAA	8/21/2015	Aaa	8/25/2015	AAA	8/21/2015
Revenue	AA	5/3/2016	Aa2	4/29/2016	AA-	5/3/2016

52. Is the project intended to allow the applicant to provide or receive water or sewer services to or from another entity?

☐ Yes. If yes, the applicant must attach, at a minimum, the proposed agreement, contract, or other documentation establishing the service relationship, with the final and binding agreements provided prior to loan closing.

☐ **Attached**

X No.

Part D: Project Information

53. Description of Project Need (for example, is the project needed to address a current compliance issue, avoid potential compliance issues, extend service, expand capacity, etc.): Rehabilitation and expansion of the tertiary filtration systems as the South Austin Regional and Walnut Creek Wastewater Treatment Plants will improve effluent quality and increase the capacity of each plant to produce reclaimed water. The Montopolis Tank project will provide storage capacity for Austin Water's Central Low Service Area customers, resulting in a more reliable reclaimed water supply. The Montopolis project also will allow for the connection of additional customers in the Central Service Area of Austin Water's reclaimed system. The Burleson Road Pressure Conversion, Onion Creek Mains, Cemetery Main, and Decker Lane Main projects all extend mains to serve additional reclaimed water customers. Expansion of Austin's reclaimed water supply results in conservation of the drinking water supply and helps meet future water supply needs.

54. Description of Project, including a bulleted list of project elements/components, and alternatives considered (including existing facilities):

- Rehabilitation and expansion of the tertiary filtration system at South Austin Regional WWTP to improve effluent quality and increase capacity to 72 MGD
- Rehabilitation of the tertiary filtration system at Walnut Creek WWTP to improve effluent quality, increase reliability, and improve capacity to 75 MGD
- Construction of 19,000 feet of reclaimed main on Decker Lane to serve the Colony Park development and park, as well as the Travis County Expo Center
- Construction of 18,000 feet of reclaimed main to serve several cemeteries, a school, UT facilities, Huston-Tilotson University, and parks
- Construction of 12,000 feet of reclaimed main to establish a pressure zone in the Burleson area and allow for expansion of the reclaimed system to the Onion Creek area
- Construction of 25,000 feet of reclaimed main to serve parks, a golf course, a school and developments in the Onion Creek area
- Construction of a 4 million gallon ground storage tank and pump station for the reclaimed water system in the Montopolis area

A complete preliminary engineering feasibility data must include:

a. A description and purpose of the project, including existing facilities.
   - Note: CWSRF and DWSRF must address issues scored in Intended Use Plan submittal

   X **Attached**

b. **If project is for __Construction only__, then attach** the appropriate Engineering Feasibility Report:

   a) **__Water__** **(**TWDB-0555 at http://www.twdb.texas.gov/financial/instructions/doc/TWDB-0555.pdf)

   ☐ **Attached**

   b) **__Wastewater__** **(**TWDB-0556 at http://www.twdb.texas.gov/financial/instructions/doc/TWDB-0556.pdf)

   ☐ **Attached**

c. DWSRF applicants must complete a Projected Draw Schedule (TWDB-1202 at http://www.twdb.texas.gov/financial/instructions/doc/TWDB-1202.xls)

55. Water Made Available (For projects requesting a construction component):

a. New supply______________(acre-feet/year) **)** *_________($) capital cost*

- o The **increase** in the total annual volume of water supply that will be made available to the recipient(s) by the proposed project.
- o Water Plan project examples: new groundwater wells, reservoir development, pipelines to sources.

b. New Conservation savings____________(acre-feet/year) __________($) capital cost

- o Annual volume of anticipated water savings resulting from implementation of the proposed conservation project including water loss) and other conservation activities,
- o Water Plan project examples: municipal conservation, advanced Water Conservation, on-farm conservation, brush control, irrigation conservation.

c. New Reuse supply _38,429 anticipated annual demand by 2070 (acre-feet/year) _86,980,456__($) capital cost

- o Increase in the annual volume of (direct or indirect) reuse water supply that will be made available to the recipient(s) by the proposed project.
- o Water Plan project examples: direct reuse, non-potable reuse, recycled water programs.

d. Maintenance of Current Supply______________(acre-feet/year) _________($) capital cost

- o Volume of recipients' current supplies that will be maintained by implementing the proposed project
- o Water Plan project examples: None. Not a water plan project. (Examples of these type projects: treatment rehabilitation, system storage facilities, system upgrades).

56. Project Location:
See attached maps – several locations across Austin

Attach a map of the service area and drawings as necessary to locate and describe the project. The map should show the project footprint and major project components.
X **Attached**

57. Attach the Census tract numbers in which the applicant's service area is within. The Census tracts within your area may be found at:
http://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml

Please follow these steps:

- Select Advanced Search.
- Select the Geographies button located below Topics (left side of page).
- On the top of the window select the Name tab.
- In the text box, type "All Census Tracts within___" (Fill in the blank with the name of a County Subdivision or a Place.) Select "Go".
- If your town is a County Subdivision, select the geography labeled "All Census Tracts (or parts) within City, County, State" from the Geography Results. If your

town is a place select the geography labeled "All Census Tracts (or parts) full-or-partially within City, State" from the Geography Results.

- Close the Geographies Search window.
- Use the Topics on the left side of the page to further refine your search or to select a table(s) from your search results.

X **Attached Census tracts (<u>See Austin's smart meter SWIFT application</u>)**

58. Project Schedule:
    a) Requested loan closing date.
    <u>Annually each December (12/2016 through 12/2022)</u>

    b) Estimated date to submit environmental planning documents.
    <u>June 2016 through Oct 2018 (will vary with each individual project)</u>

    c) Estimated date to submit engineering planning documents.
    <u>Sept 2015 through Oct 2018 (will vary with each individual project)</u>

    d) Estimated date for completion of design.
    <u>Sept 2015 through Oct 2018 (will vary with each individual project)</u>

    e) Estimated Construction start date for first contract.
    <u>March 2016 (actual start date for South Austin Regional WWTP Filtration Project)</u>

    f) Estimated Construction end date for last contract.
    <u>August 2020 for Cemetery Reuse Main</u>

59. **Attach** a copy of current and future populations and projected water use or wastewater flows. Include entities to be served.
☐ **Attached (See Austin's Smart Meter SWIFT application)**

60. Attach the most current itemized project cost estimate (include all costs and funding sources). Utilize the budget format provided (TWDB-1201 at http://www.twdb.texas.gov/financial/instructions/ . If applying for pre-construction costs only (i.e., P, A, D) then itemize only the relevant portions in the attached budget template
X **Attached**

61. Attach the appropriate Project Information Form:
☐ **Wastewater:** Attached a completed Wastewater Project Information Form WRD-253a http://www.twdb.texas.gov/financial/instructions/index.asp

X **Water:** Attached a completed Water Project Information Form WRD-253d http://www.twdb.texas.gov/financial/instructions/index.asp

62. If the project is for Construction only, wastewater projects that involve the construction of a new plant or the expansion of an existing plant and/or associated facilities, attach evidence that an application for a new Texas Pollution Discharge Elimination System Permit or amendment to an existing permit related to the proposed project has been filed with the Texas Commission on Environmental Quality (TCEQ). Final permit authorization must be obtained from the TCEQ before funds can be released for construction activities.
☐ **Attached**
X No. Provide explanation: <u>Not applicable for this project</u>

63. If this project will result in: (a) an increase by the applicant in the use of groundwater, (b) drilling a new water well, or (c) an increase by the applicant in use of surface water, then the applicant must demonstrate that it has acquired – by contract, ownership or lease – the necessary property rights, groundwater permits, and/or surface water rights sufficient for the project before funds can be released for construction.

a) Does the applicant currently own all the property rights, groundwater permits and surface water rights needed for this project?

X Yes If yes, please attach the completed, appropriate form.
1. WRD 208A (http://www.twdb.texas.gov/financial/instructions/index.asp) (Surface Water)
☐ **Attached** **(<u>see Austin's smart meter SWIFT application</u>)**
2. WRD 208B (http://www.twdb.texas.gov/financial/instructions/index.asp) (Groundwater)
☐ **Attached**

☐ No
☐ N/A

b) If all property rights, groundwater permits, and surface water rights, needed for this project have not yet been acquired, identify the rights and/or permits that will need to be acquired and provide the anticipated date by which the applicant expects to have acquired such rights and/or permits.

Type of Permit Water Right	Entity from which the permit or right must be acquired	Acquired by lease or full ownership	Expected acquisition date	Permit / Water Right ID No.

All property rights and surface water rights have been acquired for this project

c) List any major permits not identified elsewhere that are necessary for completion of project. Also, list any more necessary minor permits that may involve particular difficulty due to the nature of the proposed project.

Austin Water Project	Permit	Issuing Entity	Permit Acquired (Y/N)
Montopolis Tank & Pump Station	Site Development	City of Austin	Pending
Montopolis Tank & Pump Station	Building Permit	City of Austin	Pending
Burleson Road Reuse Main	General Permit	City of Austin	Pending
Cemetery Reuse Main	General Permit	City of Austin	N
Decker Lane Reuse Main	General Permit	City of Austin	N
Onion Creek Reuse Main	General Permit	City of Austin	N
SAR WWTP Filter Imp	General Permit	City of Austin	N
SAR WWTP Filter Imp	Building Permit	City of Austin	Pending
WC WWTP Filter Imp	Site Development	City of Austin	N

64. Has the applicant obtained all necessary land and easements for the project?

☐ Yes. If yes, attach the site certificate (ED-101 at http://www.twdb.texas.gov/financial/instructions/index.asp
☐ **Attached (no land is involved)**

☐ No. If no, **fill out the table below** and describe the land or easements that will need to be acquired, provide the anticipated date by which the applicant expects to have the land or easements, and indicate if funding from TWDB is to be used for the acquisition.

Austin Water Project	Description of Land or Easement Permit	Entity from which the permit or right must be acquired	Acquired by lease or full ownership	Expected acquisition date	To Be Funded by TWDB (Yes/No)
Montopolis Tank & Pump Station	Deed/Esmts	Praxair Company	Full ownership	Nov 2012	No
Burleson Road Reuse Main	Easements	Several	Easements	Nov 2016	No
Cemetery Reuse Main	Easements	To be determined	Easements	Apr 2019	No
Decker Lane Reuse Main	Easements	To be determined	Easements	Jul 2017	No
Onion Creek Reuse Main	Easements	To be determined	Easements	May 2020	No

65. Has a Categorical Exclusion (CE), Determination of No Effect (DNE), Finding of No Significant Impact (FONSI), Record of Decision (ROD), or any other environmental determination been issued for this project?
X Yes (FONSI issued for all reuse projects except cemetery main, CE issued by TWDB for South Austin Regional Wastewater Treatment Plant Filtration project)
X Attach a copy of the finding.
X No (for Walnut Creek Wastewater Plant Filtration project and Cemetery Reuse Main)

66. Is the project potentially eligible for a Categorical Exclusion (CE)/ Determination of No Effect (DNE) because it involves only minor rehabilitation or the functional replacement of existing equipment?
X Yes
☐ No

67. Are there potentially adverse environmental or social impacts that may require mitigation or extensive regulatory agency or public coordination (e.g. known impacts to properties eligible for listing on the National Register of Historic Places; potentially significant public controversy; need for an individual permit from the U.S. Army Corps of Engineers)?
☐ Yes
  ☐ If yes, attach additional information
X No

Part E: State Water Implementation Fund for Texas (SWIFT) Applicants Only:

68. Identify the type of SWIFT funding (If more than one funding option is being requested indicate the amount of funding for each):

☐	Deferred	$
X	Low Interest Loan	$86,980,456
☐	Board Participation	$

69. For multi-year funding request or phased commitments, provide a schedule reflecting the closing dates for each loan requested.

X Attached

70. **Notice to SWIFT Applicants:** Texas Water Code Sec. 15.435(h) requires all recipients of financial assistance from the SWIFT to acknowledge any applicable legal obligations in federal law, related to contracting with disadvantaged business enterprises, and state law, related to contracting with historically underutilized businesses. Checking the boxes below serves as this acknowledgement.

X As an applicant for financial assistance from SWIFT, I acknowledge that this project must comply with any applicable legal obligations in federal law related to contracting with disadvantaged business enterprises.

X As an applicant for financial assistance from SWIFT, I acknowledge that this project must comply with applicable legal obligations in state law (Texas Government Code Chapter 2161 and Texas Administrative Code Chapter 20, Subchapter B) related to contracting with historically underutilized businesses.

71. Provide drafts of the following documents:

a. Proposed Bond Ordinance

☐ **Attached (<u>see Austin's smart meter SWIFT application</u>)**

b. Private Placement Memorandum

☐ **Attached (<u>see Austin's smart meter SWIFT application</u>)**

Part F: Economically Distressed Programs (EDAP) Applicants Only:

<u>Omitted for Austin's SWIFT Loan Application</u>

Part G: CWSRF/DWSRF Applicants Only

<u>Omitted for Austin's SWIFT Loan Application</u>

Part H: Documentation of "Green" Projects and Project Components

CWSRF and DWSRF Applicants Only

<u>Omitted for Austin's SWIFT Loan Application</u>

Part I: Summary of attachments to application

Following is a list of the documents that may be necessary in order to process this application. While not all of the listed information below may be required for all projects, an applicant should review the application carefully because incomplete applications will not be processed until all of this information has been provided. In addition, please make sure your entity system name appears on every attachment. **Label each attachment with the number of the pertinent application section (i.e. "Part B5").**

Check list for your convenience

Part A	**General Information**
X No. 6	Draft or executed consulting contracts - engineering and construction attached – **see smart meter (AMI) application for financial advisor and bond counsel contracts**
☐No. 12	Existing security document for refinancing – **see smart meter application**

Not applicable

Part B	**Legal**
X No. 17	Resolution (TWDB-0201A) – Executed City Council Resolution from 4/21/16
X No. 18	Application Affidavit (TWDB-0201)
X No. 19	Certificate of Secretary (TWDB-201B)
☐No. 20	Water Supply Corporations
	☐Articles of Incorporation
	☐Certificate of incorporation from the Texas Secretary of State
	☐By-laws and any amendments
	☐Certificate of status from the Texas Secretary of State
	☐Certificate of account status from Texas Comptroller
☐No. 21	Resolution/ordinance authorizing the issuance of parity debt – **see smart meter app**
☐No. 22	Certificate of Convenience & Necessity – **see smart meter application**
☐ No. 23	Enforcement Actions – **see smart meter application**
☐No. 24	Affidavit of No Objection – **not applicable**
☐No. 25	Two copies of the Water Conservation Plan (TWDB-1968 and TWDB-1965)
☐No. 26	Water use surveys http://www.twdb.texas.gov/waterplanning/waterusesurvey/index.asp
☐No. 27	Water Loss Audit http://www.twdb.texas.gov/conservation/resources/waterloss-resources.asp

Not applicable

Part C	**Financial (see Austin's smart meter application)**
☐ No. 39	Assessed Values by Classifications – see smart meter application
☐No. 40	Direct and Overlapping Tax Table – see smart meter application
☐ No. 45	Proforma for each year of debt outstanding – see smart meter application
☐No. 46	Five year comparative system operating statement. – see smart meter application
☐ No. 47	Annual audit and management letter – see smart meter application
☐No. 49	Outstanding debt schedule – see smart meter application
☐No. 52	Service provider contracts – **not applicable for reuse projects**

Part D	**Project Information**
X No. 54a	Preliminary Engineering Feasibility Data (PEFD)
X No. 54b	Engineering Feasibility Report Water (TWDB-0555) Wastewater (TWDB-0556)
☐No. 54c	Project Draw Schedule (TWDB-1202) – **not applicable (only for SRF applications)**
X No. 56	Project Maps
☐No. 57	Census Tract(s) – **see smart meter application**
☐No. 59	Current and future populations and projected water use or wastewater flows **(see smart meter application)**
X No. 60	Project Cost Estimate Budget (TWDB-1201)

X No. 61	Wastewater Project Information Form (WRD-253a) Water Project Information Form (WRD-253d)
X No. 62	Texas Pollution Discharge Elimination System Permit
☐No. 63	If applicant has property rights and permits a. WRD-208A (Surface Water) – **see smart meter application** b. WRD-208B (Groundwater)
☐No. 63c	Additional Permits – **not applicable**
X No. 64	Site certificate, evidencing land ownership for the project. (ED-101)
X No. 65	Categorical Exclusion (CE), Finding of No Significant Impact (FONSI), Record of Decision or any other supporting document
☐No. 67	Social or environmental issues – **not applicable**
Part E	**State Water Implementation Fund for Texas (see smart meter application)**
☐ No. 69	Multi-year/phased commitment schedule – see smart meter application
☐ No. 71a	Draft Bond Ordinance – see smart meter application
☐ No. 71b	Private Placement Memorandum – see smart meter application

Texas Water
Development Board
P.O. Box 13231, Austin, Texas 78711-3231

SWIFT

Austin SWIFT Loan Application
Part A, Item 6
South Austin Regional WWTP
Filtration Project
Construction Contract

MATOUS CONSTRUCTION, LTD
CONSTRUCTION CONTRACT

CITY OF AUSTIN
PUBLIC WORKS DEPARTMENT

PROJECT MANUAL

FOR

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT FILTER IMPROVEMENTS

FDU NUMBER: 4570 2307 8040
C.I.P. PROJECT NUMBER: 3333.015
IFB 6100 CLMC 562

Prepared by

AECOM

AECOM Technical Services, Inc.
400 West 15th Street, Suite 600
Austin, Texas, 78701
TBPE REG. No. F-3580

CITY OF AUSTIN
Public Works Department
PO Box 1088
Austin, TX 78704

SHELBY G. ECKOLS
41485
Shelby G. Eckols
9/9/15

JOHN N. BUSER
90881
John N. Buser
9/9/15

VOLUME 1 of 4

September 14, 2015

CITY OF AUSTIN
PUBLIC WORKS DEPARTMENT

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PUBLIC WORKS DEPARTMENT

PROJECT MANUAL

FOR

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT FILTER IMPROVEMENTS

Shelby G. Eckols, P.E.
AECOM
Process/Mechanical/Civil

SHELBY G. ECKOLS
41485

Shelby G. Eckols
6/25/15

Brandon Goodloe, P.E.
Jose I. Guerra, Inc.
Structural

Brandon M. Goodloe

BRANDON M. GOODLOE
92456

6-25-2015

Kegham Harutunian, P.E.
Harutunian Engineering, Inc.
Electrical/I&C

K.A. Harutunian

K. A. HARUTUNIAN
59181

6/12/2015

Thomas W. Rohlack, PE, BCEE
CAS Consulting & Services, Inc.
Civil

THOMAS W. ROHLACK
86365

6/29/15

Certifications

LUMP SUM BID FORM

Section 00300L

City Manager
Austin, Texas

The undersigned, in compliance with the Invitation for Bids for construction of the following Project:

South Austin Regional Wastewater Treatment Plant Filter Improvements

(CIP ID# 3333.015) (IFB# 6100 CLMC 562) for the City of Austin, Texas, having examined the Project Manual, Drawings and Addenda, the site of the proposed Work and being familiar with all of the conditions surrounding construction of the proposed Project, having conducted all inquiries, tests and investigations deemed necessary and proper; hereby proposes to furnish all labor, permits, material, machinery, tools, supplies and equipment, and incidentals, and to perform all Work required for construction of the Project in accordance with the Project Manual, Drawings and Addenda within the time indicated for the lump sum prices of:

EXCAVATION SAFETY SYSTEMS UNIT PRICES: The undersigned Bidder agrees that the Base Bid for the Work includes the following amounts in the Bid for excavation safety systems as specified in Item Number 509S of the Specifications and in case of an authorized adjustment to the scope of Work, the following unit price(s) will be used in adjusting the Contract Amount:

Quantity	Unit	Item Description	Unit Price	Amount
1,761	ln. ft.	Trench Safety systems	$ 10.00	$ 17,610.00

ALLOWANCES

Allowance #1	Allowance for Permits and Fees Paid by CONTRACTOR, as Evidenced by Paid Receipts, and Required for Completion of the Project, complete in place, for Five Thousand Dollars and Zero Cents	$ 5,000.00
Allowance #2	Allowance for Procurement of the permanent badge decals or ID badge blanks, per Section 00819, for One Thousand Dollars and Zero Cents	$ 1.000.00

SUBTOTAL ALLOWANCES $ 6,000.00

Bid Item	Quantity	Unit	Item Description	Amount
1	1	L.S.	Rehabilitation of the South Austin Regional Wastewater Treatment Plant Filters excluding work associated with Special Specification 11399, complete in place, for	14,035,000.00 ~~14,00~~ BΔM $ ~~14,035.~~00
2	1	L.S.	Disk Filter System in accordance with Contract Specification 11399, complete in place, for	$ 6,200,000.00

BASE BID.. = $ 20,235,000.00
(Base Bid includes Allowances and Excavation Safety Systems Unit Prices, if applicable.) 20,258,610.00

ALTERNATE NO. 1: Conversion of existing Filter Basins 1 and 2 to cloth media filters and demolition of existing backwash pump room floor, removal of existing backwash pump discharge piping, construction of a new backwash pump room floor, and all associated structural, mechanical, and electrical and instrumentation complete in place for,

_______________ = $ 3,950,000.00 Figures

ALTERNATE NO. 2: Cleaning of entire volume of mudwell, complete in place for,

_______________ = $ 100,000.00 Figures

ALTERNATE NO. 3: Removal of all abandoned piping in the Filter Building Upper Pipe Gallery Level, complete in place for,

_______________ = $ 150,000.00 Figures

ALTERNATE NO. 4: Removal of all existing and abandoned piping at the filter building lower pipe gallery level, complete in place for,

_______________ = $ 160,000.00 Figures

ALTERNATE NO. 5: Demolition and removal of existing Air Scour Blowers Nos. 1 and 2, High Pressure Air Compressor and Receiver, all associated valves, piping, and instruments, complete in place for,

_______________ = $ 65,000.00 Figures

ALTERNATE NO. 6: Cleaning of entire volume of clearwells, complete in place for,

_______________ = $ 85,000.00 Figures

ALTERNATE NO. 7: Providing a temporary filtration and bypass pumping system for the duration of construction, complete in place, for

_______________ = $ 1,315,000.00 Figures

TOTAL BID (Base Bid Plus Alternate 1).. = $ ~~24,185,000.00~~ $24,208,610.00

TOTAL BID (Base Bid Plus Alternate 1 & 2)....................................... = $ ~~24,285,000.~~ $24,308,610.00

TOTAL BID (Base Bid Plus Alternate 1, 2, & 3).................................. = $ 24,435,000. $24,458,610.00

TOTAL BID (Base Bid Plus Alternate 1, 2, 3, & 4).............................. = $ 24,545,000 24,568,610.00

TOTAL BID (Base Bid Plus Alternate 1, 2, 3, 4, & 5)........................... = $ 24,610,000. 24,633,610.00

TOTAL BID (Base Bid Plus Alternate 1, 2, 3, 4, 5, & 6)........................ = $ 24,695,000. 24,718,610.00

TOTAL BID (Base Bid Plus Alternate 1, 2, 3, 4, 5, 6, & 7)..................... = $ 26,070,000. 26,093,610.00

Notes:

1. For information pertaining to Rolling Owner Controlled Insurance Program (ROCIP), see Sections 00810 and 00820.
2. For information pertaining to Bid alternate prioritization, see Section 00820.
3. For a more detailed explanation of Bid alternates, see Section 01030.
4. For a more detailed explanation of Bid allowances, see Section 1020

BID GUARANTY: A Bid guaranty must be enclosed with this Bid , as required in Section 00020 or Section 00020S, in the amount of not less than five percent (5%) of the total Bid. Following the Bid opening, submitted Bids may not be withdrawn for a period of 90 Calendar Days. Award of Contract will occur within this period, unless mutually agreed between the parties. The Bid guaranty may become the property of the OWNER, or the OWNER may pursue any other action allowed by law, if:

- Bidder withdraws a submitted Bid within the period stated above;
- Bidder fails to submit the required post Bid information within the period specified in Section 00020 or 00100, or any mutually agreed extension of that period; or
- Bidder fails to execute the Contract and furnish the prescribed documentation (bonds, insurance, etc.) needed to complete execution of the Contract within five (5) Working Days after notice of award, or any mutually agreed extension of that period.

The Bid includes all Automobile Liability and Builder's Risk Insurance premiums required to meet the insurance limits in the Supplemental General Conditions and includes all premiums for a Performance Bond and a Payment Bond in the sum of one hundred percent of the Contract Amount. The Bid excludes all costs for the insurance coverages and limits, up to the limits set forth in the Supplemental General Conditions, duplicated by those in the ROCIP, including the costs for all proposed Subcontractors for such coverages and limits as described in the Supplemental General Conditions, and as calculated in accordance with the Insurance Cost Form, Section 00425.

The Bid also includes the cost to provide and maintain through completion of Work all necessary safety rails, barricades, platforms, fences, covers, and signs necessary to adequately protect and safeguard all vehicular and pedestrian traffic within proximity of the Work. The safety information identified in the Project Safely Manual, and in the Supplemental General Conditions, outlines the minimum safety requirements for the Project. CONTRACTOR shall not limit the amount of effort directed toward its safety program based on the requirements identified in the Project Safety Manual. This program is in addition to CONTRACTOR's existing safety program, not in lieu of that program.

TIME OF COMPLETION: The undersigned Bidder agrees to commence work on the date specified in the written "Notice to Proceed" to be issued by the OWNER and to **substantially** complete construction of the improvements, as required by the Project Manual, Drawings and Addenda for the Work within **eight hundred and fifty (850) Calendar Days**, and to reach **Final Completion** within **sixty (60) Calendar Days** after **Substantial Completion** as required by the Project Manual, Drawings and Addenda for the work. The Bidder further agrees that should the Bidder fail to **finally** complete the Work within the number of days indicated in the Bid or as subsequently adjusted, Bidder shall pay the liquidated damages for each consecutive day thereafter as provided below; unless the OWNER elects to pursue any other action allowed by law.

WAIVER OF ATTORNEY FEES: In submitting its bid, in consideration for the waiver of its right to attorney's fees by the OWNER, the Bidder knowingly and intentionally agrees to and shall waive the right to attorney's fees under Section 271.153 of the Texas Local Government Code in any administrative proceeding, alternative dispute resolution proceeding, or litigation arising out of or connected to any Contract awarded pursuant to this solicitation process.

LIQUIDATED DAMAGES: The Bidder understands and agrees that the timely completion of the described Work is of the essence. The Bidder and OWNER further agree that the OWNER's actual damages for delay caused by failure to timely complete the Project are difficult, if not impossible to measure. However, with respect to the additional administrative and consultant costs to be incurred by OWNER, the reasonable estimate of such damages has been calculated and agreed to by OWNER and Bidder. Therefore, the Bidder and the OWNER agree that for each and every **Calendar** Day the Work or any portion thereof, remains incomplete after the **Substantial** Completion date as established by the above paragraph, "Time of Completion", payment will be due to the Owner in the amount of **one thousand seven hundred and sixty** dollars **($1,760.00)** per **Calendar Day** as liquidated damages, not as a penalty, but for delay damages to the OWNER. Bidder and the OWNER further agree that for each and every **Calendar Day** the Work or any portion thereof, remains incomplete after the **Final** Completion date as established by the above paragraph, "Time of Completion", payment will be due to the OWNER in the amount of **four hundred and fifty** dollars **($450.00)** per **Calendar Day** as liquidated damages, not as a penalty, but for delay damages to the OWNER. Such amount shall be deducted by the OWNER from any Contract payment due. In the event of a default or breach by the CONTRACTOR and demand is made upon the surety to complete the project, in accordance with the Contract Documents, the surety shall be liable for liquidated damages pursuant to the Contract Documents in the same manner as the CONTRACTOR would have been.

OWNER reserves the right to reject any or all Bids and to waive any minor informality in any Bid or solicitation procedure (a minor informality is one that does not affect the competitiveness of the Bidders).

The undersigned acknowledges receipt of the following addenda:

Addendum No. 1 dated October 5, 2015 Received October 5, 2015
Addendum No. 2 dated October 14, 2015 Received October 14, 2015
Addendum No. 3 dated ____________ Received ____________
Addendum No. 4 dated ____________ Received ____________
Addendum No. 5 dated ____________ Received ____________

Secretary, *if Bidder is a Corporation

(Seal)

Matous Construction, Ltd.
Bidder

Authorized Signature

CEO
Title

October 22, 2015
Date

8602 North Highway 317

Belton, TX 76513
Address

254.780.1400 / 254.780.2599
Telephone Number / FAX Number

bruce@matousconstruction.com
Email Address for Person Signing Bid

janna@matousconstruction.com
Email Address for Bidder's Primary Contact Person

* Copy of Corporate Resolution and minutes with certificate of officer of Bidder as to authority of signatory to bind Bidder is to be signed and dated no earlier than one week before Bid date, and attached to this document.

End

ATTACHMENT J

BIDDERS AUTHENTICATION

(To be returned within three (3) days of notification)

Name of Bidder: Matous Construction, Ltd.

IFB Number: 6100 CLMC 562

CIP ID Number: 3333.015

THE STATE OF TEXAS

COUNTY OF TRAVIS

I certify that my responses and the information provided in Attachments E-I are true and correct to the best of my personal knowledge and belief and that I have made no willful misrepresentations in this Section, nor have I withheld any relevant information in my statements and answers to questions. I am aware that any information given by me in this Section may be investigated and I hereby give my full permission for any such investigation and I fully acknowledge that any misrepresentations or omissions in my responses and information may cause my bid to be rejected.

Bidder's full name and entity status:

Matous Construction, Ltd., a Texas limited partnership

Signature, Authorized Representative of Bidder

CEO

Title

10-26-19

Date

CERTIFICATE OF NON-SUSPENSION OR DEBARMENT

Section 00405

The City of Austin is prohibited from contracting with or making prime or sub-awards to parties that are suspended or debarred or whose principals are suspended or debarred from Federal, State, or City of Austin Contracts. Covered transactions include procurement contracts for goods or services equal to or in excess of $25,000.00 and all non-procurement transactions. This certification is required for all bidders on all City of Austin Contracts to be awarded with values equal to or in excess of $25,000.00 and all non-procurement transactions.

The CONTRACTOR hereby certifies that its firm and its principals are not currently suspended or debarred from bidding on any Federal, State, or City of Austin Contracts.

PROJECT Name: South Austin Regional Wastewater Treatment Plant Filter Improvements

PROJECT Address: 1017 Fallwell Lane, Del Valle, Texas 78617

CONTRACTOR'S Name Matous Construction, Ltd.

Signed by (Authorized Representative)

Printed Name: Bruce A. Matous

Title CEO of the General Partner

Date October 22, 2015

END

Bidding Requirements, Contract Forms and Conditions of the Contract

INSURANCE COST FORM

Section 00425A

Project Name: South Austin Regional Wastewater Treatment Plant Filter Improvements

CIP ID Number: 3333.015

In the event the bidder is awarded the Contract, it is agreed that the bidder will permit the OWNER or its ROCIP Administrator to inspect the insurance policies and audit the methods and rates used in determining the premium cost stated below. Requests for inspection of any policies or payroll records will be made in writing ten (10) days in advance of any review which will be conducted at the project site or an OWNER or ROCIP Administrator office near the site.

The "**Total Insurance Cost Excluded from Base Bid**" (and the "Total **Insurance Cost Excluded from Alternate No.(s)**", as appropriate for this project) amount(s) as stated within this form represents the amount of cost the bidder has excluded from the Bid for insurance coverages for the prospective CONTRACTOR and all Subcontractor(s) and Sub-Subcontractor(s) which the OWNER anticipates furnishing through ROCIP. This cost includes but is not limited to insurance premiums, expected losses within any retention or deductible program, overhead and profit. Instructions to assist with calculation of these costs are included on the following page.

The bidder as insured hereby assigns and transfers to the OWNER, its rights, title and interest in any and all returns of premium, dividends, discounts, merit bonus or other adjustments applicable to the OWNER's Rolling Owner Controlled Insurance Program. This assignment shall pertain to the policies as now written and as subsequently modified, rewritten, or replaced in the policies of the OWNER's, including any additional amounts of coverage as a result thereof. This assignment is valid only for insurance policies whose premiums have been paid by the OWNER on behalf of the prospective CONTRACTOR/Subcontractor(s)/Sub-Subcontractor(s).

Total Insurance Cost Excluded from Base Bid	= $ 250,000.
Total Insurance Cost Excluded from Alternate No.1	= $ 50,000.
Total Insurance Cost Excluded from Alternate No.2	= $ 2,000.
Total Insurance Cost Excluded from Alternate No.3	= $ 5,000.
Total Insurance Cost Excluded from Alternate No.4	= $ 6,000.
Total Insurance Cost Excluded from Alternate No.5	= $ 2,000.
Total Insurance Cost Excluded from Alternate No.6	= $ 1,000.
Total Insurance Cost Excluded from Alternate No.7	= $ 18,000.

Bidder's Name: Matous Construction, Ltd.

Signed by:

Date: October 22, 2015

Title: CEO

CITY OF AUSTIN INSTRUCTIONS FOR IDENTIFYING INSURANCE COSTS

The ROCIP contract documents require that the Bidding Contractor exclude from the bid the cost of insurance provided by ROCIP. This includes the cost of said insurance for all contractors/ subcontractors of any tier who are performing work on site. These instructions are intended to be a tool to assist you in calculating your insurance costs.

Workers' Compensation Premium Calculation:

(A) Payroll/$100 X (B) Rate X (C) Experience Mod Factor X (D) Other factors as included on the policy = (E) Workers' Compensation Premium

(A) Payroll (remuneration) is the estimated amount of labor dollars including benefit costs that you anticipate for the project term. Payrolls should be broken down by Workers' Compensation Class Code. The calculation is payroll divided by $100 and then multiplied by the rate for each Class Code.

(B) Rates are based on Workers' Compensation Class Codes which identify the kind(s) of work the employees in that trade are performing. They are set by the Insurance Carrier and can be found in your "regular" Workers' Compensation Policy.

(C) Experience Modification Factors are based upon your past claim and premium experience that is filed by your previous Insurance Carriers. If you do not have an Experience Modifier Factor, use a 1.00 factor in the calculation.

(D) Other factors include Increased Limits, Scheduled Credits, Premium Discounts, etc.

(E) Workers' Compensation Premium is the insurance cost for Workers' Compensation that must be excluded in your bid price and recorded for the Contractor and all Subcontractors at every tier on the bidder's Insurance Cost Identification Worksheet.

General Liability Premium Calculation:

(A) Rate Base (Payroll/Sales) X (B) Rate X (C) Other factors as included on the policy = (D) General Liability Premium

(A) Rating base for General Liability may be Payroll (remuneration) or Sales/Receipts. Please refer to your "regular" General Liability Policy for rate base and rates used to calculate your current premium.

(B) Rates – again, refer to your regular policy and keep in mind that Payroll is per $1,000 and Sales/Receipts usually per $1,000

(C) Other factors include experience modifier, premium discounts, debits, credits, etc.

(D) The General Liability Premium is the insurance cost for General Liability that must be excluded in your bid price and recorded for the prime/general and all subcontractors at every tier on the bidder's Insurance Cost Identification Worksheet.

Expected Losses or Allocated Self-Insured Retention (if applicable):

In the event the Contractor or any Subcontractor retains a coverage or portion of coverage by a self-insured retention, deductible or other means, the contractor should estimate the portion of losses or retention which is estimated for or allocated to this project.

END

CONTRACTOR AFFIDAVIT OF RECEIPT AND PROVISION OF ROCIP INFORMATION

As an authorized representative of the Bidder/Contractor, I acknowledge and agree that the Bidder/Contractor has received the required ROCIP Information referenced in Section 00425B of the Contract Documents for the referenced Project and has provided the ROCIP Information to the Owner. I certify that the representations and information in this Affidavit are true and correct to the best of my personal knowledge and belief and that I have made no willful misrepresentations in this Affidavit, nor have I withheld any relevant information. I am aware that the information given will be relied upon in entering into a subsequent Contract.

Bidder/Contractor:

Matous Construction, Ltd.
(business entity name)

Name:

Printed Name: Bruce A. Matous
(Authorized Representative)

Date: October 22, 2015

CITY OF AUSTIN
BIDDER'S AFFIDAVIT OF NON-COLLUSION, NON-CONFLICT OF INTEREST, AND ANTI-LOBBYING FOR
IFB NO. 6100 CLMC 562
FOR South Austin Regional Wastewater Treatment Plant Filter Improvements

CIP ID Number: 3333.015

State of Texas

County of Travis

The undersigned "Affiant" is a duly authorized representative of the bidder for the purpose of making this Affidavit, and, after being first duly sworn, has deposed and stated and hereby deposes and states, to the best of his or her personal knowledge and belief as follows:

> The term **"Bidder"**, as used herein, includes the individual or business entity submitting the bid and for the purpose of this Affidavit includes the directors, officers, partners, managers, members, principals, owners, agents, representatives, employees, other parties in interest of the Bidder, and anyone or any entity acting for or on behalf of the Bidder, including a subcontractor in connection with this bid.
>
> The terms **"City"** and **"Owner"** are synonymous.

1. **Anti-Collusion Statement.** The Bidder has not and will not in any way directly or indirectly:

   a. colluded, conspired, or agreed with any other person, firm, corporation, bidder or potential bidder to the amount of this bid or the terms or conditions of this bid.

   b. paid or agreed to pay any other person, firm, corporation bidder or potential bidder any money or anything of value in return for assistance in procuring or attempting to procure a contract or in return for establishing the prices in the attached bid or the bid of any other bidder.

2. **Preparation of Invitation for Bid and Contract Documents**. The Bidder has not received any compensation or a promise of compensation for participating in the preparation or development of the underlying bid or contract documents., In addition, the Bidder has not otherwise participated in the preparation or development of the underlying bid or contract documents, except to the extent of any comments or questions and responses in the bidding process, which are available to all bidders, so as to have an unfair advantage over other bidders, provided that the Bidder may have provided relevant product or process information to a consultant in the normal course of its business.

3. **Participation in Decision Making Process.** The Bidder has not participated in the evaluation of bids or proposals or other decision making process for this solicitation, and, if Bidder is awarded a contract hereunder, no individual, agent, representative, consultant or sub contractor or consultant associated with Bidder, who may have been involved in the evaluation or other decision making process for this solicitation, will have any direct or indirect financial interest in the Contract, provided that the Bidder may have provided relevant product or process information to a consultant in the normal course of its business.

4. **Present Knowledge.** Bidder is not presently aware of any potential or actual conflicts of interest regarding this solicitation, which either enabled Bidder to obtain an advantage over other bidders or would prevent Bidder from advancing the best interests of OWNER in the course of the performance of the Contract.

5. **City Code.** As provided in Sections 2-7-61 through 2-7-65 of the City Code, no individual with a substantial interest in Bidder is a City official or employee or is related to any City official or employee within the first or second degree of consanguinity or affinity.

6. **Chapter 176 Conflict of Interest Disclosure.** In accordance with Chapter 176 of the Texas Local Government Code, the Bidder:

   a. does not have an employment or other business relationship with any local government officer of OWNER or a family member of that officer that results in the officer of family member receiving taxable income;

   b. has not given a local government officer of OWNER one or more gifts, other than gifts of food lodging transportation or entertainment accepted as a guest, that have an aggregate value of more than $100 in the twelve month period preceding the date the officer becomes aware of the execution of the Contract or that OWNER is considering doing business with the Bidder; and

   c. does not have a family relationship with a local government officer of OWNER in the third degree of consanguinity or the second degree of affinity.

   As required by Chapter 176, Bidder must file the Conflicts of Interest Questionnaire with the Purchasing Department no later than the seventh business day after the commencement of contract discussions or negotiations with the City or the submission of a Bid, response to a request for proposals, or other writing related to a potential contract with OWNER. The questionnaire must be updated not later than the seventh day after the date of an event that would make a statement in the questionnaire inaccurate or incomplete. There are statutory penalties for failure to comply with Chapter 176.

7. **Anti-Lobbying Ordinance.** As set forth in paragraph 1.i. of the Instructions to Bidders Section 00100, between the date that the Invitation for Bid was issued and the date of full execution of the Contract, Bidder has not made and will not make a representation to a member of the City Council, a member of a City Board, or any other official, employee or agent of the City, other than the authorized contact person for the solicitation, except as permitted by the Ordinance.

If the Bidder cannot affirmatively swear and subscribe to the forgoing statements, the Bidder shall provide a detailed written explanation in the space provided below or, as necessary, on separate pages to be annexed hereto.

Signature: ____________ Date: October 22, 2015

Printed Name: Bruce A. Matous

Title: CEO

Firm/Entity: Matous Construction, Ltd.

Subscribed and sworn to before me this 22nd day of Oct, 2015.

____________ My Commission Expires 10.31.2017

Notary Public

JANNA S JANES
NOTARY PUBLIC
State of Texas
Comm. Exp. 10/31/2017

BIDDER'S EXPLANATION:

END

NONRESIDENT BIDDER PROVISIONS

Section 00475

CIP ID Number: 3333.015

Bidder must answer the following questions in accordance with Vernon's Texas Statutes and Codes Annotated Government Code § 2252.002, as amended:

A. Is the bidder that is making and submitting this bid a "resident bidder" or a "non-resident bidder"?

Answer: Resident Bidder

(1) Texas Resident Bidder - A bidder whose principal place of business is in Texas and includes a Contractor whose ultimate parent company or majority owner has its principal place of business in Texas.

(2) Nonresident Bidder - A bidder who is not a Texas Resident Bidder.

B. If the Bidder is a "Nonresident Bidder", does the state, in which the Nonresident Bidder's principal place of business is located, have a law requiring a Nonresident Bidder of that state to bid a certain amount or percentage under the bid of a Resident Bidder of that state in order for the nonresident bidder of that state to be awarded a contract on his bid in such state?

Answer: Yes or No Which state? ____________

If the answer to Question B is "yes", then what amount or percentage must a Texas Resident Bidder bid under the bid price of a Resident Bidder of that state in order to be awarded a contract on such bid in said state?

Answer: ____________

____
Signature

END

STATE OF TEXAS
COUNTY OF TRAVIS

THIS AGREEMENT is made and entered into this **28th** day of **January**, **2016**, by and between the City of Austin, Texas, a municipal corporation, organized and existing under laws of State of Texas, acting through its City Manager or other duly authorized designee, hereinafter referred to as the "OWNER," and **Matous Construction, Ltd.**, of the City of **Belton**, County of **Bell**, and State of **Texas**, hereinafter referred to as the "CONTRACTOR."

In consideration of the promises, performances, payments and agreements set forth herein CONTRACTOR hereby agrees to commence and complete the following Project:

South Austin Regional Wastewater Treatment Plant Tertiary Filter Improvements

In accordance with the Project Manual, Drawings and Addenda, which are incorporated herein by reference and made a part hereof and which have been prepared by **AECOM Technical Services, Inc.** and approved by OWNER, and OWNER agrees to pay the CONTRACTOR the total amount of:

$24,718,610.00

Twenty Four Million, Seven Hundred Eighteen Thousand, Six Hundred Ten Dollars

The CONTRACTOR hereby agrees to commence work on the date specified in the written Notice to Proceed, in accordance with the Bid Form, Section 00300, to be issued by the OWNER and to **substantially** complete construction of all Work, as required by the Project Manual, Drawings and Addenda for the Work within **Six Hundred Seventy (670) Calendar** Days. **Final** completion shall be achieved within **Sixty (60) Calendar** Days after substantial completion. Waiver of any breach of this Contract shall not constitute waiver of any subsequent breach.

In consideration of the award and execution of this Contract, and in consideration of the waiver of its right to attorney's fees by the OWNER, the CONTRACTOR knowingly and intentionally waives its right to attorney's fees under Section 271.153 of the Texas Local Government Code in any administrative proceeding, alternative dispute resolution proceeding, or litigation arising out of or connected to this Contract.

OWNER agrees to pay CONTRACTOR from available funds for performance of the Contract in accordance with the Bid and the provisions of the Contract Documents, subject to additions and deductions, as provided therein.

The OWNER's payment obligations are payable only and solely from funds available for the purposes of this Agreement.

Although drafted by OWNER, this Agreement, in event of any disputes over its meaning or application, shall be interpreted fairly and reasonably, and neither more strongly for nor against either party.

OWNER	§ **CONTRACTOR**
	§ **Matous Construction, Ltd.**
By:__________	§ **By:**__________
City of Austin (Signature)	§ (Signature)
2/23/16	§ 1/28/16
Date	§ Date
Assistant Director ~~Div. Mgr.~~, Capital Contracting Office	§ BRUCE A. MATOUS
Title of Signatory	§ Printed Name of Signatory

APPROVED AS TO FORM:

By:____________________
Law Department

2/19/16
Date

§
§ CEO
§ Title of Signatory, Authorized Representative
§
§ **ATTEST (as applicable)**
§
§____________________
§ **Secretary of Corporate Bidder or Corporate General Partner** *

*Copy of Corporate Resolution and minutes with certificate of officer of CONTRACTOR as to authority of signatory to bind CONTRACTOR is to be signed, dated no earlier than one week before the date of award of Contract, and attached to this document.

END

Bond #106306255

PERFORMANCE BOND

Section 00610

STATE OF TEXAS
COUNTY OF **Travis**

Bond No.:
C.I.P. ID No.: **3333.015**

Project: **South Austin Regional Wastewater Treatment Plant Tertiary Filter Improvements**

Know All Men By These Presents: That **Matous Construction, Ltd.** of the City of **Belton**, County of **Bell**, and State of **Texas**, as Principal, and Travelers Casualty and Surety Company of America, a solvent company authorized under laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto **City of Austin** (OWNER), in the penal sum of **Twenty Four Million, Seven Hundred Eighteen Thousand, Six Hundred Ten Dollars ($24,718,610)** for payment whereof, well and truly to be made, said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

Conditions of this Bond are such that, whereas, Principal has entered into a certain written contract with OWNER, dated the **Twenty-Eighth** day of **January**, **2016**, which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

Now, therefore, the condition of this obligation is such, that if said Principal shall faithfully perform said Agreement and shall in all respects duly and faithfully observe and perform all and singular covenants, conditions and agreements in and by said contract agreed and covenanted by Principal to be observed and performed, and according to true intent and meaning of said Agreement hereto annexed, then this obligation shall be void; otherwise to remain in full force and effect. If OWNER notifies Principal and Surety the OWNER is considering declaring Principal in default, Surety agrees to meet with OWNER and Principal no later than fifteen days after receipt of such notice to discuss methods of performing the Work of the Contract.

Provided, however, that this bond is executed pursuant to provisions of Chapter 2253, Texas Government Code as amended and all liabilities on this bond shall be determined in accordance with provisions of said Article to same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change in Contract Time or Contract Amount shall in anywise affect its obligation on this bond, and it does hereby waive notice of any such change in Contract Time or Contract Amount.

In witness whereof, said Principal and Surety have signed and sealed this instrument this 28th day of January, 2016.

Matous Construction, Ltd.
By
Bruce A. Matous
(Signature)
Title Chief Executive Officer
Address 8602 N Hwy 317
Belton, TX 76513

Surety Travelers Casualty and Surety Company of America
By Emily Mikeska
Emily Mikeska
(Signature)
Title Attorney-In-Fact
Address 1023 Canyon Creek Drive, Suite 110
Temple, TX 76502

Telephone 254-771-5700 Fax 254-771-5710
E-Mail Address emikeska@ward-moore.com

Name and address of Resident Agent of Surety:

John R. Ward - Ward & Moore Insurance Services, LP

P. O. Box 179, Gatesville, TX 76528

Note: Bond shall be issued by a solvent Surety company authorized to do business in Texas, and shall meet any other requirements established by law or by OWNER pursuant to applicable law. A copy of surety agent's "Power of Attorney" must be attached hereto.

END

WARNING: THIS POWER OF ATTORNEY IS INVALID WITHOUT THE RED BORDER

TRAVELERS

POWER OF ATTORNEY

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 226746

Certificate No. 006325942

KNOW ALL MEN BY THESE PRESENTS: That Farmington Casualty Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company are corporations duly organized under the laws of the State of Connecticut, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc., is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

John R. Ward, Douglas Moore, Emily Mikeska, and Eva O. Limmer

of the City of Temple, State of Texas, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed and their corporate seals to be hereto affixed, this 26th day of March, 2015.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

State of Connecticut
City of Hartford ss.

By: ______________________
Robert L. Raney, Senior Vice President

On this the 26th day of March, 2015, before me personally appeared Robert L. Raney, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal.
My Commission expires the 30th day of June, 2016.

Marie C. Tetreault
Marie C. Tetreault, Notary Public

58440-8-12 Printed in U.S.A.

WARNING: THIS POWER OF ATTORNEY IS INVALID WITHOUT THE RED BORDER

IMPORTANT NOTICE

To obtain information or make a complaint:

You may call Travelers Casualty and Surety Company of America and its affiliates' toll-free telephone number for information or to make a complaint at:

1-800-328-2189

You may contact the Texas Department of Insurance to obtain information on companies, coverages, rights or complaints at:

1-800-252-3439

You may write the Texas Department of Insurance:

P. O. Box 149104
Austin, TX 78714-9104
Fax: (512) 475-1771
Web: http://www.tdi.state.tx.us
E-mail: ConsumerProtection@tdi.state.tx.us

PREMIUM OR CLAIM DISPUTES:

Should you have a dispute concerning your premium or about a claim you should contact your Agent or Travelers first. If the dispute is not resolved, you may contact the Texas Department of Insurance.

ATTACH THIS NOTICE TO YOUR BOND:

This notice is for information only and does not become a part or condition of the attached document and is given to comply with Texas legal and regulatory requirements.

Bond #106306255

PAYMENT BOND

Section 00620

STATE OF TEXAS
COUNTY OF **TRAVIS**

Bond No.:
C.I.P. ID No.: **3333.015**

Project: **South Austin Regional Wastewater Treatment Plant Tertiary Filter Improvements**

Know All Men By These Presents: That **Matous Construction, Ltd.** of the City of **Belton**, County of **Bell**, and State of **Texas**, as Principal, and Travelers Casualty and Surety Company of America, a solvent company authorized under laws of the State of Texas to act as surety on bonds for principals, are held and firmly bound unto **City of Austin** (OWNER), and all Subcontractors, workers, laborers, mechanics and suppliers as their interests may appear, all of whom shall have right to sue upon this bond in the penal sum of **Twenty Four Million, Seven Hundred Eighteen Thousand, Six Hundred Ten Dollars ($24,718,610)** for payment whereof, well and truly to be made, said Principal and Surety bind themselves and their heirs, administrators, executors, successors and assigns, jointly and severally, by these presents:

Conditions of this Bond are such that, whereas, Principal has entered into a certain written contract with OWNER, dated the **28th** day of **January**, **2016**, which Agreement is hereby referred to and made a part hereof as fully and to the same extent as if copied at length herein.

Now, therefore, condition of this obligation is such, that if the said Principal shall well and truly pay all Subcontractors, workers, laborers, mechanics, and suppliers, all monies to them owing by said Principals for subcontracts, work, labor, equipment, supplies and materials done and furnished for the construction of improvement of said Agreement, then this obligation shall be and become null and void; otherwise to remain in full force and effect.

Provided, however, that this bond is executed pursuant to provisions of Chapter 2253, Texas Government Code as amended and all liabilities on this bond shall be determined in accordance with provisions of said Article to same extent as if it were copied at length herein.

Surety, for value received, stipulates and agrees that no change in Contract Time or Contract Amount shall in anywise affect its obligation on this bond, and it does hereby waive notice of any such change in Contract Time or Contract Amount.

In witness whereof, said Principal and Surety have signed and sealed this instrument this 28th day of January, 2016.

Matous Construction, Ltd.	Travelers Casualty and Surety Company of America
Principal	Surety
By Bruce A. Matous (Signature)	By Emily Mikeska (Signature)
Title Chief Executive Officer	Title Attorney-In-Fact
Address 8602 N Hwy 317 Belton, TX 76513	Address 1023 Canyon Creek Drive, Suite 110 Temple, TX 76502

Telephone 254-771-5700 Fax 254-771-5710

E-Mail Address emikeska@ward-moore.com

Name and address of Resident Agent of Surety:

John R. Ward - Ward & Moore Insurance Services, LP

P. O. Box 179, Gatesville, TX 76528

Note: Bond shall be issued by a solvent Surety company authorized to do business in Texas, and shall meet any other requirements established by law or by OWNER pursuant to applicable law. A copy of surety agent's "Power of Attorney" must be attached hereto.

END

WARNING: THIS POWER OF ATTORNEY IS INVALID WITHOUT THE RED BORDER

TRAVELERS

POWER OF ATTORNEY

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

Attorney-In Fact No. 226746

Certificate No. 006325940

KNOW ALL MEN BY THESE PRESENTS: That Farmington Casualty Company, St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company are corporations duly organized under the laws of the State of Connecticut, that Fidelity and Guaranty Insurance Company is a corporation duly organized under the laws of the State of Iowa, and that Fidelity and Guaranty Insurance Underwriters, Inc., is a corporation duly organized under the laws of the State of Wisconsin (herein collectively called the "Companies"), and that the Companies do hereby make, constitute and appoint

John R. Ward, Douglas Moore, Emily Mikeska, and Eva O. Limmer

of the City of Temple, State of Texas, their true and lawful Attorney(s)-in-Fact, each in their separate capacity if more than one is named above, to sign, execute, seal and acknowledge any and all bonds, recognizances, conditional undertakings and other writings obligatory in the nature thereof on behalf of the Companies in their business of guaranteeing the fidelity of persons, guaranteeing the performance of contracts and executing or guaranteeing bonds and undertakings required or permitted in any actions or proceedings allowed by law.

IN WITNESS WHEREOF, the Companies have caused this instrument to be signed and their corporate seals to be hereto affixed, this 26th day of March, 2015.

Farmington Casualty Company
Fidelity and Guaranty Insurance Company
Fidelity and Guaranty Insurance Underwriters, Inc.
St. Paul Fire and Marine Insurance Company
St. Paul Guardian Insurance Company
St. Paul Mercury Insurance Company
Travelers Casualty and Surety Company
Travelers Casualty and Surety Company of America
United States Fidelity and Guaranty Company

1982 1977 1951 1896

State of Connecticut
City of Hartford ss.

By: ______________________
Robert L. Raney, Senior Vice President

On this the 26th day of March, 2015, before me personally appeared Robert L. Raney, who acknowledged himself to be the Senior Vice President of Farmington Casualty Company, Fidelity and Guaranty Insurance Company, Fidelity and Guaranty Insurance Underwriters, Inc., St. Paul Fire and Marine Insurance Company, St. Paul Guardian Insurance Company, St. Paul Mercury Insurance Company, Travelers Casualty and Surety Company, Travelers Casualty and Surety Company of America, and United States Fidelity and Guaranty Company, and that he, as such, being authorized so to do, executed the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

In Witness Whereof, I hereunto set my hand and official seal.
My Commission expires the 30th day of June, 2016.

Marie C. Tetreault
Marie C. Tetreault, Notary Public

WARNING: THIS POWER OF ATTORNEY IS INVALID WITHOUT THE RED BORDER

IMPORTANT NOTICE

To obtain information or make a complaint:

You may call Travelers Casualty and Surety Company of America and its affiliates' toll-free telephone number for information or to make a complaint at:

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1-800-252-3439

You may write the Texas Department of Insurance:

P. O. Box 149104
Austin, TX 78714-9104
Fax: (512) 475-1771
Web: http://www.tdi.state.tx.us
E-mail: ConsumerProtection@tdi.state.tx.us

PREMIUM OR CLAIM DISPUTES:

Should you have a dispute concerning your premium or about a claim you should contact your Agent or Travelers first. If the dispute is not resolved, you may contact the Texas Department of Insurance.

ATTACH THIS NOTICE TO YOUR BOND:

This notice is for information only and does not become a part or condition of the attached document and is given to comply with Texas legal and regulatory requirements.

CIP ID Number: 3333.015

City of Austin, Texas
Equal Employment/Fair Housing Office

To: City of Austin, Texas, ("OWNER")

I hereby certify that our firm conforms to the Code of the City of Austin Section 5-4-2 as reiterated below:

Chapter 5-4. Discrimination in Employment by City Contractors.

Sec. 4-2 Discriminatory Employment Practices Prohibited. **(B)** As an Equal Employment Opportunity (EEO) employer, the Contractor will conduct its personnel activities in accordance with established federal, state and local EEO laws and regulations and agrees:

(1) Not to engage in any discriminatory employment practice defined in this chapter.

(2) To take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without discrimination being practiced against them as defined in this chapter. Such affirmative action shall include, but not be limited to: all aspects of employment, including hiring, placement, upgrading, transfer, demotion, recruitment, recruitment advertising; selection for training and apprenticeship, rates of pay or other forms of compensation, and layoff or termination.

(3) To post in conspicuous places, available to employees and applicants for employment, notices to be provided by OWNER setting forth the provisions of this chapter.

(4) To state in all solicitations or advertisements for employees placed by or on behalf of Contractor, that all qualified applicants will receive consideration for employment without regard to race, creed, color, religion, national origin, sexual orientation, gender identity, disability, veteran status, sex or age.

(5) To obtain a written statement from any labor union or labor organization furnishing labor or service to Contractors in which said union or organization has agreed not to engage in any discriminatory employment practices as defined in this chapter and to take affirmative action to implement policies and provisions of this chapter.

(6) To cooperate fully with OWNER's Equal Employment/Fair Housing Office in connection with any investigation or conciliation effort of said Equal Employment/Fair Housing Office to ensure that the purpose of the provisions against discriminatory employment practices are being carried out.

(7) To require compliance with provisions of this chapter by all subcontractors having fifteen or more employees who hold any subcontract providing for expenditure of $2,000.00 or more in connection with any contract with OWNER subject to the terms of this chapter. .

For the purposes of this Bid and any resulting Contract, Contractor adopts the provisions of the City's Minimum Standard Nondiscrimination and Non-Retaliation Policy as set forth below.

City of Austin

Minimum Standard Non-Discrimination and Non-Retaliation in Employment Policy

As an Equal Employment Opportunity (EEO) employer, the Contractor will conduct its personnel activities in accordance with established federal, state and local EEO laws and regulations.

The Contractor will not discriminate against any applicant or employee based on race, creed, color, national origin, sex, age, religion, veteran status, gender identity, disability, or sexual orientation. This policy covers all aspects of employment, including hiring, placement, upgrading, transfer, demotion, recruitment, recruitment advertising, selection for training and apprenticeship, rates of pay or other forms of compensation, and layoff or termination.

The Contractor agrees to prohibit retaliation, discharge or otherwise discrimination against any employee or applicant for employment who has inquired about, discussed or disclosed their compensation.

Further, employees who experience discrimination, sexual harassment, or another form of harassment should immediately report it to their supervisor. If this is not a suitable avenue for addressing their complaint, employees are advised to contact another member of management or their human resources representative. No employee shall be discriminated against, harassed, intimidated, nor suffer any reprisal as a result of reporting a violation of this policy. Furthermore, any employee, supervisor, or manager who becomes aware of any such discrimination or harassment should immediately report it to executive management or the human resources office to ensure that such conduct does not continue.

Contractor agrees that to the extent of any inconsistency, omission, or conflict with its current non-discrimination and non- retaliation employment policy, the Contractor has expressly adopted the provisions of the City's Minimum Non-Discrimination Policy contained in Section 5-4-2 of the City Code as set forth above and the City's Non-Retaliation Policy, as the Contractor's Non-Discrimination and Non-Retaliation Policy or as an amendment to such Policy and such provisions are intended to not only supplement the Contractor's policy, but will also supersede the Contractor's policy to the extent of any conflict.

UPON CONTRACT AWARD, THE CONTRACTOR SHALL PROVIDE A COPY TO THE CITY OF THE CONTRACTOR'S NON-DISCRIMINATION AND NON-RETALIAITON POLICY ON COMPANY LETTERHEAD, WHICH CONFORMS IN FORM, SCOPE, AND CONTENT TO THE CITY'S MINIMUM NON-DISCRIMINATION AND NON-RETALIATION POLICY, AS SET FORTH HEREIN, ***OR*** *THIS NON-DISCRIMINATION AND NON-RETALIATION POLICY, WHICH HAS BEEN ADOPTED BY THE CONTRACTOR FOR ALL PURPOSES (THE FORM OF WHICH HAS BEEN APPROVED BY THE CITY'S EQUAL EMPLOYMENT/FAIR HOUSING OFFICE), WILL BE CONSIDERED THE CONTRACTOR'S NON-DISCRIMINATION AND NON-RETALIATION POLICY WITHOUT THE REQUIREMENT OF A SEPARATE SUBMITTAL. (http://austintexas.gov/page/bid-docs).*

Sanctions:

Our firm understands that non-compliance with Chapter 5-4 may result in sanctions, including termination of the contract and suspension or debarment from participation in future City contracts until deemed compliant with the requirements of Chapter 5-4.

Term:

The Contractor agrees that this Section 00630 Non-Discrimination and Non-Retaliation Certificate or the Contractor's separate conforming policy, which the Contractor has executed and filed with the Owner, will remain in force and effect for one year from the date of filing. The Contractor further agrees that, in consideration of the receipt of continued Contract payments, the Contractor's Non-Discrimination Policy will automatically renew from year-to-year for the term of the underlying Contract.

Dated this 22nd day of October, 2015.

CONTRACTOR Matous Construction, Ltd.
Authorized Signature
Title CEO of the General Partner

END

TITLE VI ASSURANCES APPENDIX A

Section 00631

During the performance of this contract, the contractor, for itself, its assignees and successors in interest (hereinafter referred to as the "contractor") agrees as follows:

1. Compliance with Regulations: The contractor shall comply with the Regulations relative to nondiscrimination in Federally-assisted programs of the Department of Transportation (hereinafter, "DOT") Title 49, Code of Federal Regulations, Part 21, as they may be amended from time to time, (hereinafter referred to as the Regulations), which are herein incorporated by reference and made a part of this contract.

2. Nondiscrimination: The contractor, with regard to the work performed by it during the contract, shall not discriminate on the grounds of race, color, or national origin in the selection and retention of subcontractors, including procurements of materials and leases of equipment. The contractor shall not participate either directly or indirectly in the discrimination prohibited by section 21.5 of the Regulations, including employment practices when the contract covers a program set forth in Appendix B of the Regulations.

3. Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the contract for work to be performed under a subcontract, including procurements of materials or leases of equipment, each potential subcontractor or supplier shall be notified by the contractor of the contractor's obligations under this contract and the Regulations relative to nondiscrimination on the grounds of race, color, or national origin.

4. Information and Reports: The contractor shall provide all information and reports required by the Regulations or directives issued pursuant thereto, and shall permit access to its book, records, accounts, other sources of information, and its facilities as may be determined by the Recipient or the Texas Department of Transportation to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of a contractor is in the exclusive possession of another who fails or refuses to furnish this information the contractor shall so certify to the Recipient, or the Texas Department of Transportation as appropriate, and shall set forth what efforts it has made to obtain the information.

5. Sanctions for Noncompliance: In the event of the contractor's noncompliance with the nondiscrimination provisions of this contract, the Recipient shall impose such contract sanctions as it or the Texas Department of Transportation may determine to be appropriate, including, but not limited to:

   (a) withholding of payments to the contractor under the contract until the contractor complies, and or (b) cancellation, termination or suspension of the contract, in whole or in part.

6. Incorporation of Provisions: The contractor shall include the provisions of paragraphs (1) through (6) in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Regulations, or directives issued pursuant thereto. The contractor shall take such action with respect to any subcontract or procurement as the Recipient or the Texas Department of Transportation may direct as a means of enforcing such provisions including sanctions for non-compliance: Provided, however, that, in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, the contractor may request the Recipient to enter into such litigation to protect the

interests of the Recipient, and, in addition, the contractor may request the United States to enter into such litigation to protect the interests of the United States.

(DOT 1050.2, 08/24/71)

Contractor's full name and entity status:
Matous Construction, Ltd., a Texas Limited Partnership

Signature, Authorized Representative of Contractor

CEO of the General Partner
Title

October 22, 2015
Date

END

CERTIFICATE OF INSURANCE

Section 00650

This Certificate shall be completed by a licensed insurance agent:

Name and Address of Agency:
Ward & Moore Insurance Services, LP
1023 Canyon Creek Road, Suite 110
Temple, TX 76502
Phone: 254-771-5700 /

Name and Address of Insured:
Matous Construction, Ltd.
8602 North Highway 317
Belton, TX 76513

Phone: **(254) 780-1400**

Prime or Sub-Contractor?: **PRIME**

Name of Prime Contractor, if different from Insured:

City of Austin Reference:
Project Name: **SAR WTP Tertiary Filter Imp.**
C.I.P. No.: **3333.015**
Project Location: **1017 Fallwell Lane**
Del Valle, TX 78617
Managing Dept.: **Public Works**
Solicitation No.: **CLMC562**
Project Manager: **Steve Parks**

Insurers Affording Coverages:

Insurer A: Amerisure Mutual Insurance Company

Insurer B: Amerisure Insurance Company

Insurer C: Travelers Property & Casualty of America

Insurer D: Hanover Insurance Company

Insurer E: Catlin Specialty Insurance Company

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YYYY)	POLICY EXPIRATION DATE (MM/DD/YYYY)	LIMITS OF LIABILITY	
A	**Commercial General Liability Policy** As defined in the Policy, does the Policy provide:	CPP2026447	1/12/2016	1/12/2017	Each Occurrence	$ 1,000,000
					General Aggregate	$ 2,000,000
	☒ Yes ☐ No -- Completed Operations/Products				Completed Operations /Products Aggregate	$ 2,000,000
	☒ Yes ☐ No -- Contractual Liability				Personal & Advertising Injury	$ 1,000,000
	☒ Yes ☐ No -- Explosion				Deductible or Self Insured Retention	$ 0
	☒ Yes ☐ No -- Collapse					
	☒ Yes ☐ No -- Underground					
	☒ Yes ☐ No -- Contractors/ Subcontractors Work					
	☒ Yes ☐ No -- Aggregate Limits per Project Form CG 2503					
	☒ Yes ☐ No -- Additional Insured Form – CG 2010					
	☒ Yes ☐ No -- 30 Day Notice of Cancellation Form – CG 0205					
	☒ Yes ☐ No -- Waiver of Subrogation Form – CG 2404					
E	**Pollution/ Environmental Impairment Policy**	CPL75010 0116	1/12/2016	1/12/2017	Occurrence Each Claim	$ 2,000,000
					Aggregate	$ 2,000,000

INSR LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YYYY)	POLICY EXPIRATION DATE (MM/DD/YYYY)	LIMITS OF LIABILITY	
A	**Auto Liability Policy** As defined in the Policy, does the Policy provide:	CA2026446	1/12/2016	1/12/2017	CSL	$ 1,000,000
					Bodily Injury (Per Accident)	$
	☒ Yes ☐ No -- Any Auto				Bodily Injury (Per Person)	$
	☒ Yes ☐ No -- All Owned Autos				Property Damage (Per Accident)	$
	☒ Yes ☐ No -- Non-Owned Autos					
	☒ Yes ☐ No -- Hired Autos					
	☒ Yes ☐ No -- Waiver of Subrogation – CA0444					
	☒ Yes ☐ No -- 30 Day Notice of Cancellation – CA0244					
	☒ Yes ☐ No -- Additional Insured – CA2048					
	☐ Yes ☒ No -- MCS 90					
B	**Excess Liability** ☒ Umbrella Form	CU2026448	1/12/2016	1/12/2017	Occurrence	$ 5,000,000
	☐ Excess Liability Follow Form	* See below for additional excess limits.			Aggregate	$ 5,000,000
B	**Workers Compensation and Employers Liability** As defined in the Policy, does the Policy provide:	WC2026452	1/12/2016	1/12/2017	☒ Statutory	
					Each Accident	$ 1,000,000
	☒ Yes ☐ No -- Waiver of Subrogation – WC420304				Disease – Policy Limit	$ 1,000,000
	☒ Yes ☐ No -- 30 Day Notice of Cancellation – WC420601				Disease – Each Employee	$ 1,000,000
D	**Is a Builders Risk or Installation Insurance Policy provided?** ☒ Yes ☐ No	IHDA70382200	4/1/2016	4/1/2018	Jobsite Limit Temporary Storage Transit Deductible	$ 24,718,610 $ 500,000 $ 500,000 $ 10,000
	☒ Yes ☐ No -- Is the City shown as loss payee/mortgagee?					
E	**Professional Liability** As defined in the Policy, does the Policy provide:	CPL7501060116	1/12/2016	1/12/2017	Each Claim (shared limit with pollution liab cov)	$ 2,000,000
	☒ Yes ☐ No -- 30 Day Notice of Cancellation Retroactive Date: 1-12-2015				Deductible or Self Insured Retention	$ 10,000

This form is for informational purposes only and certifies that policies of insurance listed above have been issued to insured named above and are in force at this time. Not withstanding any requirements, term or condition of any contract or other document with respect to which this certificate may be issued or may pertain, insurance afforded by policies described herein is subject to all terms, exclusions and conditions of such policies.

CERTIFICATE HOLDER:

City of Austin
Contract Management Department
P.O. Box 1088
Austin, Texas 78767

DATE ISSUED: 1-29-2016

AUTHORIZED REPRESENTATIVE SIGNATURE
Licensed Insurance Agent

END

C	* Excess Liability over the $5,000,000 Primary Umbrella	ZUP12P86158	1/12/2016	1/12/2017	Occurrence Limit Aggregate Limit	$5,000,000 $5,000,000

TEXAS SALES AND USE TAX EXEMPTION CERTIFICATE

Section 00670

City of Austin, Texas
P.O. Box 1088
Austin, Texas 78767

CONTRACTOR/PURCHASER: **Matous Construction, Ltd.**

Street Address: **8602 North Highway 317**

City, State, ZIP Code: **Belton, TX 76513**

PROJECT: **S. Austin Regional Wastewater Treatment Plant Tertiary Filter Improvements**

Project Manager: **Steve Parks**

FDU No.: **4480 2307 8236**

CIP ID No.: **3333.015**

Description of items to be purchased or as described on the attached order or invoice:

____

____

The Contractor may purchase all labor, materials, supplies, and equipment to be incorporated in the City of Austin realty, including easements, or completely consumed at the Project jobsite and services required by or integral to the performance of the contract for the Project without paying sales or use tax in accordance with State Comptroller Rule 3.291.

Contractor/Purchaser claims this exemption for the following reason: This contract is to be performed for the City of Austin, a tax exempt entity under the Texas Tax Code.

I understand that I will be liable for payment of sales and use taxes which may become due for failure to comply with the provisions of the Tax Code. I also understand that it is a criminal offense to give an exemption certificate to the contractor for taxable items that I know, at the time of purchase, will be used in a manner other than that expressed in this certificate and depending on the amount of tax evaded, the offense may range from a Class B misdemeanor to a felony of the second degree.

City of Austin, Texas	Title	Date
Elaine Hart ELAINE HART	CHIEF FINANCIAL OFFICER	March 20, 2014

CONTRACTOR/PURCHASER: ____________________

By: ____________________

Title: ____________________

Date: ____________________

NOTE: This certificate cannot be issued for the purchase, lease, or rental of a motor vehicle.
THIS CERTIFICATE DOES NOT REQUIRE A NUMBER TO BE VALID. Sales and Use Tax "Exemption Numbers" or "Tax Exempt" Numbers do not exist. This certificate should be furnished to the supplier. Do not send the completed certificate to the Comptroller of Public Accounts.

End

RESOLUTION NO. 20160421-005

WHEREAS, the Texas Water Development Board administers the State Water Implementation Fund for Texas (SWIFT) low interest loan program established by the Texas Legislature in 2013;

WHEREAS, the projects for Austin's portion of the 2016 Texas Water Plan, Region K, for the Lower Colorado River Basin, include a series of projects to improve the filter capacity of Austin Water's two major wastewater treatment plants and expansion of Austin's reclaimed water system:

1. Rehabilitation and expansion of the tertiary filtration system at South Austin Regional WWTP to improve effluent quality and increase capacity to 72 MGD;
2. Rehabilitation of the tertiary filtration system at Walnut Creek WWTP to improve effluent quality, increase reliability, and improve capacity to 75 MGD;
3. Construction of 19,000 feet of reclaimed main on Decker Lane to serve the Colony Park development and park, as well as the Travis County Expo Center;
4. Construction of 18,000 feet of reclaimed main to serve several cemeteries, a school, UT facilities, Huston Tillotson University, and parks;
5. Construction of 12,000 feet of reclaimed main to establish a pressure zone in the Burleson area and allow for expansion of the reclaimed system to the Onion Creek area;
6. Construction of 25,000 feet of reclaimed main to serve parks, a golf course, a school and developments in the Onion Creek area; and

7. Construction of a 4 million gallon ground storage tank and pump station for the reclaimed water system in the Montopolis area; and

WHEREAS, Austin Water would like to take advantage of low-interest SWIFT loans to finance wastewater and reclaimed water projects in annual increments through FY 2022-2023 in accordance with Austin Water's Capital Improvement Projects spending plan; **NOW, THEREFORE,**

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

1. That the City Council authorizes the city manager to file an application with the Texas Water Development Board seeking financial assistance from the State Water Implementation Fund for Texas loan program in an amount not to exceed $86,980,456 to provide for the costs of the following projects:

- Rehabilitation and expansion of the tertiary filtration system at South Austin Regional WWTP to improve effluent quality and increase capacity to 72 MGD;
- Rehabilitation of the tertiary filtration system at Walnut Creek WWTP to improve effluent quality, increase reliability, and improve capacity to 75 MGD;
- Construction of 19,000 feet of reclaimed main on Decker Lane to serve the Colony Park development and park, as well as the Travis County Expo Center;
- Construction of 18,000 feet of reclaimed main to serve several cemeteries, a school, UT facilities, Huston Tillotson University, and parks;

- Construction of 12,000 feet of reclaimed main to establish a pressure zone in the Burleson area and allow for expansion of the reclaimed system to the Onion Creek area;
- Construction of 25,000 feet of reclaimed main to serve parks, a golf course, a school and developments in the Onion Creek area; and
- Construction of a 4 million gallon ground storage tank and pump station for the reclaimed water system in the Montopolis area;

2. That Greg Meszaros, Director of Austin Water, is hereby designated the authorized representative of the City of Austin for purposes of furnishing such information and executing such documents as may be required in connection with the preparation and filing of such application for financial assistance and the rules of the Texas Water Development Board; and

3. That the following firms are authorized to assist the City in its preparation and submission of the application and may appear on behalf of and represent the City before any hearing held by the Texas Water Development Board on the application: Bond Counsel from the firm of McCall, Parkhurst and Horton, and Financial Advisor from the firm of Public Financial Management, Inc.

ADOPTED: April 21, 2016

ATTEST: Jannette S Goodall
Jannette S. Goodall
City Clerk

TWDB-0201
Revised 2/21/2013

Application Affidavit (WRD-201)

Austin SWIFT
Loan Application

Part B, Item 18

THE STATE OF TEXAS §
COUNTY OF Travis §
APPLICANT City of Austin §

BEFORE ME, the undersigned, a Notary Public in and for the State of Texas, on this day personally appeared **Greg Meszaros** as the Authorized Representative of the **City of Austin**, who being by me duly sworn, upon oath says that:

1. the decision by the **City of Austin** to request financial assistance from the Texas Water Development Board ("Board") was made in a public meeting held in accordance with the Open Meetings Act (Government Code, §551.001, et seq,) and after providing all such notice as required by such Act as is applicable to the **City of Austin**;
2. the information submitted in the application is true and correct according to my best knowledge and belief;
3. the **City of Austin** has no pending, threatened, or outstanding judgments, orders, fines, penalties, taxes, assessment or other enforcement or compliance issue of any kind or nature by the Environmental Protection Agency, Texas Commission on Environmental Quality, Texas Comptroller, Texas Secretary of State, or any other federal, state or local government, except for the following (if no such outstanding compliance issues, write in "none"):

A. One pending Agreed Order with fines to be assessed by TCEQ, as a combined enforcement action for two drinking water spills and one wastewater spill that occurred in August 2015.

B. Order of the Public Utilities Commission in Docket No. 42857 regarding the appeal by the petition of the North Austin Municipal Utility District No. 1, Northtown Municipal Utility District, Travis County Water Control and Improvement District No. 10 (Travis WCID No. 10), and Wells Branch Municipal Utility District of the wholesale water rates imposed by the City of Austin by an ordinance adopted by the Austin City Council that set rates for the City's 2012-2013 fiscal year.

4. the **City of Austin** warrants compliance with the representations made in the application in the event that the Board provides the financial assistance; and
5. the **City of Austin** will comply with all applicable federal laws, rules, and regulations as well as the laws of this state and the rules and regulations of the Board.

Official Representative

Title: Director, Austin Water

SWORN TO AND SUBSCRIBED BEFORE ME, by Greg Meszaros,

this 11 day of May, 2016.

(NOTARY'S SEAL)

FELICIA CANCINO
Notary Public, State of Texas
My Commission Expires
September 21, 2016

Felicia Cancino
Notary Public, State of Texas

Austin SWIFT Loan Application
Part B, Item 19
Council Resolution for Direct Reuse Application

TWDB—0201B
Revised 02/21/2013

Application Resolution - Certificate of Secretary (WRD-201b)

THE STATE OF TEXAS §
COUNTY OF Travis §
APPLICANT City of Austin §

I, the undersigned, Secretary of the City of Austin Texas, DO HEREBY CERTIFY as follows:

1. That on the 21st day of April, 20 16, a regular/special meeting of the Austin City Council was held at a meeting place within the City; the duly constituted members of the Austin City Council being as follows:

Mayor Steve Adler, Ora Houston, Delia Garza, Sabino Renteria, Gregorio Casar, Ann Kitchen, Don Zimmerman, Leslie Pool, Ellen Troxclair, Kathie Tovo, Sheri Gallo

and all of said persons were present at said meeting, except the following:

Council Member Casar was present at the meeting but off the dais for the vote on Resolution 20160421-005

Among other business considered at said meeting, the attached resolution entitled:

> "A RESOLUTION by the City Council of the City of Austin requesting financial participation from the Texas Water Development Board; authorizing the filing of an application for financial participation; and making certain findings in connection therewith."

was introduced and submitted to the Austin City Council for passage and adoption. After presentation and due consideration of the resolution, and upon a motion made by Council Member Houston and seconded by Council Member Renteria, the resolution was duly passed and adopted by the Austin City Council by the following vote:

8 voted "For"　　1 voted "Against"　　____ abstained

all as shown in the official Minutes of the Austin City Council for the meeting held on the aforesaid date.

2. That the attached resolution is a true and correct copy of the original on file in the official records of the Austin City Council; the duly qualified and acting members of the Austin City Council on the date of the aforesaid meeting are those persons shown above and, according to the records of my office, advance notice of the time, place and purpose of said meeting was given to each member of the Austin City Council; and that said meeting, and deliberation of the aforesaid public business, was open to the public and written notice of said meeting, including the subject of the above entitled resolution, was posted and given in advance thereof in compliance with the provisions of Chapter 551 of the Texas Government Code.

IN WITNESS WHEREOF, I have hereunto signed my name officially and affixed the seal of said City of Austin, this the 6 of May, 20 16.

(SEAL)

Jannette S Goodall
Secretary

RESOLUTION NO. 20160421-005

WHEREAS, the Texas Water Development Board administers the State Water Implementation Fund for Texas (SWIFT) low interest loan program established by the Texas Legislature in 2013;

WHEREAS, the projects for Austin's portion of the 2016 Texas Water Plan, Region K, for the Lower Colorado River Basin, include a series of projects to improve the filter capacity of Austin Water's two major wastewater treatment plants and expansion of Austin's reclaimed water system:

1. Rehabilitation and expansion of the tertiary filtration system at South Austin Regional WWTP to improve effluent quality and increase capacity to 72 MGD;
2. Rehabilitation of the tertiary filtration system at Walnut Creek WWTP to improve effluent quality, increase reliability, and improve capacity to 75 MGD;
3. Construction of 19,000 feet of reclaimed main on Decker Lane to serve the Colony Park development and park, as well as the Travis County Expo Center;
4. Construction of 18,000 feet of reclaimed main to serve several cemeteries, a school, UT facilities, Huston Tillotson University, and parks;
5. Construction of 12,000 feet of reclaimed main to establish a pressure zone in the Burleson area and allow for expansion of the reclaimed system to the Onion Creek area;
6. Construction of 25,000 feet of reclaimed main to serve parks, a golf course, a school and developments in the Onion Creek area; and

7. Construction of a 4 million gallon ground storage tank and pump station for the reclaimed water system in the Montopolis area; and

WHEREAS, Austin Water would like to take advantage of low-interest SWIFT loans to finance wastewater and reclaimed water projects in annual increments through FY 2022-2023 in accordance with Austin Water's Capital Improvement Projects spending plan; **NOW, THEREFORE,**

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF AUSTIN:

1. That the City Council authorizes the city manager to file an application with the Texas Water Development Board seeking financial assistance from the State Water Implementation Fund for Texas loan program in an amount not to exceed $86,980,456 to provide for the costs of the following projects:

- Rehabilitation and expansion of the tertiary filtration system at South Austin Regional WWTP to improve effluent quality and increase capacity to 72 MGD;
- Rehabilitation of the tertiary filtration system at Walnut Creek WWTP to improve effluent quality, increase reliability, and improve capacity to 75 MGD;
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- Construction of 18,000 feet of reclaimed main to serve several cemeteries, a school, UT facilities, Huston Tillotson University, and parks;

- Construction of 12,000 feet of reclaimed main to establish a pressure zone in the Burleson area and allow for expansion of the reclaimed system to the Onion Creek area;
- Construction of 25,000 feet of reclaimed main to serve parks, a golf course, a school and developments in the Onion Creek area; and
- Construction of a 4 million gallon ground storage tank and pump station for the reclaimed water system in the Montopolis area;

2. That Greg Meszaros, Director of Austin Water, is hereby designated the authorized representative of the City of Austin for purposes of furnishing such information and executing such documents as may be required in connection with the preparation and filing of such application for financial assistance and the rules of the Texas Water Development Board; and

3. That the following firms are authorized to assist the City in its preparation and submission of the application and may appear on behalf of and represent the City before any hearing held by the Texas Water Development Board on the application: Bond Counsel from the firm of McCall, Parkhurst and Horton, and Financial Advisor from the firm of Public Financial Management, Inc.

ADOPTED: April 21, 2016

ATTEST:
Jannette S. Goodall
City Clerk

Austin SWIFT Loan Application
Part D, Item 54
Reuse System Feasibility Report
Note: This report applies to many more projects than those included in this loan application

See page 38 for the reuse projects included in this report as noted below:

- Montopolis Tank
- Burleson Main
- Onion Creek Main
- Decker Lane Main

The Cemetery Main project is not included in this report

City of Austin Water Utility

Effective Water Resource Management

December 2008

Final Feasibility Report

Title XVI of Public Law 102-57

Submitted to:

City of Austin
Austin Water Utility
625 East 10th Street, Suite 800
Austin, Texas 78701

U. S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office

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Many thanks also to the various staff members of the U.S. Bureau of Reclamation for their time in developing and reviewing this report and their support of reclaimed water use.

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Abbreviations

af	acre-feet
af/yr	acre-feet per year
CCI	Construction Cost Index
City	City of Austin
cfs	cubic feet per second
DOR	drought of record
ENR	Engineering News Record
EPA	U.S. Environmental Protection Agency
ft	feet
FY	Fiscal Year
gpm	gallons per minute
in	inches
LCRA	Lower Colorado River Authority
MG	Million Gallons
MGD	Million Gallons per day
MUD	Municipal Utility District
NEPA	National Environmental Policy Act
NWF	National Wildlife Federation
PL	public law
Reclamation	U.S. Bureau of Reclamation
SAR	South Austin Regional
SHPO	Texas State Historic Preservation Officer
SSO	Sanitary Sewer Overflow
TCEQ	Texas Commission on Environmental Quality
TWDB	Texas Water Development Board
WWTP	Wastewater Treatment Plant

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Executive Summary

Introduction

Austin, Texas (City) is a vibrant community of approximately 770,000 located in Central Texas and serves as the State Capital. Austin draws its water supply from the Colorado River and can be viewed as a microcosm of statewide water use and environmental trends. The City has a growing population and, consequently, a growing water demand. Recreation on Colorado River reservoirs upstream of Austin has grown, as has pressure to minimize water level fluctuations to facilitate that recreation. The agricultural community has concerns over continued water availability for their needs. Additionally, there is an increased recognition that a minimum level of flow in the Colorado River and into the estuary of Matagorda Bay must be maintained for the benefit of aquatic resources.

Problems and Needs

With the City's current active water conservation and reclaimed water programs, water rights and purchased water are expected to meet demand until 2043. In 2050, however there will be an expected water shortage of 42,096 acre-feet per year (af/yr). Increased water conservation is expected to provide 21,000 af/yr, leaving 21,096 af/yr to be provided by some alternative measure, such as the use of reclaimed water.

Planning Objectives

In response to the problems and needs, and after considering public input, these planning objectives were developed to guide the study:

- Alternatives must provide at least 21,096 af/yr of an expected 42,096 af/yr water supply shortfall
- Alternatives must be cost-effective
- Alternatives must not compromise public health or the environment
- Alternatives must be acceptable to the public

Description of Alternatives

The following three alternatives were considered in this feasibility study:

No Federal Action Alternative

The No Federal Action Alternative is a base case. It assumes that there is no Federal involvement in addressing the anticipated 2050 water shortage of 42,096 af/yr. This alternative assumes that water conservation will increase by 21,000 af/yr and reclaimed water infrastructure will be limited to existing facilities and those under design or construction. Reclaimed water use will grow by 1,219 af/yr from the current level. The remaining 19,878 af/yr of demand will be met through additional raw water purchases. It should be noted that additional raw water purchases may not be available in the future. A schematic of this alternative can be found in Chapter 4.

Satellite Systems Alternative

With a satellite systems service concept, large volume water users are geographically matched with a potential reclaimed water source where a "satellite" wastewater treatment plant could be built. Under the Satellite Systems Alternative, thirteen new wastewater treatment plants located near clusters of reclaimed water customers will be built. Additionally, existing reclaimed water infrastructure already in design or under construction will be completed and customers in close proximity to the existing south and central reclaimed systems will be able to connect. To meet the 2050 water shortage of 42,096 af/yr, water conservation will increase by 21,000 af/yr and reclaimed water use will grow by 7,427 af/yr from the current level. The remaining 13,669 af/yr of demand will be met through additional raw water purchases and assumes raw water is available. A schematic of this alternative can be found in Chapter 4.

Transmission Main Alternative

The City has approximately 19 miles of existing transmission main in the southern and central part of its service area as well as pump stations and storage tanks at the Walnut Creek and SAR WWTPs. This existing infrastructure serves as the backbone of the Transmission Main Alternative and an extensive distribution system with transmission mains, tanks, and pump stations will be built to convert existing large potable water customers to reclaimed water use. To meet the 2050 water shortage of 42,096 af/yr, water conservation will increase by 21,000 af/yr and reclaimed water use will grow by at least 21,096 af/yr from the current level. Additional raw water purchases will not be necessary. A schematic of this alternative can be found in Chapter 4.

Environmental Analysis

For the three alternatives, environmental issues identified and described in the Environmental Assessment can be summarized as follows:

- Threatened and Endangered Species – No affect on threatened or endangered species, or their critical habitat.

- Wetlands – Alterations to riparian habitat are minimal.
- Historic and Archeological Sites – The City will continue consultation with the State Historic Preservation Office during detailed design of the preferred alternative (Transmission Main Alternative).
- Air Quality – Impacts are localized and temporary, occurring only over a period of months at any one location.
- Wildlife – Located within an urban setting. Impacts are localized and temporary, with no cumulative impacts to wildlife.
- Migratory Birds – Despite the anticipated loss of some trees during construction activities, migratory bird habitat would remain primarily unaltered.
- Native American Trust Assets – No impact, no Native American Trust Assets in region.
- Environmental Justice – Impacts do not appreciably exceed those occurring to the general public.

Evaluation of Alternatives

The Transmission Main Alternative is the best ranked of the three alternatives. It meets the objective of reclaiming at least 21,096 af/yr of water. It does not adversely impact the environment or public health, and its development is acceptable to the public. Additionally, it has the lowest life cycle cost per acre-foot for construction, operation, and maintenance.

Consultation and Coordination

In the past, the City has developed, reviewed, and approved various policies that form the basis of its reclaimed water program. The public has supported these policies consistently, and past surveys of customers indicate an acceptance of reclaimed water use. More recently, the City, in conjunction with the U.S. Bureau of Reclamation (Reclamation), held public meetings in December 2003 and July 2005 regarding three alternatives for the expansion of its reclaimed water program. The public was supportive of the reclaimed water program and did not express a preference in alternatives.

In addition to the general public, the study team consulted with the U.S. Environmental Protection Agency (EPA), the U.S Fish and Wildlife Service, the Texas Commission on Environmental Quality (TCEQ), the Texas Historical Commission, the Texas Parks and Wildlife Department, the Edwards Aquifer Conservation District, the National Wildlife Federation, and the San Antonio Water System during the preparation of this report.

Financial Capability

The City will serve as the non-federal sponsor for the preferred Transmission Main Alternative and is prepared to fund $138.4 million (87.4%) of the total $158.4 million cost. Over the 27-year construction period, the City intends to fund its portion of capital improvement projects for the design and construction of the reclaimed water system through the issuance of short-term commercial paper that will periodically be replaced with long-term revenue bonds. Funding for operation and maintenance of the reclaimed water system will come from user fees that will be periodically reviewed and adjusted as costs and the customer base changes. The City's financial capability is confirmed through its investment grade bond ratings. A copy of the Fiscal Year (FY) 2004-2005 financial statements is attached as Appendix A.

Research Needs

The City is conducting on-going research on the impact of reclaimed water on turf and local soils that have not been subject to the use of reclaimed water for landscape irrigation. The research may be useful in designing the expansion of the City's reclaimed water system, particularly in the sizing of transmission and distribution mains. At this point, the need for further research is not anticipated.

Conclusions

This report addressed the requirements of P.L. (Public Law) 102-575, Section 1604(c) 1-7, and the findings are that:

- The City is expected to experience a water shortage of 42,096 af/yr in 2050;
- The shortage can be eliminated through a combination of water conservation and growth of the reclaimed water system;
- Of the three alternatives considered, only the preferred Transmission Main Alternative provides a sufficient amount of reclaimed water to meet the shortage;
- Growth in the reclaimed water system is acceptable to the public;
- None of the three alternatives considered compromises public health or the environment;
- The Transmission Main Alternative is the most cost-effective alternative; and
- The City has the financial capability to fund its portion of construction costs.

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Chapter 1 – Introduction

Purpose and Scope

Authority

The *Reclamation Wastewater and Groundwater Study and Facilities Act,* P.L. (Public Law) 102-575, Title XVI as amended, directs the Secretary of the Interior to "undertake a program to investigate and identify opportunities for reclamation and reuse of municipal, industrial, domestic, and agricultural wastewater, and naturally impaired ground and surface waters, for the design and construction of demonstration and permanent facilities to reclaim and reuse wastewater." Section 1604 further authorizes the Secretary to work with Federal, State, regional, and local authorities, as necessary, to determine the feasibility of water reclamation and reuse projects that are identified in appraisal level reports. Reclamation and the City jointly developed an appraisal level report that determined there was a Federal interest in pursuing water reclamation and reuse in Austin. The appraisal level report recommended that a feasibility report be conducted.

Purpose

The purpose of this report is to examine the long-term water supply needs of the City, a strategy to meet those needs, potential uses for reclaimed water, alternative measures, public health issues, environmental issues, postponement of expanded water supplies, and the City's financial capability. This report was prepared using Reclamation's *WTR 11-01: Title XVI Water Reclamation and Reuse Program Feasibility Study Review Process.* Requirements of Section 1604 of Public Law 102-575 and its associated Guidance are addressed as follows:

TABLE 1-1 FEASIBILITY STUDY REQUIREMENTS

Section 1604 Requirements	
Problems and Needs	Chapter 2
Water Reuse Opportunities	Chapter 3
Description of Alternatives	Chapter 4
Economic Analysis	Chapter 5
Environmental Analysis	Chapter 6
Legal and Institutional Requirements	Chapter 7
Financial Capability	Chapter 8
Research Needs	Chapter 9

Study Preparation

This planning report is being conducted as a joint effort between Reclamation and the City under Cooperative Agreement No. 03FC601858. Funding for Reclamation's portion of the report was provided by Congressional appropriation in P.L. 108-7 of FY 2003. The City's portion of the report is being provided through in-kind services.

Non-Federal Sponsor

The City is the Non-Federal Sponsor of this study and would use Reclamation's Title XVI program to fund a portion of the design and construction of the reclaimed water system described in the Transmission Main Alternative, provided the project is authorized by Congress. The reclaimed water system will be owned and operated by the City.

Study Area

Setting

Austin, Texas is a vibrant community of approximately 770,000 located in Central Texas and serves as the State Capital. Austin draws its water supply from the Colorado River and can be viewed as a microcosm of statewide water use and environmental trends. The City has a growing population and, consequently, a growing water demand. Recreation on Colorado River reservoirs upstream of Austin, also known as the Highland Lakes, has increased, as has pressure to minimize water level fluctuations to facilitate that recreation. The agricultural community, particularly rice farmers in the lower reaches of the Colorado River, has concerns over continued water availability for its needs. Additionally, there is a growing recognition that a minimum level of flow must be maintained in the Colorado River for the benefit of aquatic resources along its length and into the estuary of Matagorda Bay.

Geographically, the City straddles the boundary between the Edwards Plateau of south-central Texas, commonly referred to as the "hill country," and the Blackland Prairie. Elevations of the Edwards Plateau range from about 100 to 3,000 feet (ft). Several river systems dissect the surface, creating a rough and well-drained landscape. Soils of the Edwards Plateau are usually shallow with a variety of surface textures. The Plateau is typified by limestone bedrock, making it unique in that the bedrock is very conducive to the development of large caves. The Blackland Prairie ranges in elevation from 300 to 800 ft and is gently rolling. The soil is deep, fertile, and dark in color, typically consisting of clays interspersed with sandy loams.

The City's climate is temperate, with hot summers and mild winters. Rainfall averages 32 inches per year and is uniformly distributed throughout the year.

The map below shows the general location of the City and the study area. More specific maps of the three alternatives considered in this report can be found in Chapter 4, Description of Alternatives.

CITY OF AUSTIN LOCATION MAP

Watershed Context

Senate Bill 1 from the 75th Session of the Texas Legislature charged the Texas Water Development Board (TWDB) with preparing a comprehensive statewide plan for managing and developing water resources. The TWDB did so by dividing up the state into sixteen regions, which each developed a specific plan. The City and its water supply, the Colorado River, are located in Region K. The TWDB's Region K Plan identified certain water shortages within the Colorado River Basin over its 50-year planning horizon. One of the options to help address Austin's water shortage is an extensive water reclamation program in the City.

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Chapter 2 – Problems and Needs

General

This section contains an overview of the near-term and long-term water supply and water demand for the City. From a water supply perspective, the City's major need is to address an anticipated water shortage of approximately 42,096 af/yr in 2050 in a cost-effective manner. The City's water conservation program is currently achieving 4,800 af/yr in demand reduction. Expansion of that program will provide 21,000 af/yr of the anticipated shortage, leaving 21,096 af/yr to be provided by some alternative measure, such as the use of reclaimed water.

Water Supply

According to Certificates of Adjudication issued by the Texas Water Commission (predecessor agency to the TCEQ), the City has the right to divert a maximum of 292,703 af/yr from the Colorado River for municipal use, subject to water availability. The City holds a water supply contract with the Lower Colorado River Authority (LCRA). Under the contract, the City can purchase additional water, for a total available water supply of 325,000 af/yr. Table 2-1 describes the water available to the City under currently held rights and the LCRA contract.

TABLE 2-1 SUMMARY OF CITY HELD WATER RIGHTS IN THE COLORADO RIVER

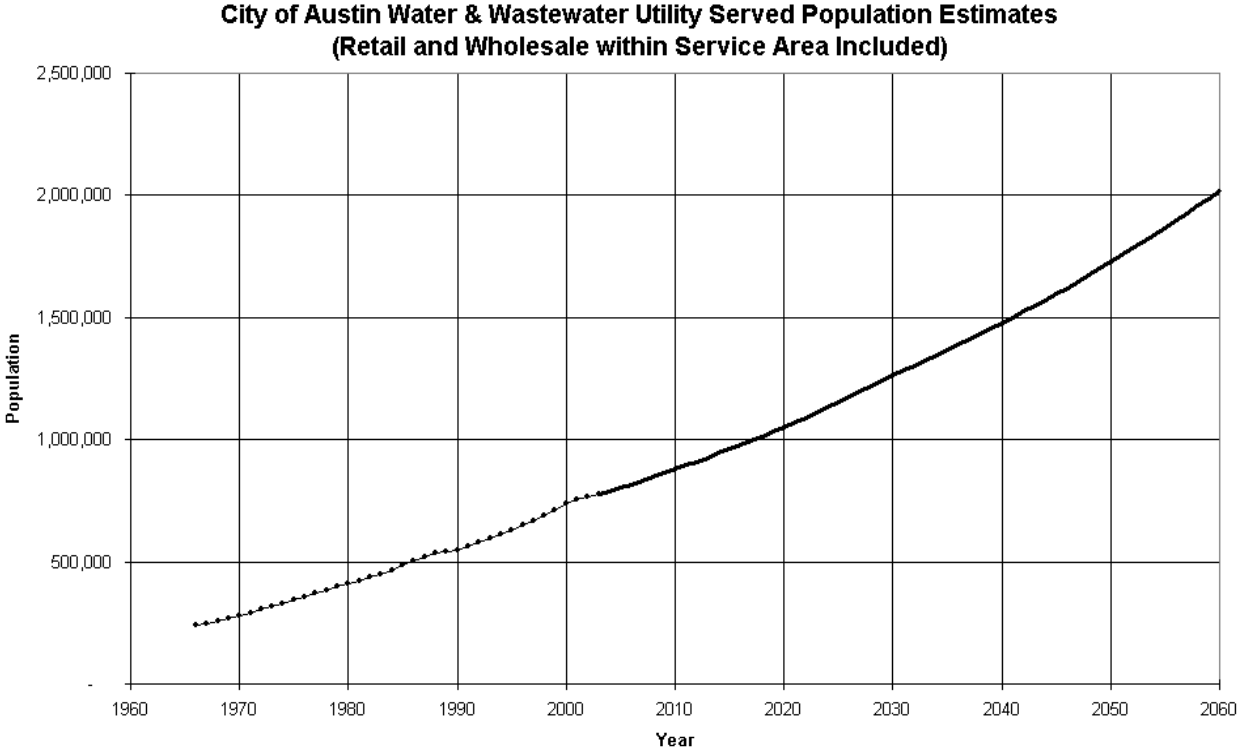
Permitted Use	Certificate of Adjudication	Priority Date	Permit Right (af/yr)
Municipal	14-5471A	6/10/1913	up to 250,000
	14-5471A	6/27/1914	up to 22,403
	14-5489	8/20/1945	up to 20,300
Subtotal			up to 292,703
Municipal	Contract Water	not applicable	at least 32,297
Total			325,000

Water Demand

Population Growth

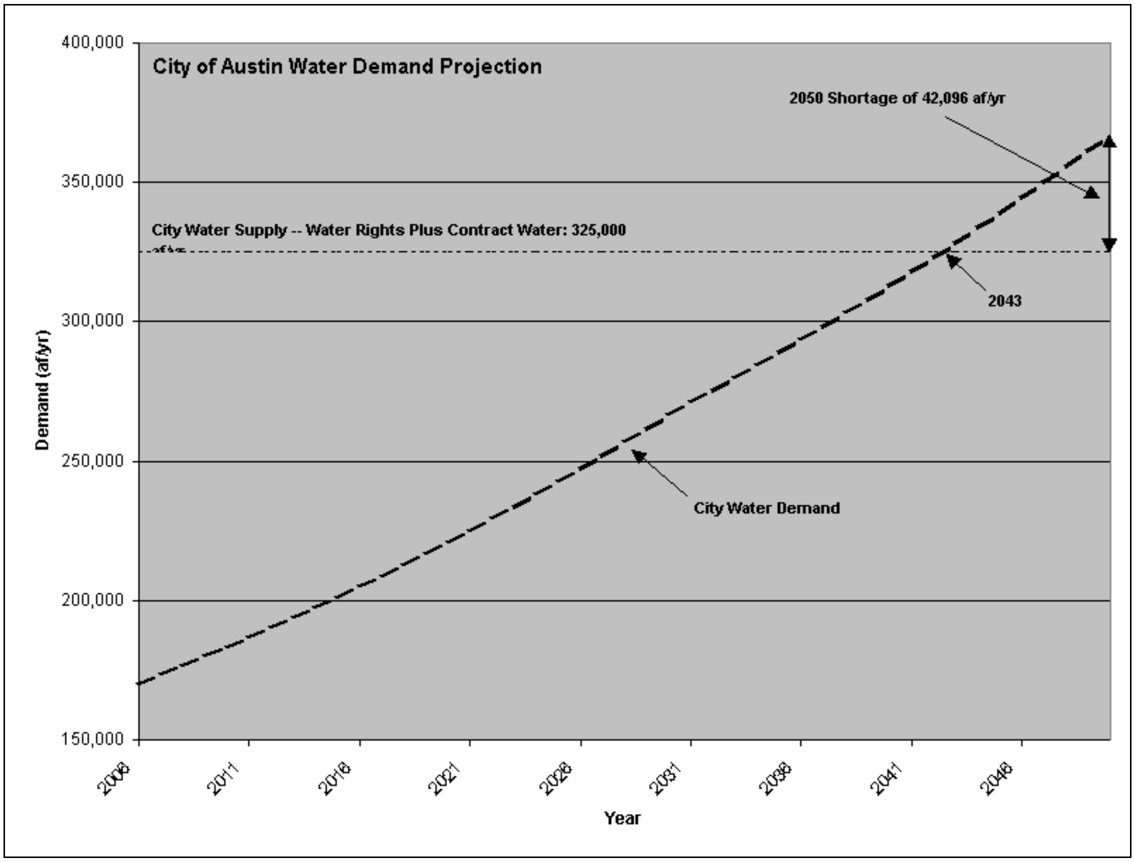
Water demand is related to population growth, and the City is expected to continue growing. From 1980 to 2000, the population served by the City's water utility increased from 408,700 to 738,229. The City's demographer predicts that the population served by the City's water utility will reach 1,726,405 in the year 2050. Graph 2-1 shows past and projected population growth in the City.

GRAPH 2-1 CITY OF AUSTIN POPULATION



The City's currently available water supply was more than sufficient to meet the expected 2006 demand of 170,049 af/yr. The City's water supply, along with the City's water conservation and reclaimed water programs, are expected to meet demand until approximately 2043. In 2050, however, there is an expected water shortage of 42,096 af/yr. See Graph 2-2.

GRAPH 2-2 PROJECT WATER DEMAND



Addressing the Need

An analysis of the demand curves and available water supply indicates that in 2043, demand will equal supply. In 2050, demand is expected to exceed supply by 42,096 af/yr. The Austin City Council has directed the Austin Water Utility to address the shortage through a combination of increased water conservation and increased use of reclaimed water. This report evaluates three alternatives to meet that shortage. In all of the alternatives, enhanced water conservation is able to reduce water demand by 21,000 af/yr beyond its current 4,800 af/yr demand reduction. The total reduction in demand due to water conservation is expected to be 25,800 af/yr.

No Federal Action Alternative

This alternative assumes that there is no Federal involvement in addressing the anticipated shortage. The City will complete reclaimed water infrastructure that is already in design or under construction. Reclaimed water use will grow by 1,219 af/yr from the current 2,108 af/yr to 3,327 af/yr. The remaining 19,877 af/yr of demand will be met through additional raw water purchases. It should be noted that additional raw water purchases may not be available in the future.

Satellite Systems Alternative

This alternative assumes that thirteen new wastewater treatment plants located near a cluster of reclaimed water customers will be built. Additionally, reclaimed water infrastructure already in design or under construction will be completed and put in service. Reclaimed water use will grow by 7,427 af/yr from the current 2,108 af/yr to 9,535 af/yr. The remaining 13,669 af/yr of demand will be met through additional raw water purchases and assumes raw water is available.

Transmission Main Alternative

The City has approximately 19 miles of existing transmission main in the southern and central part of its service area as well as pump stations and storage tanks at the Walnut Creek and SAR WWTPs. This existing infrastructure serves as the backbone of the Transmission Main Alternative. An extensive distribution system with transmission mains, tanks, and pump stations will be built to convert existing large potable water customers to reclaimed water use. Reclaimed water use will grow by at least 21,096 af/yr from the current 2,108 af/yr and will not require additional raw water purchases.

The three alternatives outlined in Table 2-2 below.

TABLE 2-2 SUMMARY OF ALTERNATIVES

Alternative	Additional Water Conservation	Additional Reclaimed Water	Additional Purchased Water	Total	Life Cycle Cost (af/yr)
No Federal Action	21,000 af/yr	1,219 af/yr	19,877 af/yr	42,096 af/yr	$841
Satellite Systems	21,000 af/yr	7,427 af/yr	13,669 af/yr	42,096 af/yr	$1,103
Transmission Main	21,000 af/yr	21,096 af/yr	0 af/yr	42,096 af/yr	$604

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Chapter 3 – Water Reuse Opportunities

General

This chapter describes sources of reclaimed water and water reuse opportunities under the three alternatives being considered. Under all three alternatives, reclaimed water will be used predominantly for landscape irrigation of golf courses, commercial properties, ball fields, schools, etc. The next largest category of use is for cooling at power plants, chilled water supply plants, office buildings, and industrial buildings. The remaining uses will be for process water at computer chip manufacturers, car washes, commercial laundries, etc.

No Federal Action Alternative

Table 3-1 describes anticipated reclaimed water sources and water use under the No Federal Action Alternative. Most demands are for existing customers and these are based on past usage. Anticipated south system demand is based on contract negotiations with the Sand Hill Energy Center. Anticipated central system demands are based on the March 2002 study entitled *City of Austin Water & Wastewater Utility Water Reclamation Initiative Planning Document.* The Balcones, Pickfair, Davenport, and Onion Creek plants are at peak capacity, with Davenport being decommissioned in 2008. The South System reaches peak capacity in 2010, followed a few years later by the Central System in 2012.

Table 3-1 No Federal Action Alternative Reclaimed Water Demand

Source	Major 2050 Uses	Reclaimed Water Supplied in 2005 (af/yr)	2050 Reclaimed* Water Supplied (af/yr)
Walnut Creek WWTP (Central System)	Landscape irrigation (90%), cooling towers (10%)	104**	952**
SAR WWTP (South System)	Landscape irrigation (39%), cooling towers (30%), process water (31%)	1,307**	1,927**
Balcones/Pickfair WWTPs	Landscape irrigation (100%)	239	239
Davenport WWTP	Not in service	249	0
Onion Creek WWTP	Landscape irrigation (100%)	209	209
Total		2,108**	3,327**

* Includes existing supply.

** Does not include 1,535 af/yr of process water used at each of the Walnut and SAR WWTPs.

Satellite Systems Alternative

Table 3-2 describes reclaimed water sources and anticipated water use under the Satellite Systems Alternative. Demands for existing customers are based on past use. Anticipated south system demand is based on contract negotiations with the Sand Hill Energy Center. Anticipated central system demands are based on a March 2002 study entitled *City of Austin Water & Wastewater Utility Water Reclamation Initiative Planning Document.* The demand for the new satellite systems is based on a May 2001 study entitled *Water Reclamation Initiative South System Master Plan.* The Balcones, Pickfair, Davenport, and Onion Creek plants are already at peak capacity, with Davenport being decommissioned in 2008. Because treatment plants are complex, it is assumed that the design and subsequent construction of a new satellite plant is initiated every other year, resulting in a 25-year construction program. Construction concludes in 2033, and this alternative reaches its full capacity in 2037.

TABLE 3-2 SATELLITE SYSTEMS ALTERNATIVE RECLAIMED WATER DEMAND

Source	Major 2050 Uses	Reclaimed Water Supplied in 2005 (af/yr)	2050 Reclaimed* Water Supplied (af/yr)
Walnut Creek WWTP (Central System)	Landscape irrigation (90%), cooling towers (10%)	104*	952*
SAR WWTP (South System)	Landscape irrigation (39%), cooling towers (30%), process water (31%)	1,307**	1,927**
Balcones/Pickfair WWTPs	Landscape irrigation (100%)	239	239
Davenport WWTP	Not in service	249	0
Onion Creek WWTP	Landscape irrigation (100%)	209	209
University of Texas WWTP	Previous study did not provide this level of detail	0	1,293
Samsung WWTP	Previous study did not provide this level of detail	0	963
Freescale Bluestein WWTP	Previous study did not provide this level of detail	0	583
Riverside WWTP	Previous study did not provide this level of detail	0	878

Source	Major 2050 Uses	Reclaimed Water Supplied in 2005 (af/yr)	2050 Reclaimed[*] Water Supplied (af/yr)
Spansion WWTP	Previous study did not provide this level of detail	0	749
IBM WWTP	Previous study did not provide this level of detail	0	504
US 290 WWTP	Previous study did not provide this level of detail	0	334
Far West WWTP	Previous study did not provide this level of detail	0	273
Cameron WWTP	Previous study did not provide this level of detail	0	254
Manchaca WWTP	Previous study did not provide this level of detail	0	169
Sematech WWTP	Previous study did not provide this level of detail	0	95
St. David's WWTP	Previous study did not provide this level of detail	0	74
Sachem WWTP	Previous study did not provide this level of detail	0	39
Total		2,108[*]	9,535[*]

* Includes existing supply.

** Does not include 1,535 af/yr of process water used at each of the Walnut and SAR WWTPs.

Transmission Main Alternative

Table 3-3 describes reclaimed water sources and anticipated water use under the Transmission Main Alternative. Demands for existing customers are based on past use. Anticipated demand in the south and central systems are based on a review of past studies with the deletion of unlikely customers and the addition of other potential customers. Balcones, Pickfair, Davenport, and Onion Creek plants are already at peak capacity, with Davenport being decommissioned in 2008. It is assumed that the design and subsequent construction of a new infrastructure project is initiated every year, resulting in a 26-year construction program. Construction starts in 2008 and concludes in 2035. This alternative reaches its full capacity in 2039.

TABLE 3-3 TRANSMISSION MAIN ALTERNATIVE RECLAIMED WATER DEMAND

Source	Major 2050 Uses	Reclaimed Water Supplied in 2005 (af/yr)	2050 Reclaimed[*] Water Supplied (af/yr)

Source	**Major 2050 Uses**	**Reclaimed Water Supplied in 2005 (af/yr)**	**2050 Reclaimed[*] Water Supplied (af/yr)**
Walnut Creek WWTP (Central System)	Landscape irrigation (47%), cooling towers (29%), process water (24%)	104[*]	19,231[*]
SAR WWTP (South System)	Landscape irrigation (63%), cooling towers (11%), process water (26%)	1,307[**]	6,434[*]
Balcones/Pickfair WWTPs	Landscape irrigation (100%)	239	239
Davenport WWTP	Not in service	249	0
Onion Creek WWTP	Landscape irrigation (100%)	209	209
Total		2,108[*]	26,113[*] (exceeds 21,096 goal)

[*] Includes existing supply.

[**] Does not include 1,535 af/yr of process water used at each of the Walnut and SAR WWTPs.

Water Reclamation Technology

The City uses the activated sludge treatment technique at all of its wastewater treatment plants. The treatment technique can be summarized as follows:

Bar Screening – wastewater travels through screens that remove large debris.
Grit Chamber – very dense particles settle to the bottom of tanks and are removed.
Primary Clarification – heavy organic particles sink to the bottom of large tanks and are removed.
Aeration – wastewater mixes with oxygen and bacteria in tanks where bacteria, through digestion, turn organic material into solids.
Secondary Clarification – digested solids settle to the bottom of the tank and are removed.
Tertiary Filters – (Walnut Creek and SAR WWTPs only) water passes through filters to remove fine particles.
Chlorine Contact Basin – filtered water is disinfected with chlorine.

The Walnut Creek and SAR WWTPs produce the highest quality water, which is classified as Type 1 by the TCEQ. The Balcones, Pickfair, Davenport, and Onion Creek produce Type 2 reclaimed water. Water quality at all plants meets or exceeds standards set by the TCEQ, and no further technology upgrades at the plants are anticipated at this time.

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Chapter 4 – Description of Alternatives

General

This section details three alternatives considered in this study – No Federal Action, Satellite Systems, and Transmission Main Alternatives. Quantities of reclaimed water supplied for each alternative are described in Chapter 3. Engineering cost estimates and life cycle cost estimates for each alternative are included in Chapter 5. A fourth alternative was considered in the Appraisal Study, but was dropped because of costs and possible environmental concerns.

No Federal Action Alternative

The No Federal Action Alternative is a base case and assumes no Federal involvement in addressing the anticipated 2050 water shortage of 42,096 af/yr. Under this alternative, water conservation will increase by 21,000 af/yr over its current level, and reclaimed water use will grow by 1,219 af/yr from the current level. The remaining 19,878 af/yr of demand will be met through the potable water system and additional raw water purchases. (Additional raw water purchases may not be available in the future). Enhanced use of the potable water system will require water treatment plant construction, the upsizing of transmission mains to bring water out of the plant, and additional elevated storage.

The No Federal Action Alternative limits reclaimed water infrastructure to existing facilities and those under design or construction. This does not preclude the addition of new reclaimed water customers, but new reclaimed water customers will be limited to those in the immediate vicinity of existing mains and mains under design or construction. The total length of main is expected to increase from 19 miles to approximately 20 miles in length. Figure 4-1 is a schematic of this alternative. Construction will be complete in 2008, with the system reaching full capacity in 2012.

Existing Facilities – Central System

The central reclaimed system provides water from the Walnut Creek WWTP. Piping in the central reclaimed system consists of four miles of transmission main. Pumping equipment consists of two low-service pumps, a one million gallon ground storage tank, and three high-service pumps at the Walnut Creek WWTP.

The central reclaimed system has one project in the design stage – a two million gallon elevated storage tank and an additional mile of 24-inch transmission main. This project provides elevated storage near existing customers and allows service to customers in the higher elevations of the Robert Mueller Municipal Airport redevelopment.

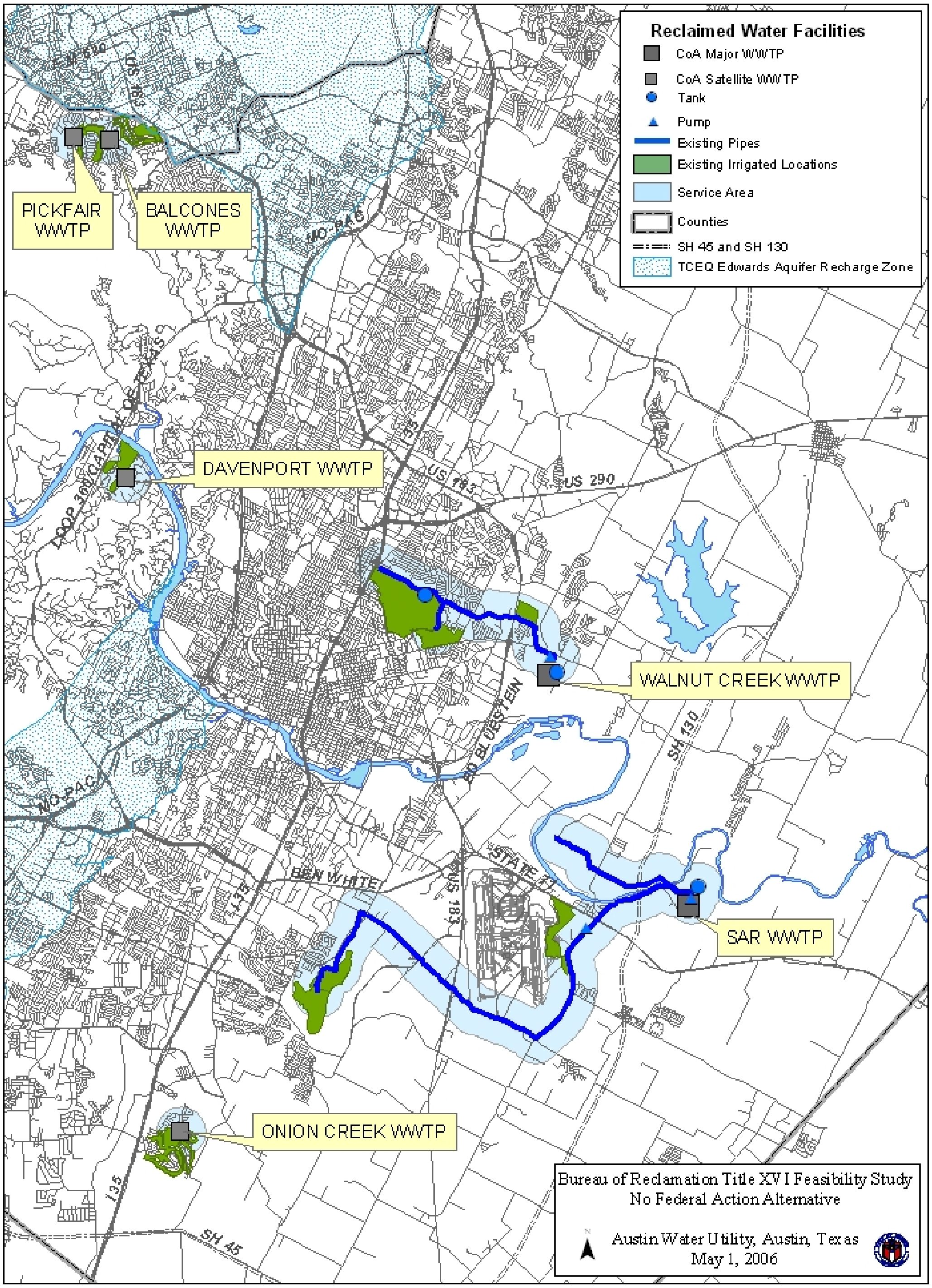
Existing Facilities – South System

The southern reclaimed system provides water from the SAR WWTP on the extreme eastern edge of the City. Piping for the south reclaimed system consists of 15 miles of transmission main. Pumping equipment consists of five high-service pumps, a 0.5 million gallon elevated storage tank, and an in-line booster pump station. Under the No Federal Action Alternative, no new infrastructure will be built in the south system.

Existing Facilities – Satellite Wastewater Treatment Plants

The Balcones and Pickfair WWTPs are located in the northwestern part of the City's service area. Reclaimed water produced at the plants is used exclusively for landscape irrigation at the Balcones and Spicewood Golf Courses. The Davenport WWTP is located in the western part of the City's service area. Reclaimed water produced at the plant is used exclusively for golf course irrigation at the Austin Country Club. The Davenport plant will be abandoned in 2008 when a sewage lift station is built to serve the area. The Onion Creek WWTP is located in the southern part of the City's service area. Reclaimed water produced at the plant is used exclusively for golf course irrigation at the Onion Creek Club. Under the No Federal Action Alternative, no new infrastructure will be built at the satellite wastewater treatment plants.

FIGURE 4-1 NO FEDERAL ACTION ALTERNATIVE SCHEMATIC



Satellite Systems Alternative

As mentioned in the description of the No Federal Action Alternative, the City has existing reclaimed water systems and customers in the southern and central part of its service area as well as at three existing satellite systems. Under the Satellite Systems Alternative, a limited number of new customers in close proximity to the existing south and central reclaimed systems will connect to these systems.

The Satellite Systems Alternative focuses primarily on the construction of thirteen additional small wastewater treatment plants located near a cluster of reclaimed water customers and a reclaimed water source. The activated sludge treatment technique will be used at all of the new satellite plants. It includes bar screening, grit removal, primary clarification, aeration, secondary clarification, filtration, and chlorination. The total length of mains will increase from the existing 19 miles to a total of 64 miles. Most of the increase in miles of mains will occur near the thirteen new wastewater treatment plants. A schematic of this alternative is shown as Figure 4-2.

It should be noted that the Satellite Systems Alternative results in a proliferation of small wastewater treatment plants in various locations throughout the City. This increases the volume of equipment to be maintained and operated, as well as the manpower devoted to maintenance.

Under the Satellite Systems Alternative, to meet the anticipated 2050 water shortage of 42,096 af/yr, water conservation will increase by 21,000 af/yr and reclaimed water use will grow by 7,427 af/yr from the current level. The remaining 13,669 af/yr of demand will be met through the potable water system and additional raw water purchases. (Additional raw water purchases may not be available in the future). Use of the potable water system will require water treatment plant construction, the upsizing of transmission mains to bring water out of the plant, and additional elevated storage. Information on the each satellite systems is provided in Table 4-1.

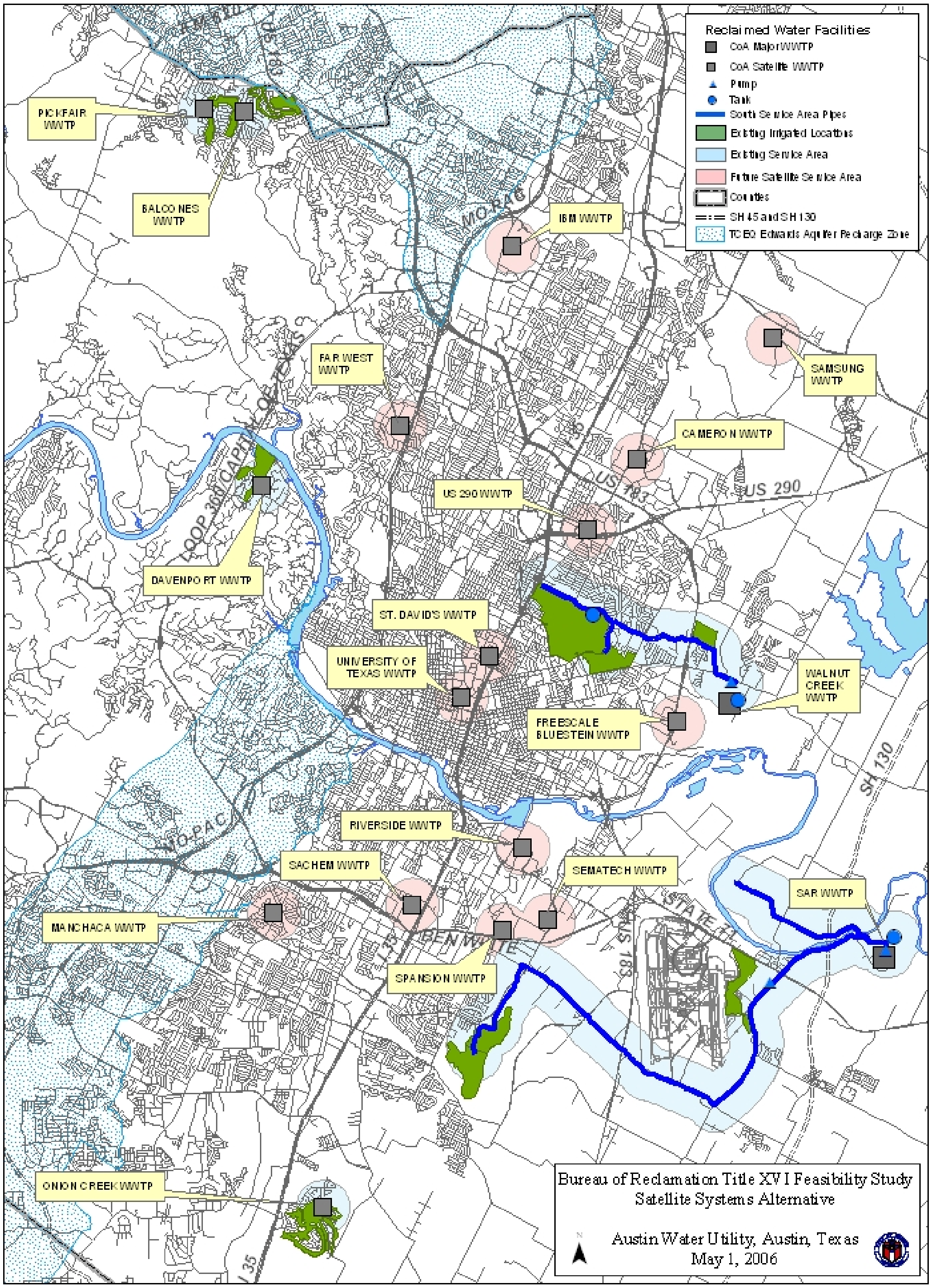
Construction of new satellite plants will commence in 2008, with construction starting on a new satellite plant every two years. Construction will be complete in 2033 for a 25-year construction schedule. The Satellite Systems Alternative will reach full capacity in 2037.

TABLE 4-1 SATELLITE SYSTEM DESCRIPTION

Name	Location	Number of Customers
University of Texas	18th & Trinity	42
Samsung	12100 Samsung Blvd	1
Freescale - Bluestein	3501 Ed Bluestein Blvd	4
Riverside	Elmont & Wickersham	90

Name	Location	Number of Customers
Spansion	5204 E Ben White	11
IBM	11501 Burnett Rd	28
US 290	Hwy 290 & Cameron Rd	37
Far West	Far West & Austin Center	22
Cameron	Cameron & Cross Park	19
Manchaca	Manchaca & Jones	17
Sematech	2706 Montopolis Dr	7
St. David’s	3000 N IH 35	4
Sachem	821 Woodward St	59

FIGURE 4-2 SATELLITE SYSTEMS ALTERNATIVE SCHEMATIC



Transmission Main Alternative

Under the Transmission Main Alternative, to meet the anticipated 2050 water shortage of 42,096 af, water conservation will increase by 21,000 af/yr and reclaimed water use will grow by 21,096 af/yr from the current level.

As described in the No Federal Action Alternative above, the City has 19 miles of existing transmission main in the southern and central part of its service area as well as pump stations and storage tanks at the Walnut Creek and SAR WWTPs. This existing infrastructure will serve as the starting point for the growth of the Transmission Main Alternative.

The miles of transmission mains will grow from 20 under no action to approximately 137 under the Transmission Main Alternative. Storage tanks in the distribution system will grow from one to seven with a combined storage capacity of 14.3 million gallons. Pump stations in the distribution system will increase from one to a total of five. Pressure zones will increase in number from two to five. The number of plant storage tanks will grow from two to three, and their capacity will increase from 2.5 million gallons to 3.5 million gallons. A schematic of this alternative is shown in Figure 4-3.

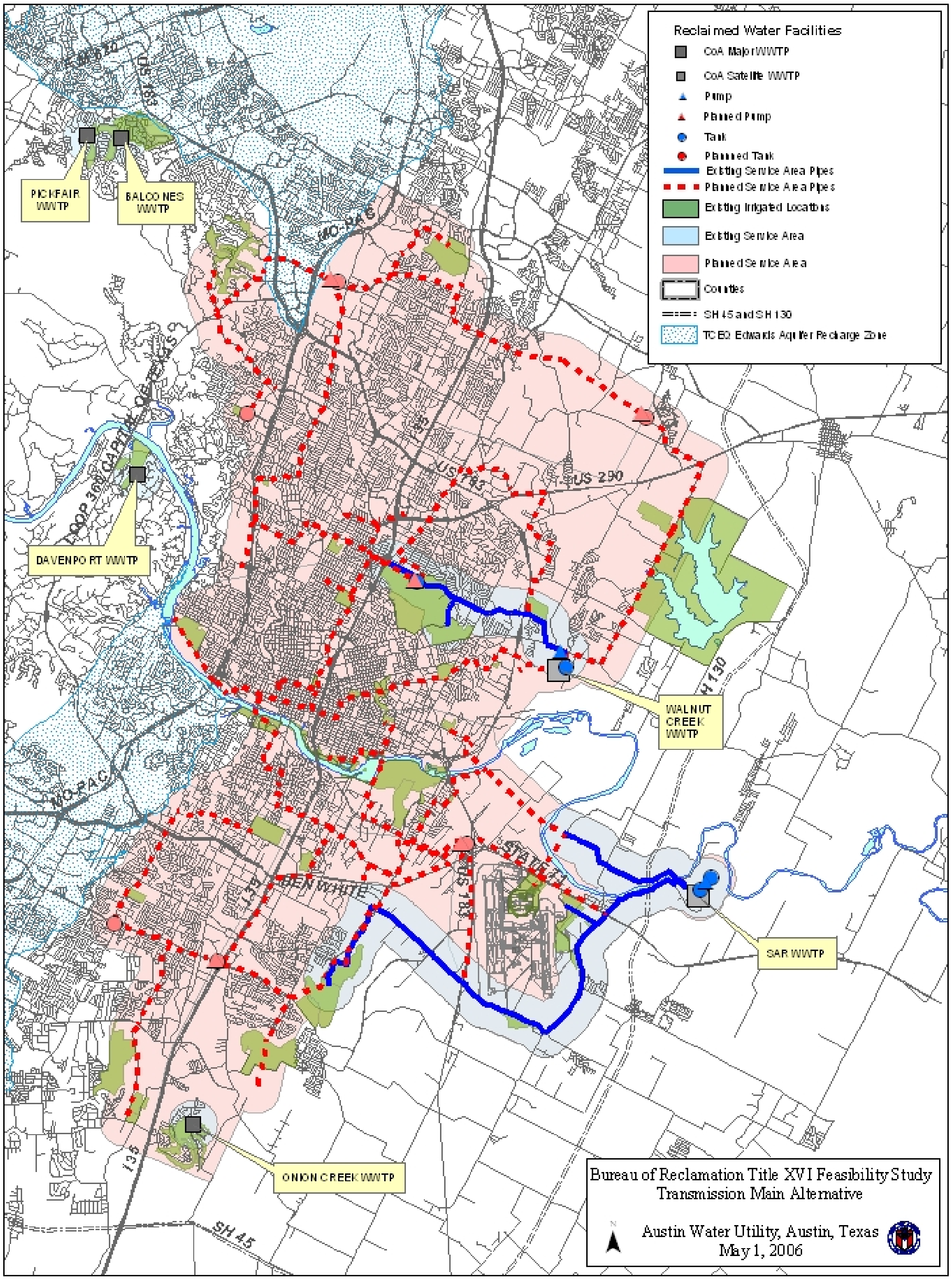
Under the Transmission Main Alternative, the central and south systems will grow significantly. This requires building and investment in infrastructure over a period of years. An important challenge is to determine the construction order. The following are priorities used to determine an implementation schedule:

- Utilizing existing infrastructure – The Utility already has invested in reclaimed water infrastructure such as tanks, pump stations, and transmission mains. The existing infrastructure should serve as the backbone for additional growth in the system. Projects in proximity to the existing system have a higher construction priority.
- Prevent deterioration of previous infrastructure investment – There are three abandoned force mains that might be suitable for reclaimed water service. There is also an 8-inch reclaimed water main that has never been placed into service. These assets need to be rehabilitated and placed in service or prepared for service. Projects that rehabilitate and preserve existing assets have a higher priority than new projects.
- Earlier service for large customers – Economies of scale exist for the reclaimed system. Projects that achieve economies of scale have a higher priority.
- Build out of pressure plains – The addition of a new pressure plain results in a quantum leap in construction cost represented by a new pump station, storage tank and transmission mains. Projects in an existing pressure zone have a higher priority than projects in a new pressure zone.

The schedule for constructing infrastructure under the Transmission Main Alternative is shown in Table 8-1. It assumes roughly the same amount of funding will be available each year in the Capital Improvement Plan. It should be noted that the implementation schedule is based on current knowledge and best engineering judgment, with near term implementation steps being better known than more distant implementation steps. The implementation schedule may need to be adjusted periodically to respond to new opportunities such as increases in demand, new customers, drought, or incentives to lure economic development, and constraints such as a loss of customers, diminished public acceptance, or budget limitations.

Construction under the Transmission Main Alternative will commence in 2008, with construction starting on a new project every year. Construction will be complete in 2035 for a 27-year construction schedule. The Transmission Main Alternative will reach full capacity in 2039.

FIGURE 4-3 TRANSMISSION MAIN ALTERNATIVE SCHEMATIC



Alternative Considered, But Dropped -- Additional Supply Alternative

In July 2003, Reclamation and the City completed a Title XVI Appraisal Report that was approved in April 2004. The Appraisal Report included a No Action – Base Case (the No Federal Action Alternative) and variants of an Aggressive Wastewater Reclamation Alternative (the Transmission Main Alternative and Satellite Systems Alternative). It also included an Additional Supply Alternative, which was comprised of pumping from the Carrizo-Wilcox Aquifer, either directly or to an off-stream reservoir, to supplement flows in the Colorado River to increase the firm yield of the Highland Lakes.

The Additional Supply Alternative augments flows in the Colorado River with groundwater from the Carrizo-Wilcox Aquifer. It would be used to supply a portion of the water demand of senior water rights holders at the downstream end of the river basin. Augmentation of Colorado River flows with groundwater reduces the releases of water from the Highland Lakes that are required to meet senior downstream water rights. The end result is an increase in the potential yield of the Highland Lakes. Upstream and downstream water rights holders both benefit from the flexibility in scheduling that can be achieved by providing additional supply closer to major water customers.

While the Appraisal Report found that the estimated annual cost per acre-foot for the Additional Supply Alternative was roughly the same as the Aggressive Wastewater Reclamation Alternative (Transmission Main Alternative and Satellite Systems Alternative), the Additional Supply Alternative contained several negative aspects such as endangered species concerns. Consequently, the Appraisal Report recommended that the Feasibility Study focus only on the Aggressive Wastewater Reclamation Alternative (Transmission Main Alternative and Satellite Systems Alternative).

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Chapter 5 – Economic Analysis

General

This section provides engineering construction cost estimates and life-cycle cost estimates for each of the three alternatives considered in this report. Life-cycle cost estimates account for the purchase of raw water and incorporate yearly operations and maintenance costs. This section ends with an analysis of the three alternatives.

Construction Cost Estimates

Engineering construction cost estimates for each of the three alternatives are given in Tables 5-1, 5-2, and 5-3. All construction costs are in April 2005 dollars. Transmission main costs are based on actual City pipeline construction project costs from December 2001 and increased by 4.09% per year to account for inflation. This corresponds to a December 2001 Engineering New Record (ENR) Construction Cost Index (CCI) of 6390 and an April 2005 ENR CCI of 7355.

For the two alternatives (No Federal Action and Satellite Systems) that rely on additional purchased water distributed through the potable water system, water treatment plant size increases and additional land requirements are based on maximum day demand, which is standard practice in the industry. Upsizing of potable water transmission mains, storage tanks, and pump stations is also required if the potable water system is used to deliver water and these costs are in the construction cost estimates.

TABLE 5-1 NO FEDERAL ACTION ALTERNATIVE ESTIMATED CONSTRUCTION COST

Item	Quantity	Units	Unit Cost (in $)	Total (in $)
Water Treatment Plant Const.	39,000,000	gal	$3.00	$117,000,000
Upsize Water Trans. Mains	60,000	lf	$80.00	$4,800,000
Upsize Water Reservoirs	19,500,000	gal	$1.25	$24,375,000
Upsize water Pump Stations	1	ls	$4,710,000.00	$4,710,000
Subtotal				$150,885,000
Engineering (10%)				$15,088,500
Land/Easements	39	ac	$170,000	$6,630,000
Contingency (10%)				$15,088,500
Subtotal				$36,807,000

Item	Quantity	Units	Unit Cost (in $)	Total (in $)
Estimated Construction Cost				$187,692,000

TABLE 5-2 SATELLITE SYSTEMS ALTERNATIVE ESTIMATED CONSTRUCTION COST

Item	Quantity	Units	Unit Cost (in $)	Total (in $)
WTP Construction	26,900,000	gal	$3.00	$80,700,000
Upsize Water Trans. Mains	60,000	lf	$50.00	$3,000,000
Upsize Water Reservoirs	13,450,000	gal	$1.25	$16,812,000
Upsize Water Pump Stations	1	ls	$3,560,000.00	$3,560,000
Subtotal				$104,072,000
WWTP Construction	13	ea	$5,367,000.00	$69,771,000
24” Reclaimed Trans. Main	10,000	lf	$184.00	$1,840,000
16” Reclaimed Trans. Main	10,000	lf	$138.00	$1,380,000
<16” Reclaimed Trans. Main	215,000	lf	$105.00	$22,627,500
Reclaimed Pump Stations	13	ea	$244,000.00	$3,172,000
Subtotal				$98,790,500
Engineering (10%)				$20,286,250
Easements (2.5% of reclaimed system subtotal)				$2,593,263
Acquire Additional WTP Land	27	ac	$170,000.00	$4,590,000
Acquire WWTP Sites	13	ea	$380,000.00	$4,940,000
Contingency (10%)				$21,239,300
Subtotal				$45,071,863
Estimated Construction Cost				$257,464,863

TABLE 5-3 TRANSMISSION MAIN ALTERNATIVE ESTIMATED CONSTRUCTION COST

Item	Quantity	Units	Unit Cost (in $)	Total (in $)
48” Reclaimed Trans. Main	250	lf	$314.00	$78,500
42” Reclaimed Trans. Main	300	lf	$288.00	$86,400
36” Reclaimed Trans. Main	48,750	lf	$231.00	$11,261,250
30” Reclaimed Trans. Main	33,150	lf	$201.00	$6,663,150
24” Reclaimed Trans. Main	264,300	lf	$184.00	$48,631,200
16” Reclaimed Trans. Main	115,400	lf	$138.00	$15,925,200
<16” Reclaimed Tran. Main	135,000	lf	$105.00	$14,175,000
Rehab Abandoned Force Mains	4	ea	$45,000.00	$180,000

Item	Quantity	Units	Unit Cost (in $)	Total (in $)
Colorado River Crossings	3	ea	$200,000.00	$600,000
Reclaimed Water Reservoir	13,250,000	gal	$1.25	$16,562,500
Acquire Reclaimed Res. Sites	6	ea	$565,000.00	$3,390,000
Reclaimed Pump Stations	6	ea	$2,050,000.00	$11,790,000
Subtotal				$129,343,200
Engineering (10%)				$12,934,320
Easements (2.5%)				$3,233,580
Contingency (10%)				$12,934,320
Subtotal				$29,102,220
Estimated Construction Cost				$158,445,420

Life Cycle Costs

For the two alternatives (No Federal Action and Satellite Systems) that assume additional water deliveries through the potable system, life cycle costs include additional surface water purchases. These two alternatives include increased costs for water treatment plant operations and maintenance, which is primarily electricity and treatment chemicals. They also assume that surface water is available for purchase, which may not be true.

Annualized construction costs are based on a 6% interest rate and a 30-year useful life. The Transmission Main Alternative's life cycle cost may be lower than estimated because its major cost component (transmission mains) has a useful life well beyond 30 years.

TABLE 5-4 NO FEDERAL ACTION ALTERNATIVE ESTIMATED LIFE CYCLE COST

Item	Quantity	Units	Unit Cost (in $)	Total (in $ per year)
Raw Water Costs	19,878	acre-feet	$115.00	$2,285,970
Subtotal				$2,285,970
Annualized Construction Costs				$13,731,952
Subtotal				$13,731,952
Pumping	2	zones	$300,000.00	$600,000
Additional WTP O&M	19,877	acre-feet	$56.07	$1,114,559
Subtotal				$1,714,559
Total				$17,732,481

Item	Quantity	Units	Unit Cost (in $)	Total (in $ per year)
Total per af				$841

TABLE 5-5 SATELLITE SYSTEMS ALTERNATIVE ESTIMATED LIFE CYCLE COST

Item	Quantity	Units	Unit Cost (in $)	Total (in $ per year)
Raw Water Costs	13,669	acre-feet	$115.00	$1,571,935
Subtotal				$1,571,935
Annualized Construction Costs				$18,704,542
Subtotal				$18,704,542
Pumping	2	Zones	$300,000.00	$600,000
Additional WTP O&M	13,669	acre-feet	$56.07	$766,421
WWTP O&M	13	Ea	$115,000.00	$1,495,000
Reclaimed Dist. System O&M	45	Miles	$2,892.00	$128,990
Subtotal				$2,990,411
Total				$23,266,888
Total per af				$1,103

TABLE 5-6 TRANSMISSION MAIN ALTERNATIVE ESTIMATED LIFE CYCLE COST

Item	Quantity	Units	Unit Cost (in $)	Total (in $ per year)
Raw Water Costs	0	acre-feet	$115.00	$0
Subtotal				$0
Annualized Construction Costs				$11,510,887
Subtotal				$11,510,887
Pumping	3	Zones	$300,000.00	$900,000
Reclaimed Dist. System O&M	113	Miles	$2,892.00	$327,075
Subtotal				$1,227,075
Total				$12,737,963
Total per af				$604

Evaluation

From a construction cost estimate, the least expensive alternative is Transmission Main ($158,445,420), followed by No Federal Action ($189,018,000), and Satellite Systems ($257,464,863). This is predominantly due to the high cost of construction for additional water and/or wastewater treatment facilities needed under the No Federal Action and Satellite Systems Alternatives. The Transmission Main Alternative requires no additional treatment facilities.

A more important factor in considering alternatives is their life cycle costs because life cycle costs include operation and maintenance costs, plus the cost to purchase additional raw water when necessary. The alternative with the lowest life cycle cost is Transmission Main ($12,737,963), followed by No Federal Action ($17,732,481) and Satellite Systems ($23,266,888).

According to Reclamation's *Guidelines for Preparing, Reviewing, and Processing Water Reclamation and Reuse Project Proposals Under Title XVI of Public Law 102-575*, the benefits of a project may be calculated "on the average annual cost of the most recent addition to the M&I water supply in the project area." This is essentially the life cycle cost estimate of the No Federal Action alternative. Without federal action, this is also the most likely alternative for meeting the expected need of 21,096 af in 2050. According to the Guidance, costs are the life cycle cost for the alternatives. As Table 5-7 below shows, the alternative with the most favorable Benefit/Cost ratio is the Transmission Main Alternative. Assuming a constant benefit, it is the most cost-effective alternative.

TABLE 5-7 COST BENEFIT EVALUATION OF ALTERNATIVES

Alternative	Annual Benefits	Annual Costs	B/C Ratio
No Federal Action	$17,732,481	$17,732,481	1.0
Satellite Systems	$17,732,481	$23,266,888	0.8
Transmission Main	$17,732,481	$12,737,963	1.4

The City's oldest water treatment plant is the Green Plant located in downtown Austin. The Green Plant is nearing the end of its useful life and is expected be taken out of service in 2008 and replaced with a new water treatment plant. Demand for water continues to grow, and planning is underway for a fourth water treatment plant, the Travis Plant. While the implementation of the Satellite Systems and Transmission Main Alternatives is unlikely to have an impact on the timing of decommissioning of the Green Plant, implementation of these alternatives will postpone the initial construction of the Travis Plant by two years.

Upstream of the City on the Colorado River are the Highland Lakes, which were built in part with federal funding. Buchanan Dam creates Lake Buchanan, which was built with federal funds and grants on the condition that it be owned and operated by a state-created agency, the LCRA. Mansfield Dam creates Lake Travis and was built jointly by Reclamation and the LCRA. A portion of the City's contracted water is stored in the Highland Lakes. Although, they are not owned by the Federal Government, Lakes Buchanan and Travis were built in part with federal funding. Water stored in these lakes serves to backup and augment the City's water supply; implementation of the Satellite Systems and Transmission Main Alternatives will reduce the demand on these facilities.

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Chapter 6 – Environmental Analysis

General

This section summarizes environmental, social, and cultural information on the three alternatives that Reclamation evaluated in order to fulfill its obligations under the National Environmental Policy Act (NEPA).

Environmental Assessment

Construction of a reclaimed water project with funding under Title XVI is a Federal action that may have environmental impacts. As a result, provisions of NEPA apply, which require that Reclamation determine the significance of environmental impacts prior to undertaking the Federal action. The following table summarizes findings from the Environmental Assessment performed on the three alternatives considered in this study.

TABLE 6-1 SUMMARY OF ENVIRONMENTAL ASSESSMENT

	No Federal Action Alternative	Satellite Systems Alternative	Transmission Main Alternative
Air Quality/Noise	Impacts are localized and temporary, occurring only over a period of months at any one location.	Impacts are localized and temporary, occurring only over a period of months at any one location.	Impacts are localized and temporary, occurring only over a period of months at any one location.
River Water Quality	Potential improvement in quality of Colorado River immediately downstream of Austin; potential minor negative impacts from surface run-off from lands irrigated with reclaimed water.	Potential improvement in quality of Colorado River immediately downstream of Austin; potential minor negative impacts from surface run-off from lands irrigated with reclaimed water.	Potential improvement in quality of Colorado River immediately downstream of Austin; potential minor negative impacts from surface run-off from lands irrigated with reclaimed water.
In-Stream Flows in the Colorado River	Critical flows are always met.	Critical flow frequency remains unchanged.	Critical flow frequency remains unchanged.
In-Stream Flows at Matagorda Bay	Critical and target flow frequency averages around 37% during the POR and between 10-15% during the DOR. Critical flows are never met in August. Both critical and target flow frequencies are lowest in the summer.	During the POR, the only decrease in critical flow frequency occurs in November (5.7%) and December (1.5%). Target flow frequency decreases across most months, but never by more than 1.7%. The average decrease is under 1%. Critical and target flow frequency never decrease during the DOR.	During the POR, critical flow frequency decreases by 5.7% in November and 5.2% in December and by less than 2% in January. Target flow frequency decreases across most months, but never by more than 4.4%. The average decrease is under 2%. Critical and target flow frequency never decreases during the POR
Wildlife Resources	Located within an urban setting. Impacts are localized and temporary, with no cumulative impacts to wildlife.	Located within an urban setting. Impacts are localized and temporary, with no cumulative impacts to wildlife.	Located within an urban setting. Impacts are localized and temporary, with no cumulative impacts to wildlife.

Threatened and Endangered Species	No likely effect on threatened or endangered species, or their critical habitat.	No likely effect on threatened or endangered species, or their critical habitat.	No likely effect on threatened or endangered species, or their critical habitat.
Native American Trust Assets	No impact – no Native American Trust Assets in region.	No impact – no Native American Trust Assets in region.	No impact – no Native American Trust Assets in region.
Environmental Justice	Impacts do not appreciably exceed those occurring to the general public.	Impacts do not appreciably exceed those occurring to the general public.	Impacts do not appreciably exceed those occurring to the general public.
Cultural Resources	No impact to cultural resources.	There will be a project-by-project consultation with the Texas Historical Commission to minimize any impact to cultural resources.	There will be a project-by-project consultation with the Texas Historical Commission to minimize any impact to cultural resources.

State Regulatory Requirements

In the State of Texas, the TCEQ holds regulatory authority for reclaimed water programs. Under that authority, it promulgated Chapter 210 of Texas Administrative Code, Title 30, regarding the use of reclaimed water. The City submitted information to and requested approval from the TCEQ for its reclaimed water program. The City operates its reclaimed water program under Authorization R10543-11, distributing reclaimed water for the irrigation of golf courses, ballparks, schools, parks, industrial centers, apartment complexes, commercial properties, home lawn watering, food crops, pastures for milking animals, and road median; cooling towers; fire fighting; industrial and manufacturing processing; maintenance of impoundments; toilet and urinal flush water; and road construction.

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Chapter 7 – Legal and Institutional Requirements

General

This section describes the consultation activities that occurred as part of this report, addresses public health and environmental issues, and describes constraints, if any, on the project.

Consultation

The City and Reclamation consulted with other agencies during the preparation of this report and its associated Environmental Assessment. These agencies include the EPA, the U.S Fish and Wildlife Service, the TCEQ, the Texas Historical Commission, the Texas Parks and Wildlife Department, the Edwards Aquifer Conservation District, and the San Antonio Water System. Their input is reflected in the design of the three alternatives.

The Environmental Assessment was prepared coincident with the report, and while it has not been finalized, preliminary drafts indicate that a Finding of No Significant Impact (FNSI) is likely.

Public Health and Environmental Quality Issues

The master plan for the City's reclaimed water system was reviewed and approved by the TCEQ, who issued a revised authorization for the program on January 6, 2006. The Austin/Travis County Health and Human Services Department have also reviewed the City's reclaimed water system and concluded that "there is no reason to expect a human health risk or environmental risk."

For the three alternatives, environmental issues identified and described in the Environmental Assessment can be summarized as follows:

- Threatened and Endangered Species – No likely affect on threatened or endangered species, or their critical habitat.
- Historic and Archeological Sites – The City will continue consultation with the State Historic Preservation Office during detailed design of the preferred alternative

(Transmission Main Alternative).

- In-Stream Flows in Colorado River – Critical flows are always met (No Federal Action Alternative). Critical flow frequency remains unchanged (Satellite and Transmission Main Alternatives).
- In-Stream Flows at Matagorda Bay – Little change in critical and target flow frequencies during the period of record and drought of record.
- Air Quality – Impacts are localized and temporary, occurring only over a period of months at any one location.
- Wildlife – Located within an urban setting. Impacts are localized and temporary, with no cumulative impacts to wildlife.
- Migratory Birds – Despite the anticipated loss of some trees during construction activities, migratory bird habitat would remain primarily unaltered.
- Native American Trust Assets – No impact, no Native American Trust Assets in region.
- Environmental Justice – Impacts do not appreciably exceed those occurring to the general public.

Water Rights

Withdrawals of surface water in the State of Texas require a permit issued by the TCEQ. Because the availability of surface water is limited, permits are issued on a priority basis, where rights with older priority dates having claim to available water before more junior rights. Most permits, including the City’s, do not require that effluent be returned to the watercourse. Austin, and its contract water supplier hold some of the oldest water rights in the Colorado River basin. All three alternatives, therefore, are consistent with water rights law in Texas.

Other

There are no known unresolved legal or institutional issues/constraints that will affect the ability of the non-federal sponsor to implement the alternatives described in this report.

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Chapter 8 – Financial Capability

General

This section outlines the City's financial standing, financial planning, schedule of expenditures, and funding available to it for designing and constructing the Transmission Main Alternative, which is the preferred alternative.

Financial Standing

The City owns and operates the Austin Water Utility, which serves approximately 180,000 residential, multifamily, commercial, industrial, and wholesale customers. The City generated approximately $307.4 million in FY 2006-2007 from water and wastewater services, and miscellaneous revenues. A copy of the end of FY 2006-2007 financial statements is attached as Appendix A.

Operating expenses for the fiscal year were $313.0 million, resulting in an ending Utility Fund Balance of $13.5 million. The operating costs for the Utility are as follows:

- 43.8 % for operation and maintenance of water, reclaimed water, and wastewater treatment facilities;
- 41.8 % for debt service; and
- 14.4 % for transfers to the General Fund, Capitol Improvements Program, and other miscellaneous funds.

Funding Plan

The City is active in the bond market and has a broad variety of both long-term and short-term bonds outstanding. To fund the non-federal portion of the reclaimed water program's design and construction, the City will use short-term commercial paper as interim financing and periodically replace that with long-term revenue bonds. **Moody's Investors Service currently rates these bonds A1, Standard and Poor's rates the outstanding bonds A, and Fitch, Inc. gives the outstanding bonds an A+ rating.** These investment grade ratings reflect Austin's sustained economic growth and diversification, solid financial position, manageable debt profile, and capital improvement plan.

The operation and maintenance of the reclaimed water program is, and will continue to be, included in the Austin Water Utility's annual budget. The funds for operating and maintaining the system facilities are, and will continue to be, obtained from user fees. The City periodically adjusts these rates based on user agreements, and changes in costs and inflation.

Project Schedule

The Transmission Main Alternative, being the preferred alternative, has a twenty-seven year construction period. Table 8-1 describes the schedule of construction and its associated schedule of expenditures. The schedule was developed to build on existing infrastructure and to assure that roughly the same amount of funding is spent each year. The schedule is based on current knowledge and best engineering judgment, with near-term implementation steps being better known than long-term implementation steps. The plan may need to be adjusted periodically to respond to new opportunities such as increases in demand, new customers, drought, or incentives to lure economic development, and constraints such as a loss of customers, diminished public acceptance, or budget limitations.

TABLE 8-1 PROJECT SCHEDULE AND FUNDING PLAN

Project Start	Project Description	Cost (in millions)
2008	Build mains to ABIA and UT	$3.7
2009	Rehabilitate existing 24" Force Main, 12" main to Clay/Kizer, 8" main to Freescale, and 12" force main along Hwy 183. Acquire Montopolis Tank site, Braker Lane Tank site, William Cannon #1 Tank site, William Cannon #2 Tank site, Harris Branch Tank site, and Far West Tank site	$4.6
2010	Build mains to Montopolis Tank and Smith Road extension	$5.6
2011	Build Montopolis Tank	$4.6
2012	Build mains to Krieg Fields, Robbins High School, Capital Complex and AISD	$4.0
2013	Expand Walnut Pump Station	$6.5
2014	Build mains to Junction 420, Kealing School Park, and Givens Park	$5.9
2015	Build loop to Givens Park, LCRA Complex, and Pitch&Putt	$5.6
2016	Build loop to Montopolis Tank, Montopolis Pump Station, and mains to Calendar Club	$5.7
2017	Build main to William Cannon Tank #1, William Cannon Tank#1, and mains to Spansion	$8.2
2018	Build mains to Goodnight Ranch and ACC Rutherford	$7.4
2019	Build loop to ACC Rutherford and mains to Fulmore Middle School	$7.2
2020	Loop mains to Pitch&Putt and loop main to William Cannon Tank#1	$6.5
2021	Build 3rd loop to Montopolis Tank	$8.0
2022	Build 2nd 1.0 MG Tank at Walnut and Harris Branch Tank	$4.7
2023	Build mains to Harris Branch Tank	$9.9
2024	Build Harris Branch Pump Station and mains to Graham Elementary School	$7.7
2025	Build Braker Lane Tank	$4.6

Burleson Rd project

Onion Creek 1&2

Decker Lane project

Project Start	Project Description	Cost (in millions)
2026	Build mains to Braker Lane Tank	$7.8
2027	Build mains to Havins Ball Field and Woodchase Apartments	$3.1
2028	Build 51st Street Pump Station and mains to State Department of Health	$4.3
2029	Build mains to NW Recreation Center and loop to Woodchase Apts	$7.4
2030	Build mains to Austin State School, Cameron Business#2, the Far West Tank, and Braker Lane Pump Station	$5.9
2031	Build mains to Far West Tank	$5.9
2032	Build main to Great Hill Golf Course, William Cannon Tank#2, and William Cannon Pump Station #1, and mains to William Cannon Tank#2	$5.0
2033	Build mains to Forest Apartments, St. Edwards University, and Rex Kitchens	$6.9
2034	Build mains to Martin/Rosewood/Zaragozo	$1.7
	Total	$158.4

Prior Financial Review

The financial capability of the City of Austin to build, operate, and maintain a reclaimed water system was reviewed by the TWDB in conjunction with a $10 million loan application. The TWDB subsequently approved the loan on May 21, 1998. While this loan and its approval was limited to what is now existing infrastructure under the No Federal Action Alternative, it demonstrates a history of prudent financial management.

Summary

Of the estimated $158.4 million construction cost for the Transmission Main Alternative, the City will rely on $20 million from the Title XVI. Program. This represents 12.6% of the total program cost. The remaining $138.4 million, (87.4% of program cost), will be provided by the City through the issuance of short-term commercial paper that will periodically be replaced by long-term revenue bonds. Operation and maintenance of the reclaimed water system will be funded through customer rates.

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Chapter 9 – Research Needs

With an existing reclaimed water customer, the First Tee Golf Course, the City is sponsoring research on the impact of reclaimed water on turf and local soils that have not been subject to the use of reclaimed water for landscape irrigation. The scope of services for the research project includes quarterly monitoring of pre-irrigation conditions, post-irrigation conditions, collection of detailed turf management records on watering efficiency, and various turf management practices. Research results may be useful in detailed engineering design of transmission and distribution mains and developing guidance on the use of reclaimed water for irrigation at golf courses and other landscaped areas. At this point the need for further research is not anticipated.

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Chapter 10 – Evaluation of Alternatives and Recommendation

Summary of Alternative Evaluation

The following table summarizes the evaluation of the various alternatives, with a lower number being more favorably ranked:

TABLE 10-1 EVALUATION OF ALTERNATIVES

	Ranking of Alternatives		
	No Federal Action	Satellite Systems	Transmission Main
Meets predicted water shortfall	3	2	1
Cost effectiveness	2	3	1
Compromises public health or the environment	1	1	1
Acceptable to the public	2	2	2
Reduces, postpones, or eliminates development of new or expanded water supplies	3	2	1
Reduces or eliminates existing diversions from natural water courses or withdrawals from aquifers	3	2	1
Reduces the demand on existing Federal water supply facilities	2	2	2
Improves surface or groundwater quality	3	2	1
Promotes and applies a regional or watershed perspective	3	2	1
Serves a small, rural, economically disadvantaged community	3	1	2
Provides significant economic benefits	3	2	1
Total	**28**	**21**	**14**

Evaluation of Alternatives

The three alternatives considered in this report are ranked in terms of the following criteria:

Meets predicted water shortfall

One of the primary goals of the reclaimed water program is to meet one half of the projected water shortage in the year 2050 (21,096 af/yr). Only the Transmission Main Alternative exceeded this amount and was therefore given the highest ranking of 1. The other two alternatives were ranked in order of their capacity.

Cost effectiveness

City of Austin staff conducted an economic analysis of construction, operation, maintenance, and additional purchased water cost. The results are summarized in the following table:

TABLE 10-2 LIFE CYCLE COST OF ALTERNATIVES

	Life Cycle Cost of Alternatives		
	No Federal Action	Satellite Systems	Transmission Main
Annualized Construction	$13,731,952	$18,704,542	$11,510,887
Annualized O&M	$1,714,559	$2,990,411	$1,227,075
Raw Water Costs (to meet 21,096 af/yr)	$2,285,970	$1,571,935	$0
Total Annual Cost	$17,732,481	$23,266,888	$12,737,962
Annual Cost per af	$841	$1,103	$604

The alternatives were ranked in order, with the alternative having the lost cost per ac/ft being ranked highest. These were (1) the Transmission Main Alternative at $604 per ac/ft, (2) the No Federal Action Alternative at $841 per ac/ft, and (3) the Satellite Systems Alternative at $1,103 per ac/ft.

Compromises public health or the environment

The TCEQ and the Austin/Travis County Health Department reviewed and approved the City's reclaimed water program, which includes the existing system, the existing satellite plants, and planned expansion. Therefore all three alternatives were given the highest ranking of one.

Acceptable to the Public

City residents have consistently supported the development of the reclaimed water program. This has been documented in numerous public hearings and citizen surveys. In the two public meetings held as part of this report, the attendees again showed support for the program. The public however, did not express a strong preference for, or against, any of the alternatives. Consequently, they are all ranked as a two.

Reduces, Postpones, or Eliminates Development of New or Expanded Water Supplies

The City predicts that potable water use will increase to 367,096 af/yr in the year 2050, a future annual growth rate of 1.8%. To meet the expected need, the City is expanding its Ullrich Water Treatment Plant and plans build two additional water treatment plants. Increased use of reclaimed water can postpone the construction and expansion of plans for these treatment plants. The Transmission Main Alternative is ranked as a one, because it has the largest increase in reclaimed water use and the largest ability to postpone the development of expanded water supplies. The Satellite Systems Alternative has the second largest increase in reclaimed water use and is ranked as a two. The No Federal Action Alternative has the smallest increase in reclaimed water use and can not realistically postpone water treatment plant expansion. It is ranked as a three.

Reduces or Eliminates Existing Diversions from Natural Water Courses or Withdrawals from Aquifers

Projecting current trends in water withdrawals under the existing reclaimed water program and existing water conservation program, the City will need 367,096 af of water in the year 2050. Under the No Federal Action Alternative and additional growth in the City's water conservation program, 344,878 af of water would need to be withdrawn from the Colorado River to meet the City's water need. It exceeds the 325,000 af available under the existing contract and water rights and is therefore ranked as a three. Under the Satellite Systems Alternative and additional growth in the City's water conservation program, 338,669 af of water will need to be withdrawn, which still exceeds the amount available. It is ranked as a two. Under the Transmission Main Alternative, 322,091 af of water would need to be withdrawn, which is below the amount available. It is therefore ranked as a one.

Reduces the Demand on Existing Federal Water Supply Facilities

Upstream of the City on the Colorado River are the Highland Lakes, which were built, in part, with federal funding and are operated for flood control and electricity generation. Buchanan Dam creates Lake Buchanan, which was built with federal funds and grants on the condition that it be owned and operated by a state created agency, the LCRA. The Mansfield Dam creates Lake Travis and was built jointly by Reclamation and the LCRA. A portion of the City's contracted water is stored in the Highland Lakes. Although, they are not owned by the Federal Government, the Highland Lakes were built in part with federal funding and water stored in these lakes serves to backup and augment the City's water supply. Consequently, all three alternatives were given a medium ranking of two because they reduce demand on these facilities.

Improves Surface or Groundwater Quality, or the Quality of Effluent Discharges, Except Where the Purpose is to Meet a Discharge Requirement

Each alternative reduces the amount of treated wastewater and associated nutrients discharged to the Colorado River and has a corresponding positive impact on river water quality. The Transmission Main Alternative is ranked as a one, because it reduces discharges the most. The Satellite Systems Alternative is ranked as a two because it has a moderate level of reduced discharges. The No Federal Action Alternative is ranked as a three because it has the lowest level of reduced discharges.

Promotes and Applies a Regional or Watershed Perspective

Senate Bill 1 from the 78th Session of the Texas Legislature charged the TWDB with preparing a comprehensive statewide plan for managing and developing water resources. The TWDB's Region K Plan identified a water shortage in the Colorado River Basin and measures to address that shortage, including the use of reclaimed water by the City. The Transmission Main Alternative is ranked as a one because, consistent with the Region K Plan, it results in the use of reclaimed water in addressing the City's long-term water supply needs. The Satellite Systems Alternative is ranked as a two because it only partially achieves the goals of the Region K Plan. The No Federal Action Alternative is ranked as a three because it results in minimal use of reclaimed water by the City and is therefore inconsistent with the Region K Plan.

Serves a Small, Rural, Economically Disadvantaged Community

The City is a diverse community with a variety of income levels. Development of the reclaimed water system can bring a low cost source of water to economically disadvantaged, low-income areas and encourage development there. According to the Environmental Assessment, the No Federal Action Alternative serves no low-income census tracts. It is therefore ranked as a three. The Transmission Main Alternative serves one low-income census tract and is ranked as a two. The Satellite Systems Alternative serves three low-income census tracts and is ranked as a one.

Provides Significant Economic Benefits

The Transmission Main Alternative can increase the volume of reclaimed water used by more than the expected 21,096 af/yr shortfall. Considering that the average Austin household uses approximately 0.65 af/yr of water, the shortfall is equivalent to 32,455 new houses with a population of 113,594. This is economically significant in a rapidly growing city with more than 770,000 residents, and this alternative is ranked as a one. The Satellite Systems Alternative can increase the volume of reclaimed water used by 6,209 af/yr. That is enough for 9,551 new houses with a population of 33,428 and is ranked as a two. The No Federal Action alternative can increase the volume of reclaimed water used by 1,219 af/yr, or enough water for 1,875 houses, with an equivalent population of 6,564. In a city the size of Austin, this is insignificant and ranks as a three.

Comparison of Alternatives

The No Federal Action Alternative is the least desirable alternative, chiefly because it does not expand the amount of reclaimed water used to any significant extent. As a result, it does not: (1) postpone the expansion of water treatment plants; (2) significantly reduce diversions; (3) fit into a regional approach to water supply issues; and (4) serve any economically disadvantaged areas of the City.

The Satellite Systems Alternative is better than the No Federal Action Alternative because it goes farther in its use of reclaimed water. It can: (1) postpone the expansion of water treatment plants; (2) reduce diversion; (3) fit into a regional water supply approach; (4) serve economically disadvantaged areas of the City; (5) offers significant economic benefit. It has two main drawbacks. First, it does not fully meet the goal of reclaiming at least 21,096 af/yr of water. Second, it is the most expensive of the three alternatives on a cost per af per year basis.

Preferred Alternative

The Transmission Main Alternative is the best ranked of the three alternatives. It exceeds the goal of reclaiming at least 21,096 af/yr of water. It does not adversely impact the environment or public health, and its development is acceptable to the public. Additionally, it has the lowest annual cost per af for development, operation, and maintenance.

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Chapter 11 – Public Involvement

General

This section details consultation with the public during the development of this report.

Past Public Involvement

In December 1990 the Austin City Council adopted a sustainability initiative to develop and implement a long-range water resource protection and conservation plan. The goals of the plan, using water conservation and reclaimed water, are to reduce the peak day water use by 10%, the average per capita daily water use by 5%, and reduce the anticipated year 2050 demand of 350,000 af/yr by 25,000 to 50,000 af/yr. The Water Reclamation Program was created as part of that initiative. By law, City Council actions are conducted in a public forum and the public was given the opportunity to comment on the sustainability initiative prior to its adoption.

In 1994 and 1996, the City conducted customer surveys to determine citizen perception of its services and products. The surveys were produced in both English and Spanish. Statistical analyses indicate a high degree of confidence in the survey results. The surveys included questions designed to gauge citizen acceptance of reclaimed water and the results were favorable. 83% of respondents were comfortable using reclaimed water for purposes other than drinking. 76% of respondents were comfortable using reclaimed water for landscape irrigation in a residential setting, and 79% of respondents were comfortable using reclaimed water for landscape irrigation in a business setting. 81% of respondents felt that reclaimed water was acceptable for manufacturing and industrial use.

On December 14, 2000, the Austin City Council adopted a Reclaimed Water Ordinance addressing the availability of reclaimed water service, system requirements, storage requirements, reclaimed water agreements, discontinuation of service, utility responsibilities, user responsibilities, allowable uses, system operations, and prohibitions by customers. Stakeholders such as the Central Austin Builder’s Association, the Austin Contractor’s & Engineers Association, and the Real Estate Committee provided input in the development of the ordinance. Prior to adoption by the City Council, the City’s Environmental Board, the City’s Planning Commission, and the Water and Wastewater Commission reviewed and approved the proposed ordinance in public forums where the public was given an opportunity to provide input. The City Council provided a fourth opportunity for public input prior to adopting the Reclaimed Water Ordinance.

Title XVI Project Public Involvement

On December 11, 2003, Reclamation and the City held a public meeting on the future development of its reclaimed water program. The meeting was promoted through an ad (in English and Spanish) in the Austin-American Statesman, a newspaper of widespread circulation in the Austin area. The City mailed approximately 60 letters of invitation to known environmental and stakeholder groups as well as sending invitations by e-mail to large commercial water customers. Additionally, the City issued a public meeting notice to the media. Seven members of the public attended representing the following stakeholder groups:

- Austin Youth River Watch – a part of the Colorado River Watch Foundation, which is an organization dedicated to the scientific study, preservation and conservation of the Colorado River;
- National Wildlife Foundation – an organization whose mission is to educate, inspire and assist individuals and organizations of diverse cultures to conserve wildlife and other natural resources and to protect the earth's environment in order to achieve a peaceful, equitable and sustainable future;
- PODER – a Latino environmental justice organization. Its mission is to redefine environmental issues as social and economic justice, and collectively set an agenda to address these concerns as basic human rights; and
- University of Texas – a major research university home to more than 48,000 students, 2,700 faculty and 17,000 staff members.

As a result of continued refinement of the three alternatives under consideration, it was felt that an additional public meeting was warranted. On July 26, 2005, Reclamation and the City held the second public meeting. The meeting was promoted through an ad (in English and Spanish) in the Austin-American Statesman. The City mailed approximately 490 letters of invitation to known environmental and neighborhood stakeholder groups and issued a meeting notice to the media. Six members of the public attended representing the following five stakeholders:

- CH_2M Hill – an engineering, construction, operations, communications, security, environmental firm;
- Klotz Associates – an engineering firm providing transportation, traffic, water and sewer, aviation, drainage, and land development services;
- Lower Colorado River Authority -- a conservation and reclamation district that delivers electricity, manages the water supply and environment of the lower Colorado River basin, develops water and wastewater utilities, provides public recreation areas,

and supports community and economic development;

- Parks and Recreation Department (City of Austin) – the Department oversees more than 16,814 acres of land containing 208 parks, 14 preserves, and 25 greenbelts, as well as operating a variety of programs for children, teenagers, seniors, golfers, and others; and
- Sierra Club – an organization dedicated to explore, enjoy, and protect the wild places of the earth and to practice and promote the responsible use of the earth's ecosystems and resources.

In order to provide context for the public discussion, the City provided background information on its existing reclaimed water program including, its history, volume of water conserved, reclaimed water quality, intended uses, regulatory framework, consistency with State and regional planning, and existing infrastructure. Then, for public comment, the City presented the No Federal Action Alternative, the Satellite Systems Alternative, and the Transmission Main Alternative.

Public Comment on the Title XVI Project

Testimony at the public meetings was generally supportive of an expansion of the reclaimed water program as well as initiatives to improve water conservation. Questions related to details of the program like volumes of reclaimed water used under the various alternatives, the cost of the alternatives, cost per gallon under the various alternatives, the number of customers these volumes could serve, miles of transmission main needed for each alternative, and a possible partnership with the Austin Clean Water Program.

A number of comments related to the potential impact of the reclaimed water program on in-stream flows in the Colorado River. In particular, the public was concerned about the impact of reclaimed water use on the river during dry periods. The impact of the various alternatives on in-stream flows in the Colorado River is covered in detail in the Environmental Assessment, which concluded that even under worse case conditions, flows in the river would be adequate to support a healthy aquatic community. The public is under the impression that there are no state requirements for in-stream flows and thought that this issue should be studied further.

Appendix B contains copies of the public meeting agendas, background documents, and meeting transcripts.

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Appendix A – Financial Statements

Appendix B – Public Workshop Transcripts

Austin SWIFT Loan Application
Part D, 54b - Montopolis Tank and Pump Station

Draft Preliminary Engineering Report

Montopolis Water Resource Initiative (WRI) Storage Reservoir and Pump Station Project

CIP Project No. 5267.035
FDU: 3990 2207 4010

Prepared for
Austin Water Utility
City of Austin, Texas

October 2013

CH2MHILL®
12301 Research Blvd., Bldg. 4, Suite 250
Austin, Texas 78759

THIS DOCUMENT IS RELEASED FOR
REVIEW, UNDER THE AUTHORITY OF
Joseph W. Jenkins, P.E. NO. 68717,
On October 1, 2013
CH2MHILL ENGINEERS, INC., TBPE NUMBER 3699

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Introduction

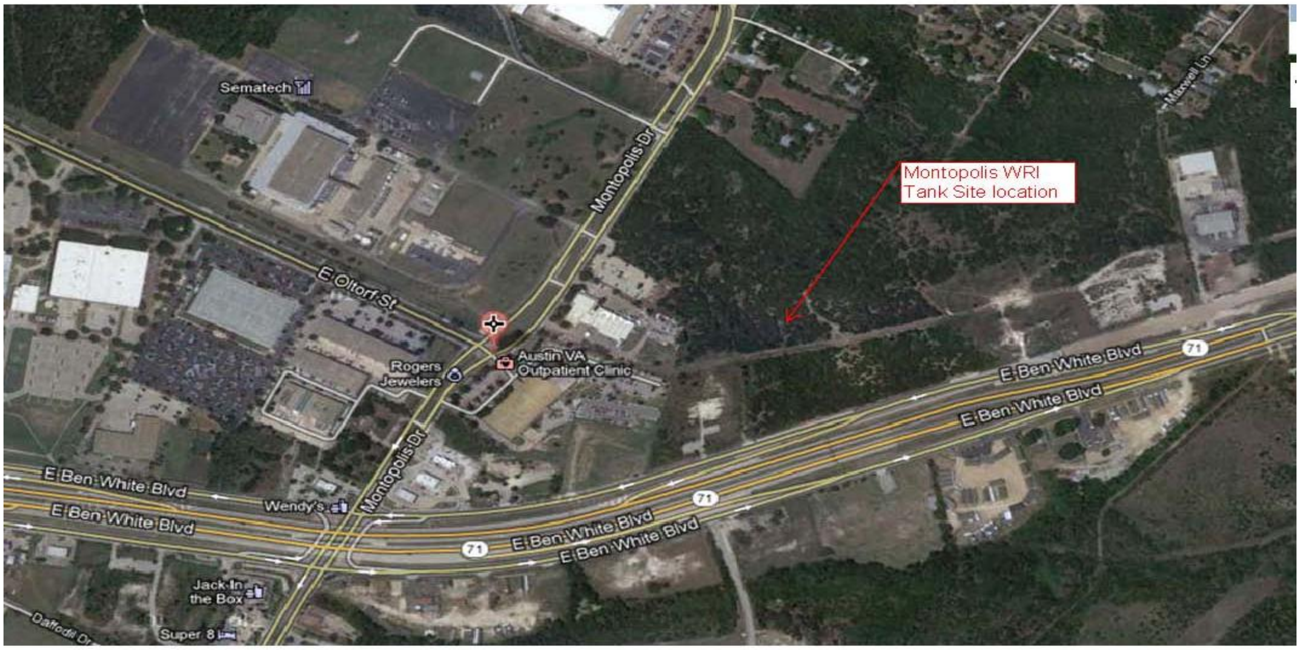
1.1 Overview

Austin Water Utility's Water Reclamation Initiative (WRI) is an integral part of the City's Water Conservation Program that currently saves 1.2 billion gallons of drinking water a year. Reclaimed water is recycled from wastewater generated by homes and businesses and treated for virtually any use not requiring higher-quality drinking water, including irrigation, cooling towers, industrial uses, and toilet flushing. Figures 1 and 2 show the Utility's near-term and long-term reclaimed water system maps. The development of a new ground storage reservoir or tank, pump station and associated piping at a site on Montopolis Drive is the continued development of this successful initiative (see Figure 3 for more detail of the project location).

1.2 Project Objectives

The Montopolis WRI storage reservoir is planned to be a ground storage tank with a storage capacity of about four (4) million gallons (MG) and is planned to be approximately 130 feet (ft) in diameter and 45 ft in height. It will store the treated and filtered wastewater effluent (reclaimed water) prior to transport for beneficial reuse applications. This reservoir is important to the function of the reclaimed water system south of the Colorado River. It will backfeed into the Central Low Service Area and provide reliability to that part of the reclaimed water system. It will also pump into the Central Service Area, provide water to customers in that area, and improve reliability of service to that area. Potential new customers include the Austin Energy Control Center, Tokyo Electron, an Austin Energy Business Park and two planned apartment complexes. A new pump station, adjacent to the tank and located at the site will convey water from the tank to the distribution system. This pump station, referred to as the "Montopolis Pump Station" will be in a building on the Montopolis site and will be designed to provide 8.6 million gallons per day (mgd) ultimate firm pumping capacity (based on four (4) pumps at 2000 gallons per minute (gpm) capacity each with one unit out of service).

Figure 3. Proposed Montopolis Reclaimed Water Storage Reservoir and Pump Station Site.



1.3 Scope of Work

The purposes of the contracted engineering services is to provide the preliminary engineering, design engineering, bid and construction engineering and post construction engineering services to support the development of this pump station.

The current authorized work is the preliminary engineering services as described in Appendix A. This report documents the preliminary engineering efforts and is the basis from which the specific design of the facilities is made.

Site Investigations

2.1 Survey – Tree and Topographic Survey

A site tree and topographic survey has been completed. The survey team used the boundary survey that was part of the City's land acquisition process as a starting point to develop the tree, topographic and visible utility survey. Figure 4 is a drawing of the tree and topographic survey. The survey indicates that there are not any historical trees as defined by the City's Tree Ordinance within the property boundaries. The topographic survey has been conducted at 1 ft intervals of slope.

This survey will be used as a basis for the site/civil work. It will be used to support the site development permit, storm water permits, and any tree mitigation requirements.

2.2 Environmental

An environmental constraints evaluation has been conducted to determine the potential occurrence of any natural or cultural resources that would be impacted by the project and the identification of local, state, or federal permitting requirements that would be required. Appendix B contains a copy of the environmental study. The study did not reveal any impacts that will require further evaluation.

2.3 Communications

The purpose of the desktop study (Pathloss study) was to establish potential communication links from the Montopolis station at the 900 MHz and 5.8 GHz frequencies to other Austin Water Utility facilities. The licensed 900 MHZ network would tie the Montopolis Station onto the existing Water Distribution Control System (WDCS) network. The 5.8 GHz network would allow the City to monitor and control the Montopolis station from multiple sites (South Austin Regional WWTP, South Service Center) and to also monitor security information, over this higher bandwidth network.

The Pathloss analysis showed that good communication can be achieved for the 900 MHz links from the Montopolis Pump Station to the Master Radio Sites at Davis Hill, Harold Court, Mount Larson and the South Service Center. The initial analysis done for the 5.8 GHz links which assumed that a 10 foot antenna would be installed on top of the Montopolis Water Storage Reservoir (50 feet above ground level total), showed that no dependable communication could be achieved from that height for that frequency. Following a site visit and meeting with the City SCADA staff, it was decided that a revised desktop modeling / analysis should be completed assuming that a new, higher communication tower would be built at the Montopolis Pump Station site. This analysis showed that a 120 foot tower would allow dependable 5.8 GHz communication links between Montopolis and Waller Creek, South Austin Regional (SAR) WWTP, the 51st Street pump station and the South Service Center. The team now has to perform a field verification study for both frequencies as described in the Technical Memorandum that is in Appendix C.

2.4 Geotechnical

The geotechnical engineer has investigated the site and has provided geotechnical information to the design team. The full geotechnical report is in Appendix D. In general the geotechnical company drilled exploratory borings as located on the site map (Figure 4) and described in the scope of work.

Pump Station Hydraulic Analysis

This section has been prepared to summarize an analysis performed on the hydraulic surge conditions for the following two pipe systems:

1) The existing 24-inch pipeline from the South Austin Regional Wastewater Treatment Plant (SAR) pump station to the new Montopolis elevated reservoir.
2) The new pump station at Montopolis that supplies the 51st Street elevated tank.

This section is organized as follows:

- Summary and Conclusions
- Method of Analysis
- Project Data
- Analyses

3.1 Summary and Conclusions

The proposed Montopolis elevated reservoir and pump station are currently under preliminary design. The facilities are part of a water resource initiative to meet the City of Austin projected water demands by utilizing reclaimed water south of the Colorado River (see Figures 1 and 2 for system maps). The goal of this surge analysis is to determine the magnitude of surge pressures experienced within the distribution system resulting from a sudden power failure at both the existing pump station at the SAR WWTP and the proposed Montopolis pump station when they are operating at their firm pump capacity. Secondarily, the analysis is used to propose solutions to remediate any possible surge problems identified.

An evaluation of the system following a SAR pump station power failure scenario resulted in the following conclusions and corresponding recommendations for mitigating the resultant hydraulic transient pressures:

- Pressures reach negative values with the most negative being full vacuum at -14.2 psi without utilizing the SAR elevated tank.
- Utilizing the existing SAR elevated tank located just downstream of the SAR pump station will mitigate any surge pressures and protect the distribution system. The SAR elevated tank will function as a surge tank that supplies water to maintain positive pressures. No additional hydraulic surge protection is necessary to protect the existing 24-inch pipe.
- Modifications to both the infrastructure and operation of the elevated SAR tank will be required for it to be utilized as a surge tank. The operating hydraulic grade line of the distribution system, approximately elevation 723, is above the high operating water level of the SAR tank, elevation 635. An altitude valve will be required to avoid overfilling the tank. The plumbing to and from the tank will need to modified so that it can be operated to supply water to the SAR WWTP in order to cycle or turn over the water in the tank. Turning over the water will reduce the chances of the distribution system being contaminated from stale water in the event of a pump station failure that would cause water from the SAR tank to be introduced into the system.

An evaluation of the system following a Montopolis pump station power failure scenario resulted in the following conclusions and corresponding recommendations for mitigating the resultant hydraulic transient pressures:

- The pressure at the discharge side of the pumps significantly reduces during an immediate shutdown of the proposed Montopolis pumping station while pumping to fill the 51st elevated tank. The pressures go below atmospheric to a full vacuum pressure of -14.2 psi resulting in water column separation.

- Hydraulic surge protection is necessary at the proposed Montopolis pump station to structurally protect the downstream distribution system from negative pressures that are later followed by an upsurge.
- The installation of multiple (approximately 11) vacuum breaker valves spaced approximately 2500 feet for the initial 25,000 feet can mitigate the negative pressures during a pump station power failure. This is the least recommended method as it is less dependable than a surge chamber. It should be noted that negative pressures can potentially lead to water system contamination by pulling into the system untreated groundwater. In addition, vacuum breaker valves provide another potential source of contamination if not properly installed.
- To structurally protect the piping system, a 525 cubic feet (approximately 3930 gallon) sealed surge chamber on the discharge side of the pump station is recommended to maintain positive pressures immediately following a pump station power failure.
- A 12-inch line with a check valve that bypasses the Montopolis pumps was modeled to determine if it would serve as surge protection. To bypass the pumps, the 12-inch line would route from the Montopolis elevated reservoir to the discharge side of the pump station and utilize a check valve to avoid recirculation of the pumps. The conclusion was that even with the Montopolis elevated reservoir near full (water level at elevation 635), it does not provide adequate protection and should not be considered as a sole alternative for sure protection.

3.2 Method of Analysis

Hydraulic models using the EPANET 2.0 program for different stages of the distribution system infrastructure were provided by the City of Austin to create the transient model inputs. The different EPANET 2.0 models contained all existing and proposed future pumps, pipes, and reservoirs of the City of Austin reclaimed water system.

The steady-state solutions were then used as input into the Hammer surge analysis computer program. The Hammer program uses the method of characteristics described by Benjamin E. Wylie and Victor L. Streeter[1]. This method consists of deriving the basic equations from physical principles (the continuity equation and conservation of energy and momentum). The equations are then solved along characteristic lines whose slope is dependent upon the acoustic wave speed.

The objectives of the analysis is to determine a probable scenario that was most likely to create the worst case of surge pressures and recommend mitigating features if either the maximum or minimum pressures exceed the standard recommended limits. The recommended mitigating features are related to surge only and designers are to include features for protection of other events such as charging or draining the line. In general, the worst case surge scenarios for the analysis of the two systems are with pump station wet wells near full, the elevated tanks being near empty, little to no other system demands, and the pumps are running near capacity with a sudden shut down from power failure. The scenarios for startup were assumed to not require a modeling analysis as it is typical that the system be started up slowly in a controlled manner. CH2M HILL's standard recommended limit for maximum upsurge pressures is to be less than the surge allowance values for the system's pipe classes and to keep minimum pressures above about -7 psig for vacuum conditions. For ductile iron pipe, the standard surge allowance is 100 psi over the pipe classification.

3.3 Project Data

3.3.1 Pipes, Pumps, and Tanks

As previously stated, steady state hydraulic models using EPANET 2.0 were provided by the City of Austin. The models were titled near-term, mid-term, and long-term. It was assumed that this represented different stages or phases of the system to meet projected reclaimed water demands. The models were converted into Hammer and utilized for the most part with the following minor changes:

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[1] Wylie, Benjamin E. and Victor L. Streeter, *Fluid Transients in Systems*, Prentice Hall, 1993

- The models were simplified to provide a conservative scenario of no other system demands other than filling the desired tank or reservoir.

- The operating elevations of the proposed Montopolis elevated reservoir were changed. The design team desired to raise the tank operating level from 590 through 630 to 600 through 640.

- A preliminary pump curve for the Montopolis pump station was used that assumed an exponential fit using the equation of (Head in feet)=360-0.00001*(Flow in gpm)^2 to fit a design operating point of 270 feet of head at 3000 gpm. This assumption should be revisited when the actual pumps are selected.

3.3.2 Acoustic Wave Speed

For this analysis, it was assumed that the existing pipeline materials in the distribution system were comprised of ductile iron materials and of a conservative pressure class required of the steady state conditions. The computed values for the different sizes and pressure classes of ductile iron pipe are shown in Table 1, below.

Table 1. Pipe Size, Class, and Pressure Wave Velocity

Pipe Diameter (inches)	Pressure Class of DIP	Wave Velocity (ft/sec)
8	350	4065
12	350	3875
16	250	3715
24	250	3460
30	150	3400
36	150	3400

All material was assumed to be Ductile Iron Pipe (DIP).

Pressure Class was estimated based on model results for steady state or operating pressures.

3.4 Analyses

3.4.1 Analysis of SAR Pump Station to Montopolis Elevated Reservoir

Each segment was first evaluated for the base condition to determine if surge mitigation is required. Figure 5 presents a schematic of the system analyzed. The initial evaluation indicated that the existing 24-inch supply pipeline requires surge mitigation. Therefore, utilizing the existing SAR elevated tank located just downstream of the SAR pump station will mitigate any surge pressures and provide acceptable conditions. The surge models were organized as described below. The model file names are shown in the parenthesis.

Boundary conditions were evaluated as described below.

3.4.1.1 Power Failure Shutdown of SAR Pump Station (Austin-exst24-inch with no SAR tank):

For this boundary condition, the pumps were shut down while operating to supply and fill the Montopolis elevated reservoir (approximately 5000 gpm). The water level in the wet well for the SAR pumps was set at the maximum operating level of 406. The Montopolis tank was conservatively set at 591 which is below the new proposed operating water levels of 600 to 640. This is conservative for the surge analysis and gives the lower limit if the operating water level changes back to the original design water levels of 590 to 630. The only air valves in the system was the 2-inch vacuum breaker valves at each of the pump discharge. A profile of the HGL envelope is shown in Figure 6.

3.4.1.2 Power Failure Shutdown of SAR Pump Station with SAR Elevated Tank (Austin-exst24-inch with SAR tank):

For this boundary condition, SAR pump station was shut down while operating at maximum discharge to supply and fill the Montopolis elevated reservoir (approximately 5000 gpm). The initial condition is for the Montopolis tank to be near empty with a water level at 591. The SAR elevated tank was set to be near full at elevation 634.9 and able to provide supply to the distribution piping via the 24-inch pipe. The operating water level of the elevated tank is 598 to 635. A profile of the HGL envelope is shown in Figure 7.

Figure 5. Model Schematic for the SAR Pump Station to the Montopolis Elevated Reservoir.

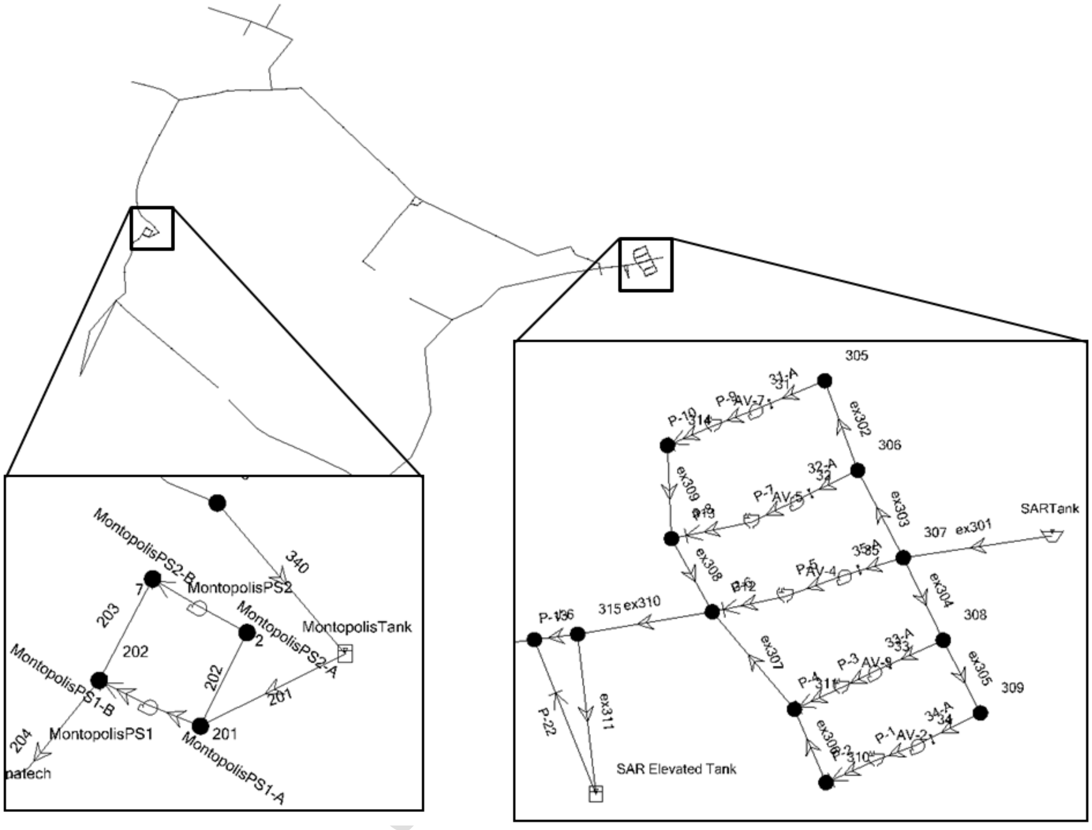


Figure 6. Hydraulic Grade Line Envelope Profile of Pipeline between SAR Pump Station and Montopolis Elevated Reservoir with no surge protection during a pump power failure.

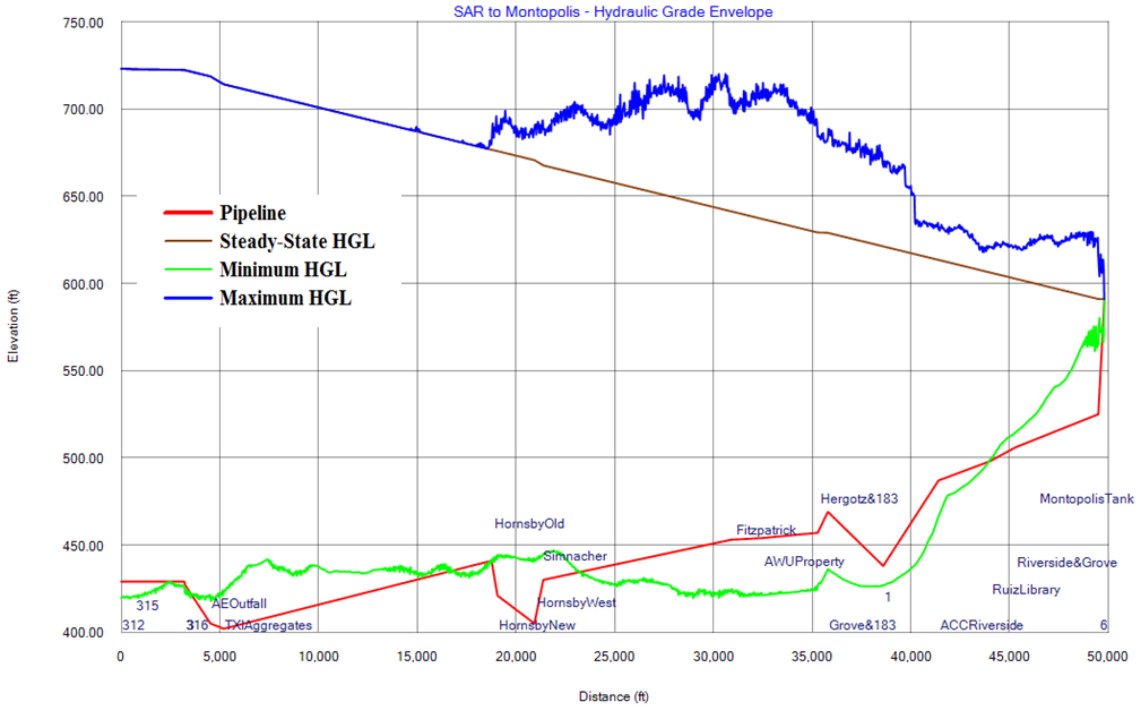
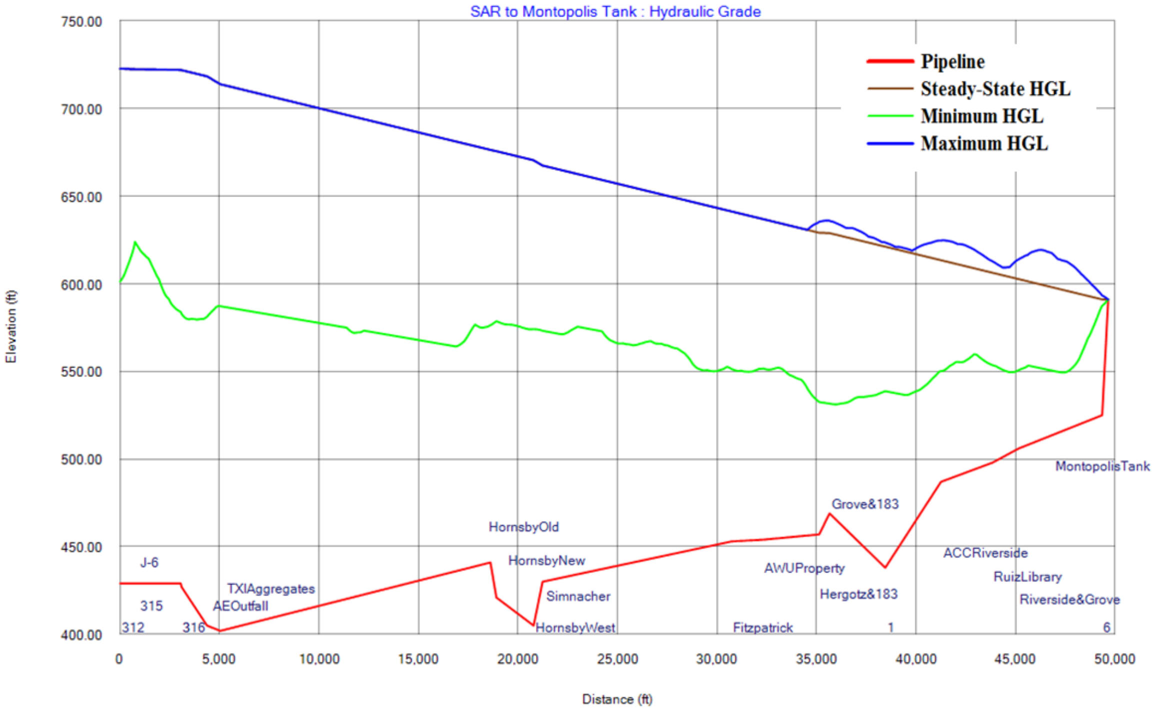


Figure 7. Hydraulic Grade Line Envelope Profile of Pipeline between the SAR Pump Station and Montopolis Elevated Reservoir with the SAR elevated tank connected to the distribution to function as surge tank during a pump power failure.



3.4.2 Analysis of Montopolis to 51st Street Elevated Tank

Each segment was first evaluated for the base condition to determine if surge mitigation components were required. Figure 8 presents a schematic of the system analyzed. This initial evaluation indicated that the first 25,000 feet of the supply pipeline required surge mitigation components. Therefore, a combination of vacuum breaker valves and surge chambers were added at appropriate locations until acceptable conditions were achieved. The surge models were organized as described below. The model file names are shown in the parenthesis.

Boundary conditions were evaluated as described below.

3.4.2.1 **Power Failure Shutdown of Montopolis Pump Station (51st-no surge protection):** For this boundary condition, the pumps were shut down while operating to supply and fill 51st elevated tank (approximately 3500 gpm). The Montopolis tank operates with a water level between 600 and 640. The initial condition is for the tank to be near full with a water level at 640. The only air valve in the system was the 4-inch vacuum breaker valves at each of the pump discharge. A profile of the HGL envelope is shown in Figure9.

3.4.2.2 **Power Failure Shutdown of Montopolis Pump Station with multiple Air Valves (51st-v4 with air valves):** For this boundary condition, Montopolis pump station was shut down while operating at maximum discharge to supply and fill 51st elevated tank (approximately 3500 gpm). The initial condition is for the Montopolis tank to be near full with a water level at 640. Vacuum breaker valves were located at the pump discharge along with 11 additional vacuum breaker valves located along the first 25,000 feet of the 16-inch and 24-inch pipeline with a spacing of approximately 2,500 feet. All air valves had a 4-inch inlet diameter. A profile of the HGL envelope is shown in Figure 10.

3.4.2.3 **Power Failure Shutdown of Montopolis Pump Station with a Surge Chamber (51st-v4 with surge chamber):** For this boundary condition, Montopolis pump station was shut down while operating at maximum discharge to supply and fill 51st elevated tank (3500 gpm). The initial condition is for the Montopolis tank to be near full with a water level at 640. A combination of vacuum breaker valves at the pump discharge and a surge chamber were used to mitigate the transient. A profile of the HGL envelope is shown in Figure 11. The two vacuum breaker valves were located at two high points in the profile, Sematech and Fulmore MS nodes.

The surge chamber serves as the primary protection. Surge chambers are the most reliable water hammer control device. Their required size is a function of pipeline length, maximum flow, acoustic wave speed in the line, pipe profile, and flow distribution. Surge chambers act as an energy source following power failure and as a shock absorber during upsurge events, such as pump startup or reverse flow following pump shutdown, respectively. Characteristically, they remove sharp pressure spikes and create smooth, controlled pressure oscillations until friction damps out transient pressure waves. A check valve on the discharge side of pumps is appropriate in conjunction with surge chambers to prevent the surge chamber from forcing flow back through the pumps. These should be non-slamming type check valves. Different outlet and inlet line sizes can often reduce the required surge chamber size.

The recommended design criterion for the surge chamber is shown in Table 2 below.

Table 2. Montopolis Surge Chamber Preliminary Design Criteria

Description	Criteria	Comments
Surge Tank Design Pressure	165 psig	• Based on pump shutoff head and should be revisited for final design • Pressure must meet ASTM code for pressure vessels
Tank Volume	525 cu. ft (3930 gallon)	• Minimum Volume • Minimum Dimensions = 5.5 ft diameter by 22 ft long

Initial Air Volume	125 cu. Ft	• 24% of tank volume (approx. 19” of height for the air pocket)
Operating Pressure	155 psig	• 3500 gpm
Approximate Elevation	600 feet	• Reference datum for pressures
Operating Flowrate (gpm) at instant of power failure	3500 gpm	• Maximum flowrate with 51st tank empty and no other demands
Connecting Pipe Sizes	8-inch diameter	• Water flows into chamber through 8-inch line and out of chamber through 8-inch line [1] • No check valve required
Minimum Pressure at Surge Tank	9.7 psig	• Minimum pressure occurring during a power outage
Maximum Pressure at Surge Tank	155 psig	• Maximum pressure occurring during a power outage
Level Controls	Air Volume in cubic feet	
LL	165	• Emergency level, bells and whistles
L	145	• Compressor OFF
M	125	• Target operation point
H	110	• Compressor ON
HH	90	• Emergency level, bells and whistles
[1] A different outlet and inlet line sizes resulted in a size reduction of the surge chamber by approximately 10 percent and does not merit the additional construction complication given the relatively small size recommended for the surge chamber.		

3.4.2.4 **Power Failure shutdown of both pumps with a bypass from the Tank (51st-tank bypass only):** The scenario is the same as the power failure without any surge protection with the exception of a 12-inch pipe that bypasses the pumps and is connected between the discharge side of the pumps and the outflow of the tank. The other assumption that cannot be guaranteed for all conditions is that the Montopolis tank is near full (water level of 635). Even if this assumption could be relied upon, the bypass does not provide the needed protection as many of the segments have negatives pressures at or near vapor pressure. A profile of the HGL envelope is shown in Figure 12.

Figure 8. Model Schematic for Montopolis Pump Station to 51st Street Elevated Tank.

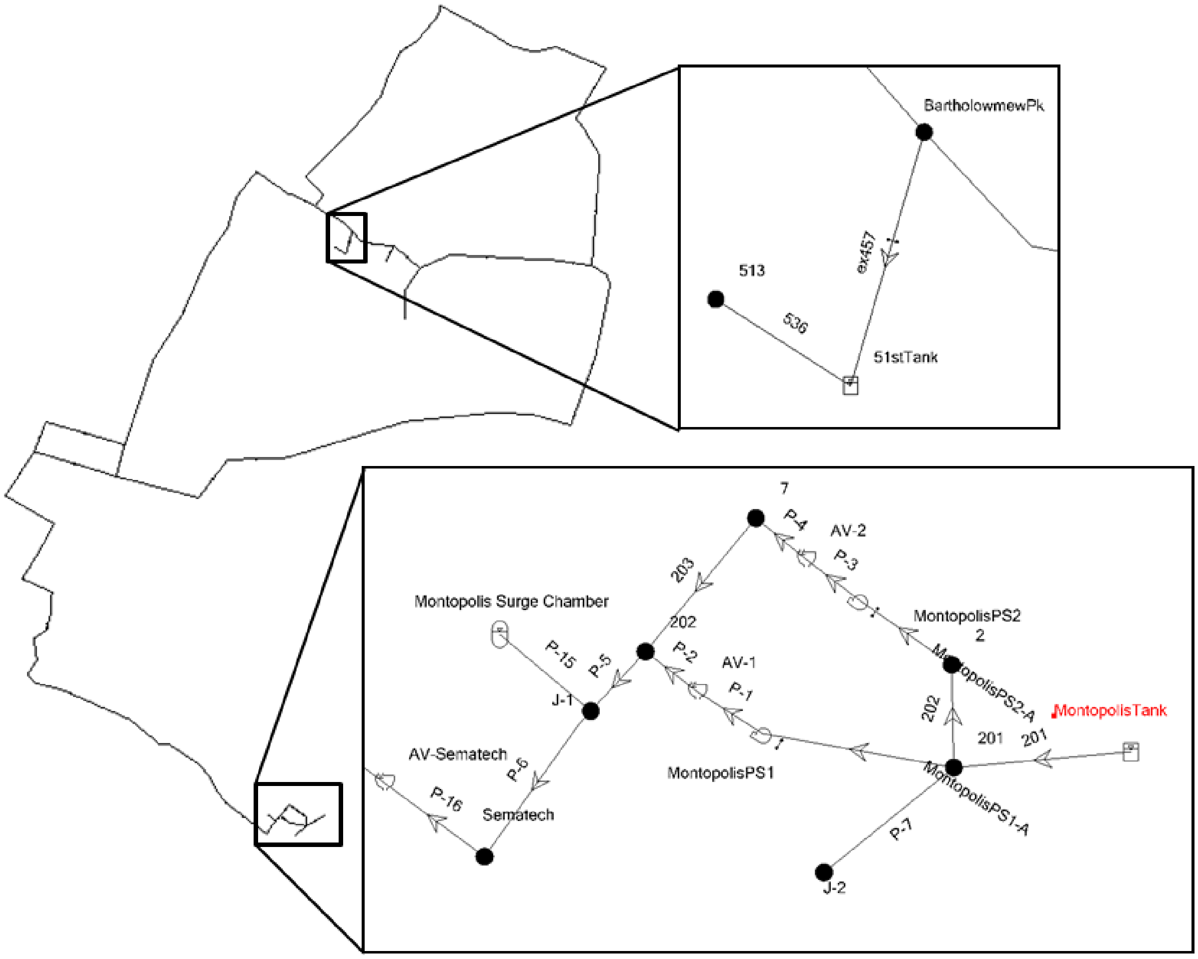


Figure 9. Hydraulic Grade Line Envelope Profile of Pipeline between Montopolis Pump Station and 51st Elevated Tank with no surge protection during a pump power failure.

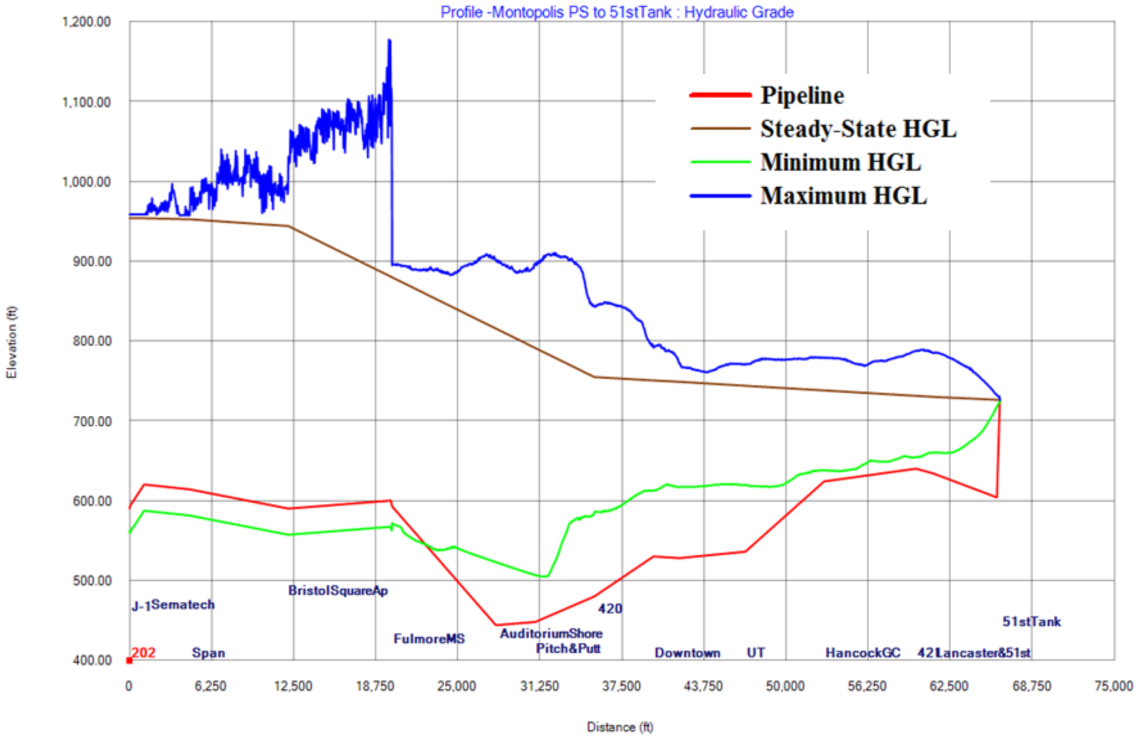


Figure 10. Hydraulic Grade Line Envelope Profile of Pipeline between Montopolis Pump Station and 51st Elevated Tank with multiple air vents for surge protection during a pump power failure.

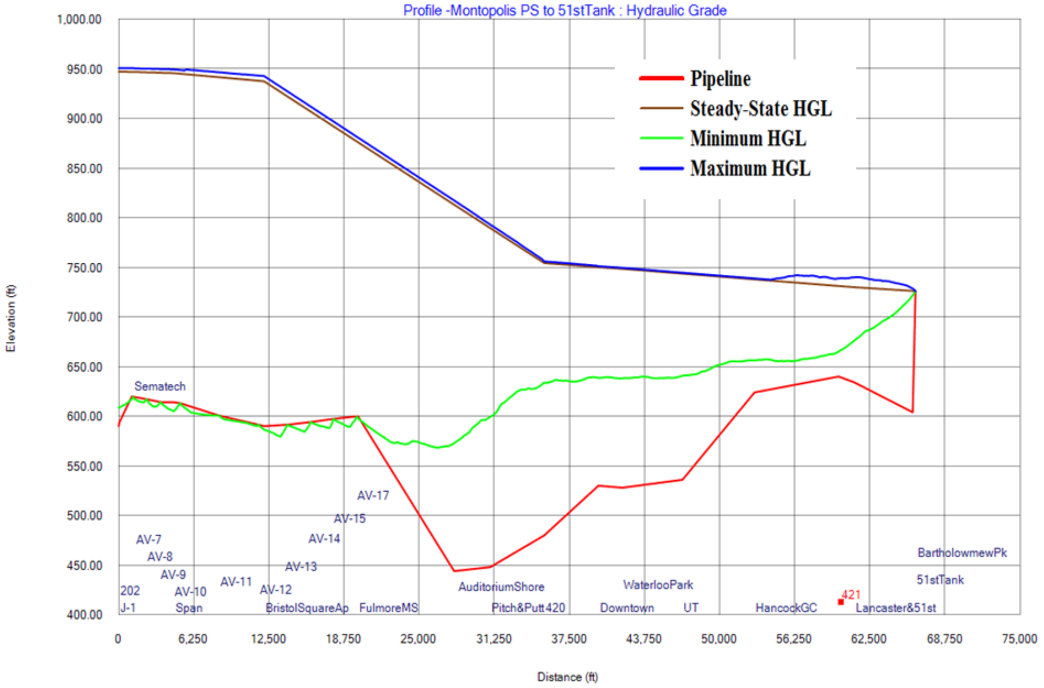


Figure 11. Hydraulic Grade Line Envelope Profile of Pipeline between Montopolis Pump Station and 51st Elevated Tank with surge chamber for surge protection during a pump power failure.

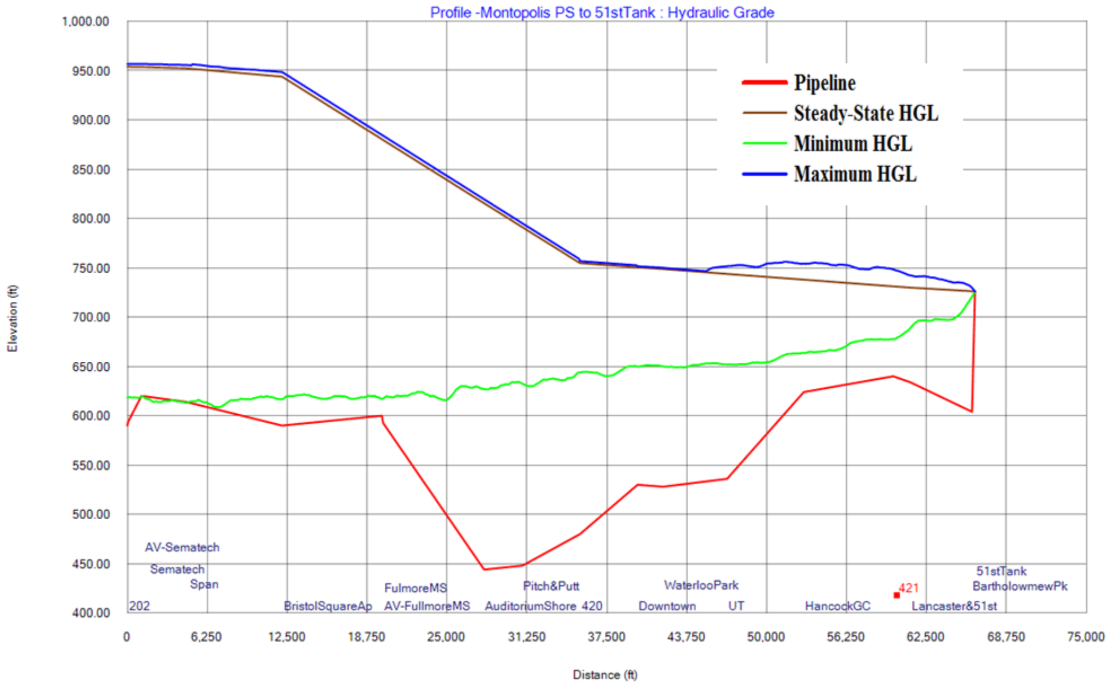
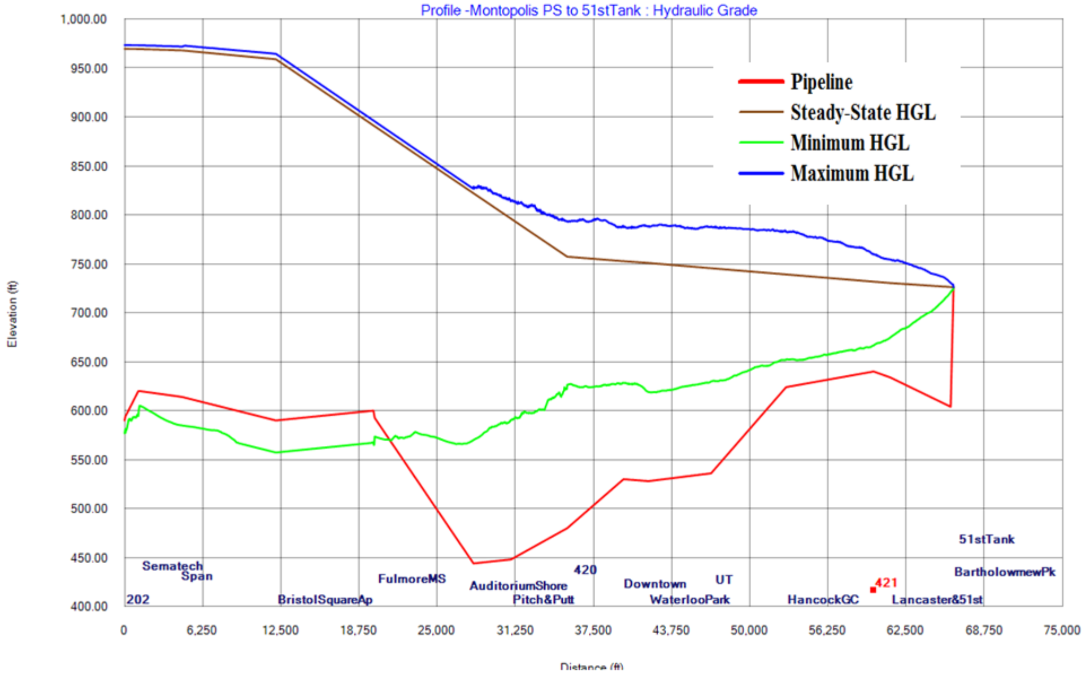


Figure 12. Hydraulic Grade Line Envelope Profile of Pipeline between Montopolis Pump Station and 51st Elevated Tank with only a 12-inch bypass pipe during a pump power failure.



Preliminary Engineering

4.1 Civil and Site Development

4.1.1 Regulatory Requirements - Regulations and Codes

4.1.1.1 City of Austin Site Plan Permitting

A City of Austin Consolidated Site Development Permit Application packet will be prepared and submitted to the City for review and approval. Items required for submittal include copies of the applicable plans and technical specifications, the Engineer's Report, Drainage Report, and Engineer's Summary Letter.

4.1.2 Standards

Standards for piping and valves are referenced under the Mechanical Design section of the report.

4.1.3 Design Criteria

The civil and site development aspects of the project will follow the standards and criteria described in the following City of Austin Design Criteria Manuals:

- Drainage Criteria Manual - Dated June 2013
- Environmental Criteria Manual - Dated June 2013
- Utilities Criteria Manual - Dated February 2013

The design will utilize the City's standard technical specifications and standard details where applicable and products from the City's Standard Products List.

4.1.4 Description of Design Concepts

4.1.4.1 Site Layout Options

The proposed facilities to be constructed on the site include the ground storage tank, pump station, paving, yard piping, electrical transformers, water quality facility, storm water detention, fencing, and other appurtenances required for the project. Preliminary site plans for two options have been developed during the Preliminary Engineering Phase, these are shown in Figures 13 and 14.

4.1.4.2 Access Driveway

Access to the site will be provided by a new driveway from Montopolis Drive, within a 30-foot wide water line and access easement previously acquired by the City of Austin. The width of the proposed driveway will be determined during final design, but is currently assumed to be limited to 15-feet wide with concrete ribbon curb to allow for grading of adjacent drainage swales on each side of the driveway. Providing a single access driveway of less than 25-feet in width will likely require variances from the City's standard driveway requirements, and will need to be discussed with the Development Review Department during the design phase. Once on the facility site, the driveway will be widened to 25-feet to meet the City of Austin Fire Department Standard (901S-2). The paving will include a hammerhead configuration to provide access roadway turnarounds, one handicap parking space, and two regular parking spaces.

Fencing around the driveway and facility will be included to provide site security. It is anticipated that the fencing will be 6-foot chain link fencing with 3 strand barbed wire to meet TCEQ requirements. The fence will be located to include a 10-foot buffer area around the site. An access gate will be provided on the driveway, which will be recessed from Montopolis Drive to allow for vehicles to pull in sufficiently from the street to park while opening the gate. The gate will be a hand operated sliding gate.

4.1.4.3 Sedimentation and Erosion Control Plan

Sediment and erosion will be controlled during construction and post-construction until the re-vegetation is fully established. Silt fencing and sediment traps are anticipated to be utilized at various areas to prevent sediment from leaving the site.

4.1.4.4 Tree Protection

Numerous trees exist on the site and several will be required to be removed to accommodate the new facilities and construction activities. Based on the tree survey performed, it is anticipated that only cedar trees will be required to be removed as a part of the project. The exact number of trees to be removed will be determined during final design.

4.1.4.5 Reclaimed Water Yard Piping

The reclaimed water mains supplying and discharging from the tank and pump station facility will be located in Montopolis Drive, and will be designed and constructed under a separate contract. The site will be supplied in the near term by a 24-inch ductile iron main in Montopolis Drive that will provide service from the central low service area and will be designed and constructed under a separate contract. The discharge from the proposed facilities will be to a 36-inch ductile iron main in Montopolis Drive that will provide service to the central service area and will be designed and constructed under a separate contract.

The proposed reclaimed water yard piping will be 42-inch diameter for the supply and 36-inch diameter for the discharge, which are sized for the ultimate system demands. The proposed reclaimed water yard piping will be ductile iron pipe, pressure class 250, wrapped in purple polyethylene. The reclaimed water mains supplying and discharging from the tank and pump station are to be laid out with restrained 11.25°, 22.5° and 45° bends and a maximum pipe deflection of 2-degrees. The pipe bedding envelope, material and trench width will conform to City of Austin Standard Details. The pipes are to be installed with a minimum cover of 3 feet in unpaved areas and 4 feet in paved areas. Separation distances between the utilities will follow the rules of TAC Chapters 210, 217 and 290.

4.1.4.6 Potable Water Service and Yard Piping

Potable water service to the site will be provided from an existing 16-inch diameter ductile iron water main in the southbound lane of Montopolis Drive. The proposed facility is located in the central south pressure zone and would have an average pressure of 41 psi at the address at Montopolis Drive based on information from the Austin Water Utility. Therefore, it is recommended that an 8-inch diameter main be extended to the tank and pump station site to provide service for a fire hydrant on the site. A service, of a size to be determined, will be extended from the 8-inch main to provide potable water service to the lavatory and hose bibs.

Due to the site being serviced with potable water and reclaimed water (an auxiliary water source) the site will require a reduced pressure backflow preventer (rpz) on the potable service line at the point of the water service. It is anticipated the 8-inch water main will be considered a City of Austin water main and the water service, water meter and rpz, will be installed at the tank site as a service off of the 8-inch main. The 8-inch water main supplying the site with potable water and fire protection is to be laid out with restrained 11.25°, 22.5° and 45° bends and a maximum pipe deflection of 3°. The water service connection will follow City of Austin Water Utility Standard Details for a single service connection. The pipe bedding envelope, material and trench width will conform to City of Austin Standard Details. The pipes are to be installed with a minimum cover of 3 feet in unpaved areas and 4 feet in paved areas. Separation distances between the utilities will follow the rules of TAC Chapters 210, 217 and 290.

4.1.4.7 Wastewater Service and Yard Piping

Wastewater service to the site will be supplied from an existing 8-inch gravity main in the northbound lane of Montopolis Drive. The pump station building is anticipated to generate wastewater flows from one lavatory with a water closet and sink, and floor drains. Due to the site topography, it is recommended that a low pressure grinder pump system be constructed to serve the site. Based on the small amount of wastewater flows to be generated by the site, a package low pressure pump system with dual pumps will be designed. The low pressure service connecting to the gravity main in Montopolis Drive will be a 2-inch diameter ASTM D2241 SDR-21 (200 psi) PVC pipe, color coded solid green exterior. Where the low pressure service connects to the existing gravity main, a new manhole is required to be constructed per the City's Utilities Criteria Manual. The new manhole design and location will be determined in final design and will be designed per the Austin Water Utilities Criteria Manual and City of Austin Standard Details. The low pressure wastewater service will be laid out following City of Austin standards for a low pressure system including a low pressure grinder pump unit with dual pumps per TAC Chapter 217. The pipe bedding envelope, material and trench width will conform to City of Austin Standard Details. The pipes are to be installed with a minimum cover of 3 feet in unpaved areas and 4 feet in paved areas. Separation distances between the utilities will follow the rules of TAC Chapters 210, 217 and 290.

4.1.4.8 Drainage and Water Quality

The existing pump station site generally sheet flows to the southeast at slopes ranging from 5% to 10%, leaving the site in an existing defined channel at the southern corner of the lot. Outlets for all onsite grading and stormwater controls will be directed to this outfall. The onsite stormwater conveyance system will consist primarily of earthen drainage channels and swales with a limited amount of culverts to convey flows under the proposed driveway. When developing the site grading, the natural flow patterns will be preserved where possible. No part of this site is in the 100-year floodplain. The access road alignment has a high point approximately 375-feet west from the Montopolis Drive right-of way (ROW) and is located roughly along a local drainage divide, draining to the Country Club East basin to the east and Carson Creek basin to the west. The majority of the driveway alignment and all of the site facility will drain to the Carson Creek basin.

For the portion of the driveway that drains to the south, flows will be conveyed within the access easement to the facility site. Depending on the ability to grade for the proposed driveway and ditches within the given access easement width, stormwater conveyance options that have been evaluated include roadside ditches or use of the driveway section with a center swale. Generally the proposed 15-foot wide driveway with 1-foot ribbon curbs contained within the 30-foot wide easement will allow for a typical ditch section with 3 to 1 side slopes, a 1-foot channel width and less than 1-foot of depth will fit on each side of the access road and will provide adequate conveyance. But, the existing access easement is constricted down to 28.69-feet where it enters the tank and pump station site, which will make it impossible to include ditches on each side of the driveway to convey the flows. Therefore, use of an inverse crown to create a center swale in the driveway is recommended. Once on the facility site, the driveway cross section would transition to normal crown to direct flows to the proposed detention and water quality facilities.

The portion of the driveway west of the high point will be conveyed to an existing low point approximately 160-feet west of the Montopolis Drive ROW. This flows offsite to a ditch that drains to the Carson Creek basin. As there is only a small amount of proposed impervious cover in this area (5,450-square feet) and there is not space available in the given easement for stormwater detention or water quality controls, discussions with the City of Austin's Development Review Department will be required to determine the best course of action in regard to detention and water quality. Because this is in the same basin as the site with the stormwater controls a possibility is to provide extra water quality and detention volume for the impervious cover in this area.

The City of Austin requirements for detention and water quality controls must be met in order to mitigate the impacts of the proposed impervious cover. Detention requirements may be satisfied with an onsite detention pond or participation in the City of Austin’s Regional Stormwater Management Program (RSMP). The COA Watershed Protection Department confirmed that the site is located within an RSMP participating watershed and may be eligible for participation if all of the requirements can be met. The RSMP program requires an application to the Watershed Protection Department documenting all hydraulic modeling and payment of participation fees. These fees are based on of the amount of proposed impervious cover, the project type which is assessed as a Commercial Development, and the appraised value of the site. The RSMP participation fees are estimated to be well in excess of constructing an onsite detention pond. This program also requires no increase in flows produced by the 2-year frequency storm event at the project site outfall. In order to attenuate the 2-year storm a detention facility will be required to be built regardless of participation in the RSMP program. Therefore, since adequate space if available for an onsite detention facility, and costs are anticipated to be much less than participation in the RSMP, construction of an onsite detention pond is recommended.

The detention pond will be sized to reduce the proposed condition flow rates to not exceed the existing condition flow rates for the 2, 10, 25, and 100 year storm events. Concrete walls may be needed to obtain the required volume depending on the final site configuration.

Vegetative Filter Strips (VFS) are generally the lowest cost form of treatment and as a distributed control are preferred to centralized treatment facilities such as ponds. A minimum VFS length of 25-feet is required by the Environmental Criteria Manual (ECM) 1.67-B.3. Due to the limited easement width for the access driveway and lack of open space at the pump station site, use of VFS does not appear to be feasible. It is recommended that water quality controls be provided by an onsite Sedimentation/Filtration pond.

There are two types of Sedimentation/Filtration ponds, Full and Partial. In partial sedimentation with filtration, a sediment chamber is located in front of the filtration basin. The sediment chamber is typically separated from the filtration basin by a berm or wall with flow spreading outlets installed or by a gabion. Partial sedimentation ponds allow the Water Quality Volume to be contained in both the sedimentation pond and the filtration pond, which allows the pond to be smaller.

In full sedimentation with filtration, the sedimentation basin receives the entire water quality volume and detains it for a draw-down time of forty-eight (48) hours. A typical configuration for this type of treatment is two ponds connected by a pipe with an orifice and riser structure to control the drawdown. ECM 1.6.5-A requires Full Sedimentation/Filtration pond where the City is responsible for maintenance. A Full Sedimentation/Bio-filtration pond was not considered because irrigation is typically needed to keep the vegetation alive and viable and because this site is not open to the public there are no aesthetic benefits to the vegetation.

All proposed impervious areas will be graded to earthen channels which will enter a splitter structure to direct runoff volumes larger than the Water Quality Volume into the detention pond. The Water Quality Volume will enter the sedimentation pond for removal of coarse sediments and then will flow into the sand bed filtration pond for final treatment.

Preliminary sizing calculations for the water quality pond are included below as Table 3. The site has no existing impervious cover. Proposed impervious cover includes the pump station building, the driveway, parking, and electrical pads. The calculations were performed for Option B which has more impervious cover. The proposed ground storage tank was not included in impervious cover calculations because the entire roof collects rainwater and drains it into the tank for use in the reclaimed water network.

Table 3. Preliminary Water Quality Calculations		
DRAINAGE AREA DATA:		
DRAINAGE AREA TO CONTROL (DA)	2.78	AC
DRAINAGE AREA IMPERVIOUS COVER (IC)	21.1	%
CAPTURE DEPTH (CD)	0.51	IN
WATER QUALITY CONTROL CALCULATIONS		
25-YEAR PEAK FLOW RATE TO CONTROL (Q25)	15.24	CFS
100-YEAR PEAK FLOW RATE TO CONTROL (Q100)	21.48	CFS
WATER QUALITY VOLUME (WQV=CD*DA*3630)	5,716	CF
MAXIMUM PONDING DEPTH ABOVE SAND BED (H)	2.5	FT
SEDIMENTATION POND VOLUME (GREATER THAN WQV)	5,716	CF
FILTRATION POND AREA (WQV/(7+2.33*H))	446	SF
FILTRATION POND VOLUME (MINIMUM 20% OF SED. VOLUME)	1,143	CF

4.2 Pump Station Structural Design

4.2.1 Codes and Standards

- IBC 2012, International Building Code 2012
- ASCE 7-10, Minimum Design Loads for Buildings and Other Structures
- ACI 318-11, Building Code Requirements for Structural Concrete
- ACI 530-11, Building Code Requirements for Masonry Structures
- AISC 14th Ed., American Institute of Steel Construction Manual Fourteenth Edition

- AISC 360-10, Specification of Structural Steel Buildings
- AISI S100-07, North American Specification for the Design of Cold-formed Steel Structural Members
- ASTM International:
    - A36/A36M, Specification for Carbon Structural Steel
    - A307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
    - A588/A588M, Specification for High-strength Low-alloy Structural Steel with 50 ksi Minimum Yield Point with Atmospheric Corrosion Resistance
    - A706/A706M, Specification for Low-alloy Steel Deformed and Plain Bars for Concrete Reinforcement
    - A992/A992M, Standard Specification for Structural Shapes
    - C33/C33M, Specification for Concrete Aggregates
    - C90, Specification for Loadbearing Concrete Masonry Units
    - C91, Specification for Masonry Cement
    - C140, Test Method Sampling and Testing Concrete Masonry Units and Related Units
    - C150, Specification for Portland Cement
    - C172, Practice for Sampling Freshly Mixed Concrete
    - C270, Specification for Mortar for Unit Masonry

4.2.2 Design Criteria – Assumptions and Calculations

4.2.2.1 Design Loads in Accordance with IBC 2012 Chapter 16

The following is a list of the applicable design load methods that shall be utilized in the structural design of the Montopolis WRI Pump Station per the IBC 2012 Chapter 16:

- Uniformly Distributed and Concentrated Live Loads (1603.1.1, 1607)
- Impact Loads (1607.9)
- Live Load Reduction (1603.1.1, 1607.10)
- Roof Live Loads (1603.1.2, 1607.10); Roof Live Load = 20 psf
- Roof Snow Loads (1603.1.1, 1608); Ground Snow Load, P_g=5 psf
- Wind Loads (1603.1.4, 1609)
    - Design Option Utilized (1609.1.1, 1609.6)
    - Basic Wind Speed (1609.3); V_{ult}=115 mph
    - Building Risk Category (1604.5); Risk Occupancy Category IV due to water treatment facilities required to maintain water pressure for fire suppression
    - Wind Exposure Category (1609.4); Category C
    - Net Pressure and Internal Pressure Coefficients (1609.6.2, ASCE 7-10)
    - Component and Cladding Pressures (ASCE 7-10)
    - Main Wind Force Resisting System Pressures (1609.1.1, 1609.6.3, ASCE 7-10)
    - Component and Cladding Pressures (1609.6.4.4.1, ASCE 7-10)
- Earthquake Design Data (1603.1.5, 1613); Section (1603.1.5) states that "…the following information related to seismic loads shall be shown, regardless of whether seismic loads govern the design of the lateral-force-resisting system of the building…"
    - Seismic Factor (ASCE 7-10); I_e=1.0
    - Risk Category (ASCE 7-10); Category II
    - Mapped Spectral Response Accelerations (1613.3.1, ASCE 7-10); S_s=0.085, S_1=0.029

  - Site Class (1613.3.2, ASCE 7-10); Class D
  - Spectral Response Coefficients (1613.3.4, ASCE 7-10); S_{DS}=0.09, S_{D1}=0.047
  - Seismic Design Category (1613.3.5, ASCE 7-10); Category A
  - Design Base Shear (ASCE 7-10); 0.01W_x, Total dead load of structure
  - Seismic Response Coefficient (ASCE 7-10); C_s=0.014
  - Response Modifications Factor (ASCE 7-10); R=2
  - Basic Seismic Force Resisting System(s) (ASCE7-10); Ordinary reinforced masonry shear walls
  - Analysis Procedure Used (ASCE 7-10); Equivalent Lateral Force Procedure
- Flood Loads (1613.1.7, 1612); Verify if the project is located in a flood hazard zone and provide the flood hazard design and documentation as required by Section 1612.
- Other Loads
  - Handrails and Guardrails (1607.8)
  - Soil Lateral Loads (1610); To be provided by a registered Geotechnical Engineer
  - Crane Loads (1607.13)

4.2.2.2 Serviceability Requirements in Accordance with IBC 2012 Chapter 16

All roof members, floor members, exterior walls, and interior partitions shall be designed to the following maximum deflection limits:

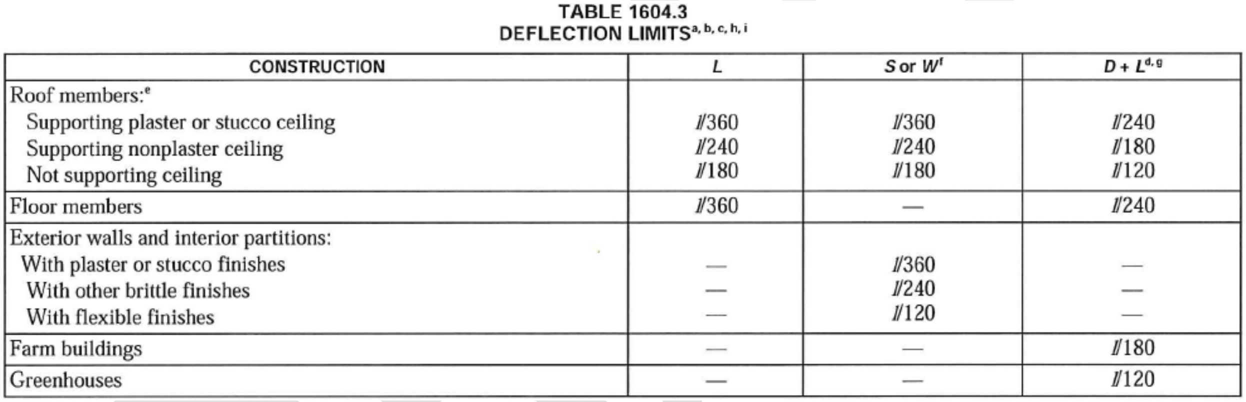


TABLE 1604.3
DEFLECTION LIMITS[a, b, c, h, i]

CONSTRUCTION	L	S or W^f	$D + L^{d,g}$
Roof members:[e]			
Supporting plaster or stucco ceiling	l/360	l/360	l/240
Supporting nonplaster ceiling	l/240	l/240	l/180
Not supporting ceiling	l/180	l/180	l/120
Floor members	l/360	—	l/240
Exterior walls and interior partitions:			
With plaster or stucco finishes	—	l/360	—
With other brittle finishes	—	l/240	—
With flexible finishes	—	l/120	—
Farm buildings	—	—	l/180
Greenhouses	—	—	l/120

4.2.2.3 Special Inspections and Tests in Accordance with IBC 2012 Chapter 17

The following is a list of the applicable Special Inspections and Tests to be carried out during the construction phase of the Montopolis WRI Pump Station per the IBC 2012 Chapter 17:

- Structural Steel special inspections shall be in accordance with the quality assurance inspection requirements of AISC 360. Required verification and inspection of steel construction other than structural steel shall be in accordance with IBC 2012 Table 1705.2.2.
- Concrete construction special inspections and verifications shall be in accordance with IBC 2012 Table 1705.3.
- Masonry construction special inspections shall be in accordance with TMS 402/ACI 530/ASCE 5 and TMS 602/ACI 530.1/ASCE 6 quality assurance program requirements.
- Special inspections for existing site soil conditions and fill placements shall be in accordance with IBC 2012 Table 1705.6. The approved project specific geotechnical report and the signed and stamped construction documents shall be used to determine compliance. During fill placement, the special inspector and/or testing agency shall determine that the proper materials and procedures are used in accordance with the provisions of the approved project specific geotechnical report.

4.2.3 Description of Design Concepts

The following is a description of the proposed structural systems for the Montopolis WRI Pump Station categorized by Foundation Design, Roof Framing Design, Column Design, and Lateral Design.

4.2.3.1 Foundation Design

The geotechnical field exploration was conducted by HVJ and Associates, Inc. of Austin, TX and the report was submitted by CH2M HILL. The report indicated that the existing soils consist of a series of expansive clays with a high to very high shrink-swell potential. It was recommended to utilize a "remove and replace" soil stabilization procedure which consists of over-excavating the fat clay to a depth to allow for 6 feet of compacted fill below the bottom of the foundation system. It should be noted that the pump station design requires 5 feet minimum deep troughs to allow for the entry, distribution, and exit of the reclaimed water pipes. This would require compacted fill to a depth of up to 11 feet to meet the requirements of the geotechnical report. It is recommended to contact the geotechnical engineer concerning possible alternatives for fill requirements at these trough locations and/or the possibility of utilizing a suspended foundation system. It should also be noted that the geotechnical report doesn't provide values for the utilization of drilled straight-shaft or under-reamed piers to carry the principle column loads. This may be a more viable option to support high concentrated loads than the recommended spread footings option since the maximum allowable net bearing pressure for the footing design is relatively low (5,000 psf). See the attached preliminary foundation plan for reference (Figure 15).

The following are three proposed foundation design options based on the submitted geotechnical report and the required project parameters:

- *Soil Supported Concrete Foundation with Spread Footings*

  This foundation option consists of a slab-on-grade concrete foundation system with perimeter grade beams seated a minimum of 1 foot below existing grade. Interior stiffening beams will be required with a maximum allowable spacing of 15 feet and a depth of at least 2 feet. The soil supported slab thickness is estimated to be 5 inches to 6 inches thick. Principle column loads and pumping equipment shall be supported by spread footings seated a minimum of 1 foot below existing grade. Additional information is required from the geotechnical engineer on allowable net bearing pressures of the soils occurring at the 5 feet deep troughs in order to determine the trough foundation members.

- *Soil Supported Concrete Foundation with Drilled Straight-Shaft or Under-reamed Piers*

  This foundation option consists of a slab-on-grade concrete foundation system with perimeter grade beams seated a minimum of 1 foot below existing grade. Interior stiffening beams will be required with a maximum allowable spacing of 15 feet and a depth of at least 2 feet. The soil supported slab thickness is estimated to be 5 inches to 6 inches thick. Principle column loads shall be supported by drilled straight-shaft or under-reamed piers. Pumping equipment shall be supported by spread footings. Allowable net bearing pressures and skin friction values are required from the geotechnical engineer in order to determine required diameters and depths of the piers. Additional information is required from the geotechnical engineer on allowable net bearing pressures of the soils occurring at the 5 feet deep troughs to determine the trough foundation members.

- *Suspended Foundation with Drilled Straight-Shaft or Under-reamed Piers*

  This foundation option consists of a suspended slab concrete system with perimeter and interior spanning beams all supported by drilled straight-shaft or under-reamed piers. The slab thickness is estimated to be 8 inches to 10 inches thick. Principle column loads shall be supported by drilled straight-shaft or under-reamed piers. All concrete structural spanning members shall be poured onto 8" deep void forms and pre-cast concrete soil retainers shall be provided at the perimeter and interior beams. This option while being the most expensive of the three will also provide the most structurally stable design and should be considered if a Potential Vertical Rise (PVR) of the foundation system needs to be limited to less than 1 inch.

4.2.3.2 Roof Framing and Column Design

The roof framing superstructure shall consist of a pre-fabricated, pre-engineered metal building structure comprised of hot-rolled steel bent frames at an approximate 20 feet spacing supporting cold-formed purlins at two to four feet on center spacing and a 1 ½" deep corrugated metal roof deck. The superstructure will be required to resist gravity loads only. The columns shall consist of hot-rolled steel wide flange columns, possibly tapered, that are integral in the bent frame structure. In order to install and remove pumping equipment, an internal crane is also required with a hoist beam and two track beams. Required crane loads shall be submitted to engineer prior to design. It should be noted that the pre-fabricated, pre-engineer metal building fabricator shall submit to the Engineer of Record any and all column reactions onto the foundation for proper foundation design. See the attached preliminary roof framing plan for reference (Figure16).

4.2.3.3 Lateral Design

The lateral loads onto the structure from wind or seismic forces shall be resisted by the surrounding concrete masonry units (CMU) exterior walls. The exterior CMU walls shall consist of reinforced 8" CMU split-face block will all reinforced cells fully grouted. In order to transfer the lateral loads into the roof diaphragm, special connections will be required at the top of the CMU wall to the steel bent frames consisting of steel angles and post-installed anchors. See the attached preliminary roof framing plan for reference (Figure 16).

4.3 Pump Station Architectural Design

The following paragraphs will describe standards and considerations taken into account for the development of a preliminary architectural design concept for the proposed Pump Station Building.

4.3.1 Regulatory Requirements

The following is a listing of local technical codes and regulations adopted by the City of Austin. Such codes, and approved amendments, shall apply to the design and construction of the proposed building.

- 2012 International Building Code (IBC)
- 2012 International Energy Conservation Code (IECC)
- 2012 International Fire Code (IFC)
- 2012 Uniform Plumbing Code (UPC)
- 2011 National Electrical Code (NEC)
- 2012 Texas Accessibility Standards (TAS)

Figure 17 is an example of code review notes in the construction documents for this type of project.

4.3.2 Standards

The following architectural design standards have been taken from the Austin Water Utility's Design Criteria Manual for Pump Stations. These items have selected with the purpose of showing standards that are considered integral to the design of the building. The standards are as follows:

- Building profile shall be kept as low as functionally possible to avoid interference with surrounding landscape and neighboring properties.
- Roof systems should go with the visual context of the facility
- Pitch roofs desired
- Use of highly reflective wall and roof surfaces is discouraged
- Roof hatches, if provide, to be securable
- Provide 14' wide x 18' high, electric service door for truck access. Include ample clear space inside the building for loading and unloading of equipment. Provide exterior bollards on either side of service door.
- Provide 3'x7' personnel door for inspection and maintenance staff. Use "BEST Core System" compatible hardware and cylinder locks.
- All concrete floors to slope to area drains and/or sumps

- Building design shall complement the surrounding landscape and neighborhood
- Exterior walls shall utilize masonry veneer and/or stucco
- Windows between pump room and electrical room, if provided, shall be carefully located to allow for clear and obstructed viewing of both rooms
- Provide exterior lighting to satisfy functional and security needs
- Fixtures to be full cut-off to avoid light pollution within project site as well as neighboring properties
- Natural lighting of the interior of the building in the form of skylights and/or clerestory windows is encouraged
- Exterior windows, if provided, should satisfy energy, acoustical and security requirements. Window height should meet security fencing height requirements.
- All glazing should limit light leakage to adjacent properties and direct or reflected glare from sunlight
- Exterior equipment to be fully screened from public view
- The use of enclosed vaults and confined spaces shall be avoided wherever possible
- All construction materials shall comply with applicable regulations, including restrictions on the use of volatile organic content, lead, mercury, CFCs and asbestos

4.3.3 Description of Design Concept

Figure 18 illustrates the preliminary exterior elevation views of the pump station. The pump station will have the following salient architectural features:

- The building size, dictated by process and equipment requirements, has been preliminarily shown in this Report. However, specific requirements to be finalized during the detailed design phase of the Project
- The proposed building locations have been chosen for flow of maintenance vehicles and their limited site impact
- It will be a single story building with a total building area of 4347 square feet
- Building height will be 25’-4”, from finished floor to top of roof overhang
- The building use and occupancy classification will be low-hazard factory industrial, Group “F-2”. Factory industrial uses that involve fabrication and manufacturing of non-combustible materials which during finishing, packing or processing do not involve a significant fire hazard.
- The type of construction will be type II-B. Types I and II construction are those types of construction in which the building elements are of non-combustible materials. Additionally, type B construction will not require supplementary fire-resistance ratings for building elements such as structural frame, bearing and non-bearing walls, roof systems and floor assemblies.
- To economically achieve the required structural “clear-spans”, the proposed building will utilize a pre-engineered structural steel frame.
- The skin of the building will consist of a combination of 8-inch and 12-inch concrete masonry units (CMU). The change in CMU sizes will allow for an exterior design accent in the form of a change of materials from CMU veneer to stucco.
- CMU pilasters are being proposed as additional articulation on the exterior of the building to enhance the architectural design and highlight the distribution of structural elements on the inside of the building.
- Material colors will be carefully selected to harmonize with the surrounding landscape and to minimize visual impact on future development in the adjacent properties.
- Exterior windows will be placed along the long wall of the pump room to allow for natural lighting. Window units will consist of composite sandwich panels that combine controlled, usable, natural daylight with improved energy efficiency. The proposed translucent panels have been used at other Austin Water Utility facilities such as the Ullrich Water Treatment Plant.

4.3.4 Texas Accessibility Standards (TAS)

The proposed building is exempt from compliance with 2012 TAS guidelines as per article 203.5 which states that *“Spaces frequented only by service personnel for maintenance, repair, or occasional monitoring of equipment shall not be required to comply with accessibility standards or to be on an accessible route. Machinery spaces include, but are not limited to elevator pits or elevator penthouses; mechanical, electrical or* *communications equipment rooms; piping or equipment catwalks; water or sewage treatment pump rooms and stations; electric substations and transformer vaults; and highway and tunnel utility facilities"*

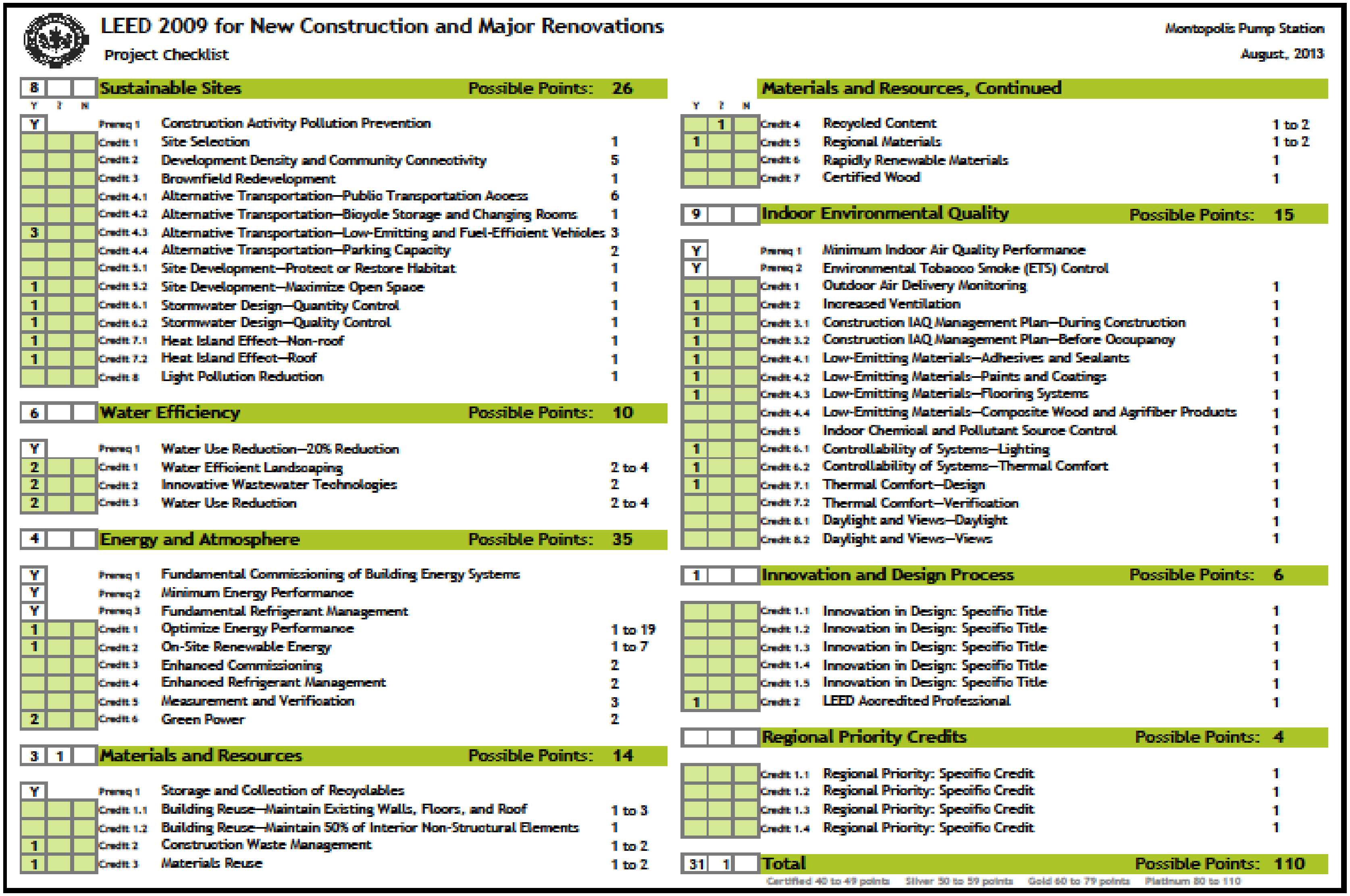
4.3.5 Sustainability Through Design

Because of its unique programmatic and functional requirements, the design of the proposed facility will not be a candidate for certification with the Leadership in Energy and Environmental Design (LEED) Program. LEED is an internationally recognized green building certification system for designating, constructing and certifying green buildings. The voluntary rating system was designed by the U.S. Green Building Council (USGBC), a non-profit trade organization of leaders from across the building industry working to promote buildings that are environmentally responsible, profitable and healthy places to live and work.

It was determined during the early stages of development of this Report that the design team would strive to incorporate green and sustainable design principles when possible. The measures incorporated to use these principles will be based on LEED credits, even if certification is not pursued. Reduction of heat island effect, using low emitting materials, water use reduction, using recycled content and/or regional products and recycling construction waste are all basic examples of green attributes that the design team might choose to incorporate. More expensive and involved measures such as commissioning, wastewater technologies, increased ventilation and daylighting will first need to be evaluated by the team and approved by the Owner prior to being incorporated into the design of the building.

The attached LEED 2009 Project Checklist will show the attainable credits based on potential costs. The credits shown highlighted in yellow are expected to be examples of basic and less costly examples of green principles. On the other hand, the credits highlighted in blue have the potential of being more involved and therefore more costly. The attached LEED analysis also includes a brief description of each credit and suggestion for implementation of each credit.

Figure 19. LEED 2009 Project Checklist.



LEED 2009 for New Construction and Major Renovations

Project Checklist

Montopolis Pump Station

August, 2013

8			Sustainable Sites	Possible Points:	26
Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
			Credit 1	Site Selection	1
			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
			Credit 4.1	Alternative Transportation—Public Transportation Access	6
			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Rooms	1
3			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Vehicles	3
			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
1			Credit 5.2	Site Development—Maximize Open Space	1
1			Credit 6.1	Stormwater Design—Quantity Control	1
1			Credit 6.2	Stormwater Design—Quality Control	1
1			Credit 7.1	Heat Island Effect—Non-roof	1
1			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1

6			Water Efficiency	Possible Points:	10
Y			Prereq 1	Water Use Reduction—20% Reduction	
2			Credit 1	Water Efficient Landscaping	2 to 4
2			Credit 2	Innovative Wastewater Technologies	2
2			Credit 3	Water Use Reduction	2 to 4

4			Energy and Atmosphere	Possible Points:	35
Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
1			Credit 1	Optimize Energy Performance	1 to 19
1			Credit 2	On-Site Renewable Energy	1 to 7
			Credit 3	Enhanced Commissioning	2
			Credit 4	Enhanced Refrigerant Management	2
			Credit 5	Measurement and Verification	3
2			Credit 6	Green Power	2

3	1		Materials and Resources	Possible Points:	14
Y			Prereq 1	Storage and Collection of Recyclables	
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2	Construction Waste Management	1 to 2
1			Credit 3	Materials Reuse	1 to 2

			Materials and Resources, Continued		
Y	?	N			
	1		Credit 4	Recycled Content	1 to 2
1			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
			Credit 7	Certified Wood	1

9			Indoor Environmental Quality	Possible Points:	15
Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
			Credit 1	Outdoor Air Delivery Monitoring	1
1			Credit 2	Increased Ventilation	1
1			Credit 3.1	Construction IAQ Management Plan—During Construction	1
1			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
1			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
1			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
1			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Products	1
			Credit 5	Indoor Chemical and Pollutant Source Control	1
1			Credit 6.1	Controllability of Systems—Lighting	1
1			Credit 6.2	Controllability of Systems—Thermal Comfort	1
1			Credit 7.1	Thermal Comfort—Design	1
			Credit 7.2	Thermal Comfort—Verification	1
			Credit 8.1	Daylight and Views—Daylight	1
			Credit 8.2	Daylight and Views—Views	1

1			Innovation and Design Process	Possible Points:	6
			Credit 1.1	Innovation in Design: Specific Title	1
			Credit 1.2	Innovation in Design: Specific Title	1
			Credit 1.3	Innovation in Design: Specific Title	1
			Credit 1.4	Innovation in Design: Specific Title	1
			Credit 1.5	Innovation in Design: Specific Title	1
1			Credit 2	LEED Accredited Professional	1

			Regional Priority Credits	Possible Points:	4
			Credit 1.1	Regional Priority: Specific Credit	1
			Credit 1.2	Regional Priority: Specific Credit	1
			Credit 1.3	Regional Priority: Specific Credit	1
			Credit 1.4	Regional Priority: Specific Credit	1

31	1		Total	Possible Points:	110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

LEED Analysis (LEED 2009 BD+C)

Sustainable Site

Credit 4.3 Alternative Transportation – Low-Emitting and Fuel-Efficient Vehicles
Provide a minimum of 5% of preferred parking space for low-emitting and fuel-efficient vehicles.
Suggestion: provide above mentioned.

Credit 5.2 Maximize Open Space
Provide vegetated open space for 20% of the project's site area.
Suggestion: provide above mentioned area.

Credit 6.1 Stormwater Design – Quantity Control
Implement a stormwater management plan that prevents the post development peak discharge rate and quantity from exceeding the predevelopment peak discharge rate and quantity for the 1- and 2-year 24-hour design storms.
Suggestion: design and implement above-mentioned plan.

Credit 6.2 Stormwater Design – Quality Control
Implement a stormwater management plan that reduces impervious cover, promotes infiltration and captures and treats the stormwater runoff from 90% of the average annual rainfall using acceptable best management practices. (BMPs used to treat runoff must be capable of removing 80% of the average annual post development total suspended solids load based on existing monitoring reports.)
Suggestion: design and implement above-mentioned plan.

Credit 7.1 Heat Island Effect – Non-roof
Use hardscape materials with a solar reflectance index (SRI) of 29 or more.
Suggestion: Use materials such as white concrete for driveway and parking spaces.

Credit 7.2 Heat Island Effect – Roof
Cover 75% or more roofing area with roofing materials with an SRI of 78 minimum (slope > 2:12) or 29 minimum (slope < 2:12)
Suggestion: Use standing seam metal roofing that meets the SRI requirements.

Water Efficiency

Credit 1 Water Efficient Landscaping
Reduce portable water consumption for irrigation by 50%.
Suggestion: Install cistern for rainwater collection to use for irrigation.

Credit 2 Innovative Wastewater Technologies
Reduce portable water usage by 50%.
Suggestion: Install water-conserving fixtures or cistern for rainwater collection to reduce the use of portable water by 50%.

Credit 3 Water Use Reduction
Provide plumbing fixtures which reduces 30-40% of water usage (calculated against LEED baseline; 1.6 gpf for commercial toilet, 1 gpf for commercial urinal, 0.25 gallon per cycle for meter faucet)
Suggestion: install fixtures with water usage that are 30-40% lower.

Energy and Atmosphere

Credit 1 Optimize Energy Performance
Using a computer model to simulate whole building energy usage. And calculate proposed energy performance model to baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007.
Suggestion: perform computer simulation to compare proposed energy performance and baseline to determine % of energy reduction.

Credit 2 On-Site Renewable Energy
Use on site renewable energy system to offset building energy costs. Suggestion: Install Photovoltaic system, wind energy systems, etc.

Credit 6 Green Power
Have a 5 year contract with a green energy provider.
Suggestion: 100% of Austin Energy power is created with green power, such as wind energy.

<u>Materials and Resources</u>

Credit 2 Construction Waste Management
Contractor to develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or comingled. Minimum % to be 50% debris to be recycled or salvaged.
Suggestion: Contractor to develop and implement above-mentioned plan.

Credit 3 Materials Reuse
Use salvaged, refurbished or reused materials, the sum of which constitutes at least 5% to 10%, based on cost, of the total value of materials on the project.
Suggestion: Architect to suggest and Contractor to document cost on salvaged, refurbished or reused materials to contribute at least 5% of total value of materials.

Credit 4 Recycled Content
Use materials with recycled content such that the sum of postconsumer recycled content plus ½ of the preconsumer content constitutes at least 10% or 20%, based on cost, of the total value of the materials in the project.
Suggestion: Architect to suggest and Contractor to document cost of recycled materials based on requirement.

Credit 5 Regional Materials
Use building materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site for a minimum of 10% or 20%, based on cost, of the total materials value.
Suggestion: Contractor to source materials within 500 miles of project site.

<u>Indoor Environmental Quality</u>

Credit 2 Increased Ventilation
Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2007.
Suggestion: provide above mentioned.

Credit 3.1 Construction Indoor Air Quality Management Plan – During Construction

Develop and implement an indoor air quality management plan for the construction and preoccupancy phases of the building. Meet or exceed the recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association IAQ guidelines for Occupied Buildings Under Construction; protect stored on-site and installed absorptive materials from moisture damage.
Suggestion: provide above mentioned.

Credit 3.2 Construction Indoor Air Quality Management Plan – Before Occupancy
Before Occupancy, install new filtration media and perform a building flush-out (air) or perform air testing per EPA and LEED standards.
Suggestion: provide above mentioned.

Credit 4.1-4.2 Low-Emitting Materials – Adhesives and Sealants, paints and coatings
Suggestion: Specify low VOC materials

Credit 6.1-6.2 Controllability of Systems – Lighting, Thermal Comfort
Provide individual control of lighting and thermal comfort of 50% of the building occupants to enable adjustments to suit individual task needs and preferences.
Suggestion: provide above mentioned

Credit 7.1 Thermal Comfort – Design
Design HVAC system and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy.
Suggestion: provide above mentioned

4.4 Pump Station Heating, Ventilation, and Air Conditioning (HVAC) and Plumbing Design

4.4.1 Regulatory Requirements – Regulations and Codes

The main regulations associated with the HVAC and plumbing systems are the building code requirements as adopted by the City of Austin. These code requirements include:

- 2012 International Building Code
- 2012 Uniform Mechanical Code
- 2012 Uniform Plumbing Code
- 2012 International Fire Code
- 2012 International Energy Conservation Code
- 2011 National Electric Code (NEC)

4.4.2 Standards

1. American Society of Heating, Refrigerating and Air Conditioning Engineers
   a. 2009 Fundamentals Handbook
   b. 62.1, Ventilation for Acceptable Indoor Air Quality
   c. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
2. National Fire Protection Association Standards
   a. 70, National Electric Code (NEC)
   b. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems

4.4.3 Design Criteria – Assumptions and Calculations

The sizing of the HVAC equipment for the pump room is based on projected pump sizes of 300 HP, with allowances made for the building wall and roof assembly. The pumps have been assumed to each be 92% efficient. The final sizing of the HVAC equipment will be determined based on the final pump selection. The HVAC is being selected under the assumption that all pumps will operate simultaneously.

The sizing of the HVAC equipment for the electrical room is based on the heat requirements of electrical control switchgear from previous City of Austin projects. The room is assumed to have loads 1W/SF for lighting, 8 kW of electrical equipment, and 2 kW for other miscellaneous loads in the space.

4.4.4 Description of Design Concepts

4.4.4.1 HVAC

Per the City of Austin's standards, an HVAC system will be designed to maintain the temperature in the pump room of 85 degrees Fahrenheit. This will require approximately 30 tons of air conditioning equipment. Air from the units would be ducted to grilles located as high as possible above the spaces being served. The conditioned air will provide dehumidification to lessen corrosion to the equipment and piping as well as prevent equipment from reaching excessive temperatures. The unit would also be equipped with electric heat to maintain a room temperature above 40 degrees Fahrenheit during winter months.

The air conditioning provided for the pump room will be provided using one of two types of systems. The first option is to use a packaged unit located on a concrete pad at grade level outside the building. Locating the unit outside of the building allows for the units to be serviced without needing to enter the main pump room. The disadvantage to this system is that a small section of ductwork must be routed outside the building to reach the packaged unit. The second option is to provide split DX cooling systems. These systems would consist of an air handler inside the space mounted on a concrete pad, with a condensing unit located on a concrete pad at grade level outside the building. The advantage of this system is that the air handlers can be serviced from inside the space and all the ductwork is completely routed within conditioned space for the building. The disadvantage for this type of unit is that indoor space must be allocated for the air handler, and when service clearances are considered the amount of space required for the condensing unit outside will be not be much less than what is required for a packaged unit.

Per the City of Austin's direction, the intent of the design is to provide a single unit to serve the pump room space. No additional redundancy will be necessary.

The electrical room will be served by a series of 4 ductless split HVAC systems, with condensing units outside. The units will maintain a temperature of 80 degrees or less within the space. The total projected capacity for this system is 4 tons.

Both the pump room and the electrical room shall also be provided with a thermostatically controlled ventilation fan. The ventilation fan will operate in the case of a failure of the HVAC system, to ensure air movement across the space and protect the equipment from damage.

4.4.4.2 Plumbing

The restroom shall consist of a floor mounted flush valve water closet and a lavatory. These fixtures will be designed to be compatible with the American's with Disabilities Act. The fixtures will be selected in accordance with the City of Austin water usage requirements, with the water closet using 1.28 gallons per flush and the lavatory faucet using 0.5 gallons per minute.

Potable hose bibs will be provided in the pump room and outside for wash down of the space. The pump room will have sloped floors to drain to a common sump. The sump will either gravity drain or be pumped into the grinder pump station.

The lavatory drains will also be directed to the grinder pump station.

4.5 Storage Reservoir Design

4.5.1 Regulatory Requirements – Regulations and Codes

1. International Building Code (IBC 2012)
2. American Concrete Institute (ACI) 318: Building Code Requirements for Structural Concrete
3. ACI 350: Code Requirements for Environmental Engineering Concrete Structures
4. ACI Manual of Concrete Practice
5. American Institute of Steel Construction (AISC) Steel Construction Manual
6. ANSI/ AWWA D100-11, Welded Steel Tanks for Water Storage
7. ANSI/AWWA D102-11, Coating Steel Water-Storage Tanks
8. ANSI/AWWA D106-10, Sacrificial Anode Cathodic Protection System for the Interior Submerged Surfaces of Steel Water-Storage Tanks

4.5.2 Standards

City of Austin Water Utility: Concrete and Welded Ground Storage Reservoir, Fluted and Composite Elevated Welded Steel Tank – Draft General Standards & Design Criteria, dated July, 2009.

4.5.3 Design Criteria – Assumptions and Calculations

The Design of the Steel Reservoir will be in general conformance with the City of Austin Water Utility Design Criteria noted above.

4.5.4 Description of Design Concepts

The proposed 4 million gallon storage reservoir will be a 130 ft. diameter by 40 ft. tall steel tank with the general configuration as shown on Figure 20. All loading for design shall be in accordance with ASCE 7-10. Fabrication and construction of the steel reservoir will be in accordance with AWWA D100-11.

The reservoir will have the following features:

- A minimum of one stainless steel roof vent with pest screens as detailed on Figure 21.
- Overflow pipe with flap gate and catchment basin as detailed on Figure 23.
- Roof safety railing encircling catholic protection ports as detailed on Figure 21.
- Roof access hatch with interior stainless steel ladder with safety climb as detailed on Figure 21.
- Roof access ladder with safety climb and anti-climb provisions.
- Minimum of two 36-inch diameter hinged man-holes on bottom of tank shell.
- Roof gutter and rain water collection system.
- Drain pipe with catchment basin and line to detention pond.

The foundation for the steel reservoir will be in accordance with the "Geotechnical Investigation for the Proposed Montopolis Pump Station Facilities" prepared by HVJ Associates and dated September, 2013. The foundation subgrade will be prepared by removing a minimum of 6 feet of existing soil and then reconditioning and recompacting a minimum of 12 inches of existing soil. A minimum 4 inch thick seal slab is to be placed over the reconditioned soil. Compacted structural select fill is then placed in 6 inch lifts to 8 inches below the bottom of the steel tank base. A 4 inch seal slab is then placed followed by a 4 inch sand cushion. The reservoir shell wall will be placed on a minimum 4 feet deep reinforced concrete ring beam. A detail of this foundation is shown on Figure 22.

4.6 Mechanical Design

4.6.1 Regulatory Requirements – Regulations and Codes

The main regulation related to the process mechanical piping and equipment is the State regulations related to Reclaimed Water – 30 Texas Administrative Code (TAC) Chapter 210 - Use of Reclaimed Water. Subchapter B - GENERAL REQUIREMENTS FOR THE PRODUCTION, CONVEYANCE, AND USE OF RECLAIMED WATER, §§210.21 - 210.25 – is included in Appendix E and lists the main State requirements that will be incorporated into the design of the Montopolis reclaimed water storage and pump station.

4.6.2 Standards

The following standards will be referenced as part of the mechanical design of pumps, piping, and valves:

4.6.2.1 Pump Standards

1. Hydraulic Institute Standards (HIS)
2. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

4.6.2.2 Pressure Tank and Pipe Standards

1. **American Society of Mechanical Engineers (ASME):**
   a. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
   b. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
   c. B1.20.1, Pipe Threads, General Purpose (Inch).
   d. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
   e. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   f. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
2. **American Water Works Association (AWWA):**
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings for Water.
   d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   f. C116/A21.16, Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
   g. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
   h. C153/A21.53, Ductile-Iron Compact Fittings for Water Service.
   i. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
   j. C606, Grooved and Shouldered Joints.
3. **ASTM International (ASTM):**
   a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
   b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   c. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
   d. A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
f. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
h. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
i. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
j. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
k. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
l. A197/A197M, Standard Specification for Cupola Malleable Iron.
m. A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
n. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
o. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
p. A276, Standard Specification for Stainless Steel Bars and Shapes.
q. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
r. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
s. A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
t. A320/A320M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
u. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
v. A403/A403M, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
w. A536, Standard Specification for Ductile Iron Castings.
x. A563, Standard Specification for Carbon and Alloy Steel Nuts.
y. A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
z. A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
aa. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
bb. B32, Standard Specification for Solder Metal.
cc. B43, Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
dd. B61, Standard Specification for Steam or Valve Bronze Castings.
ee. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
ff. B75, Standard Specification for Seamless Copper Tube.
gg. B88, Standard Specification for Seamless Copper Water Tube.
hh. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar and Shapes.
ii. B462, Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe

Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.

jj. D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension.
kk. D413, Standard Test Methods for Rubber Property Adhesion to Flexible Substrate.
ll. D543, Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
mm. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
nn. D1330, Standard Specification for Rubber Sheet Gaskets.
oo. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
pp. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
qq. D2000, Standard Classification System for Rubber Products in Automotive Applications.
rr. D2310, Standard Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
ss. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
tt. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
uu. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
vv. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
ww. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
xx. D3222, Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
yy. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
zz. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
aaa. D4894, Standard Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials.
bbb. D4895, Standard Specification for Polytetrafluoroethylene (PTFE) Resin Produced from Dispersion.
ccc. F436, Standard Specification for Hardened Steel Washers.
ddd. F437, Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
eee. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
fff. F441/F441M, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
ggg. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
hhh. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
iii. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

4.6.2.3 Valve Standards

1. **American Water Works Association (AWWA):**

a. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
b. C500, Metal-Seated Gate Valves for Water Supply Service.
c. C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).

   d. C508, Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
   e. C509, Resilient-Seated Gate Valves for Water Supply Service.
   f. C510, Double Check Valve Backflow Prevention Assembly.
   g. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
   h. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   i. C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
   j. C541, Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   k. C542, Electric Motor Actuators for Valves and Slide Gates.
   l. C550, Protective Interior Coatings for Valves and Hydrants.
   m. C606, Grooved and Shouldered Joints.
   n. C800, Underground Service Line Valves and Fittings.

2. **ASTM International (ASTM):**
   a. A276, Standard Specification for Stainless Steel Bars and Shapes.
   b. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   c. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   d. A564/A564M, Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
   e. B61, Standard Specification for Steam or Valve Bronze Castings.
   f. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
   g. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
   h. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
   i. B139/B139, Standard Specification for Phosphor Bronze Rod, Bar and Shapes.
   j. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
   k. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
   l. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
   m. D429, Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates.
   n. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

3. **Manufacturers Standardization Society (MSS):**
   a. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
   b. SP-81, Stainless Steel, Bonnetless, Flanged Knife Gate Valves.
   c. SP-85, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
   d. SP-88, Diaphragm Valves.
   e. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

4. **National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1000 Volts Maximum).**

5. **Underwriters Laboratories (UL).**

6. **USC Foundation for Cross-Connection Control and Hydraulic Research.**

4.6.2.4 Austin Water Utility Standards

The project will follow the standards and criteria described in Austin Water Utility's Pump Station Design Manual – "Pump Station- GENERAL STANDARDS & DESIGN CRITERIA, created April 2009." Table 4 is a preliminary list of the major components of the Montopolis Pump Station project. The design will include the City's standard specifications where applicable and approved products as listed on the component list.

Table 4. Preliminary Lists of Main Project Components.

		Preliminary List of Main Project Components		
Estimated Quantity	**Units**	**Description**	**City of Austin Approved Product List - Product Description**	**SPL No.**
		curb cut - driveway permit		
820	ft	asphalt driveway w/concrete ribbon curb 15 ft wide		
		chain link driveway entry gate w/ pedestrian gate on side		
2760	ft	intruder resistant chain link fencing around property - 8 ft w/ three strand barbed wire on top		
		42 in. dia ductile iron (DI) tie-in to existing 42 in. DI pipe	Ductile Iron Pipe and Fittings	WW-27
		36 in. dia DI tie-in to existing 36 in. DI pipe	Ductile Iron Pipe and Fittings	WW-27
900	ft	42 in dia DI yard piping to reservoir	Ductile Iron Pipe and Fittings	WW-27
		30 in dia electric solenoid operated altitude valve w/ vault		
1200	ft	36 in dia DI yard piping from pump station	Ductile Iron Pipe and Fittings	WW-27
		6 in dia DI potable water tap to existing 8 in DI potable water	Ductile Iron Pipe and Fittings	WW-27
900	ft	6 in dia DI potable water yard piping	Ductile Iron Pipe and Fittings	WW-27
2		hydrants	Fire Hydrants	WW-3
		4 in. dia PVC force main tie-in to 8 in gravity sanitary sewer (manhole)	PVC Gravity Sewer Pipe (6 inch to 15 inch Diameter)	WW-227
1200	ft	4 in dia sanitary sewer force main PVC yard piping	PVC Gravity Sewer Pipe (6 inch to 15 inch Diameter)	WW-227
		2 pump package grinder sanitary sewer/drain pump station - (300 gpm each)		
		4 million gallon capacity welded steel ground storage tank - 130 ft. dia and 45 ft high		
		storage tank foundation - 8 ft over excavation - piers - expansive clay		
		concrete overflow catchment box - 20x20x5		
		Pax Water Technologies Mixer in storage tank		
		10 ft mast antennae mounted to top of tank		
260	ft	36 in dia DI suction piping from tank to pump station	Ductile Iron Pipe and Fittings	WW-27
		5,000 gallon capacity hydropneumatic tank w/ compressor		
		pump station foundation - two below grade pipe chases - over excavation - drilled piers - expansive clay		

		pump station building - 70x65x20 High - prefabricated steel building w/ split face CMU wall		
		16 ft wide manual roll-up door		
		bridge crane ?? Tons		
4		2000 gpm 300 hp horizontal split case pumps - constant speed		
5		12 in dia electric operated ball valves	Ball Valves for Curb Stops	WW-275
5		12 in dia venturi meters		
4		12 in dia check valves	Swing Check Valves, AWWA C508	WW-123
4		20 in dia gate valves	Resilient-Seated Gate Valves, AWWA C515	WW-700
2		36 in dia gate valves with bypass	Resilient-Seated Gate Valves, AWWA C515	WW-700
3		12 in dia gate valves	Resilient-Seated Gate Valves, AWWA C515	WW-700
1		12 in dia pressure relief valve	Pressure Reducing Valves	WW-319
1		chlorine analyzer		
		Electrical room HVAC		
		pump room HVAC		
		ADA compliant restroom		
		pipe chase and floor drain sump pumps		
		Outdoor lighting		
		Indoor lighting		
		Outdoor cameras and motion detectors		
		Indoor cameras and motion detectors		
		building washdown hose stations		
		building grounding system		
		electrical switch gear		
		motor starters -soft start		
		electrical panels		
		instrument panels		
		lighting panels		
		pad mounted transformer		
500	ft	site paving - 20 ft. wide asphalt with ribbon curb		
		site drainage		
		clearing and grubbing		
		landscaping		
		retaining wall around tank		
		18 in dia altitude valve at the wastewater plant in vault		
		36 in dia check valve at the wastewater plant in vault	Swing Check Valves, AWWA C508	WW-123
		Misc electrical		

		Instruments - 4 pressure switches, 5 limit switches, 4 vibration transmitters, 4 temperature switches		

4.6.3 Design Criteria – Assumptions and Calculations

The Water Conservation Program's near-term, midterm, and long-term hydraulic models, discussed in Section 4, are used as the basis of the Montopolis pump station and storage reservoir design. To meet the projected future demands and the program's minimum operating criteria, a 4 MG storage reservoir and firm pump capacity of 6,000 gpm is needed at the Montopolis site. The model also set the approximate elevations of the reservoir close to 590 to 600 ft. elevation at the foundation and 630 to 640 ft. elevation for the full operating range needed to maintain targeted operating pressures in the pressure zone between the SAR WWTP and the Montopolis site. The proposed elevations have also been set in a range that is an acceptable operating head for the existing pumps at the SAR WWTP.

The Montopolis pumps are assumed to need a capacity approximately 2,000 gpm each at about 325 ft. of total dynamic head (TDH) in order to provide flow into the central service area.

4.6.4 Description of Design Concepts

4.6.4.1 Montopolis Pump Station

Figure 24 is a process and instrumentation diagram that schematically highlights main components of the pump station and how they are connected. It indicates how the flow is controlled and the options for how it can be directed.

The general design concept is to monitor the water level in the new Montopolis storage reservoir. When the water level in the Montopolis reservoir drops below a set level, the recycled water pumps at the SAR WWTP will be activated to fill the Montopolis reservoir. Once the full set point is reached, the SAR WWTP recycle pumps will be de-activated. This subsystem will serve the central low service area (highlighted in light blue on the system maps, Figures 1 and 2).

The long term plan for the Montopolis site's pump control is to monitor the water level at the 51st Street elevated storage reservoir and start pumps when the 51st Street reservoir needs water. This will occur once the north central service area and the south central service area are interconnected through a river crossing connection. In the interim the Montopolis pumps will be controlled by a set pressure range operating in conjunction with the surge tank. To minimize pump cycles, a pump with reduced capacity is recommended for this interim phase with space being maintained for the larger pump in the future.

Coming off of the pump discharge header is a pressure relief line that will allow pumped water to circulate back to the suction side of the pumps or to the storage reservoir if the pressure setting on the valve is exceeded. This assists in minimizing build-up of high line pressure due to a blocked pipe or inadvertently closed valve. It also allows maintenance and operations staff to run or test pumps without sending flow out to the system.

On this same header line there is a control valve that, if opened, allows flow from the central service area to fill the Montopolis storage reservoir, which then provides supply to the central low service area back from the central service area. This provides redundant sources to the central low service area, SAR WWTP or Walnut Creek WWTP through 51st Street reservoir.

Finally, for reservoir maintenance, there is a bypass line around the reservoir directly to the suction header.

A small mixer is planned for the reservoir to keep it mixed. This will assist in maintaining water quality. Based upon the information from the Utility Staff's operating experience, re-chlorination equipment is not needed at this time; however, connections into the reservoir will be designed so that if in an emergency or in the future chlorine can easily be added. An amperometric-type total chlorine analyzer will monitor the chlorine residual as it is pump out from the pump station into the central service zone.

Figures 26 and 27 show the preliminary layout of the pumps and header piping in the pump station building. The floor will be sloped and the equipment and pipe drains will be directed to sumps in the pipe gallery. Depending on the elevation of the grinder pump station, the sump may gravity feed into the grinder station or be pumped into the grinder station.

Having the pipes from the reservoir and the pump discharge enter and leave the building below grade and in a pipe chase allows assess around the pumps, pump control valves, and flow meters from two sides.

An overhead bridge crane is provided to assist in the maintenance and removal of the pumps and valves.

4.6.4.2 Pumps

Since the site has some natural slope and the pump building floor can be at a lower elevation than the storage reservoir floor, a centrifugal-type pump is recommended. The pumps will have a flooded suction and do not require a wet well or pump can to house the pump like a vertical-type pump requires. Many of Austin Water Utility's water system pump stations have centrifugal type pumps. Centrifugal pumps take more floor space because of the motor location, but the vertical pumps require more headspace so that the pumps can be removed from the pump can or wet well. The horizontal pumps have easier access to bearings, seals, couplings, and impellers than the vertical pumps. Pump efficiencies are similar between the types in the pressure ranges these pump will be operating.

4.6.4.3 South Austin Regional Wastewater Treatment Plant Reclaimed Water Pump Station

The South Austin Regional Wastewater Treatment Plant (SAR WWTP) has a reclaimed water pump station and elevated storage reservoir that currently supplies the plant with reclaimed water and the low central service area that includes the airport and the Hornsby Bend Biosolids Management Plant. As noted in the hydraulic analysis section, the hydraulic gradient at the SAR WWTP reclaimed water pump station must increase so that minimum operating pressures can be maintained to all of the projected customers in the low central service area. To accomplish this goal, modifications are required at the SAR WWTP reclaimed pump station to keep the existing storage reservoir from overflowing, yet continue to utilize the water in the reservoir and to maintain service at the plant at pressures it commonly needs.

Figure 28 highlights the recommended piping modifications at the SAR WWTP reclaimed elevated storage reservoir. A check placed on the 36 in. diameter tank outlet pipe will allow flow out of the tank to the low central service if the pressure drops below the tank water elevation and during a negative surge wave. As noted in the surge analysis this minimizes vacuum pressures on the reclaimed pipeline that result from a sudden power failure. Under normal operating conditions the check valve will be closed and keep the higher pipeline pressure for pushing water into the SAR WWTP elevated reservoir and overflowing it.

To elevated reservoir can still be used to supply the plant at the pressures it has been operating. The 12 in. diameter pipe feeding the plant non-potable water system must be relocated around the fill-valve so that the plant system will continue to utilize the water in the reservoir or "float" off the reservoir. A new altitude valve will be placed on the 24 in. diameter "fill-pipe" that will open to fill the reservoir as the plant uses the water.

The SAR WWTP reclaimed water system pump control sequence will be modified accept a level signal from the Montopolis storage reservoir to activate the pumps instead of the SAR WWTP elevated reclaimed water reservoir.

4.7 Instrumentation and Control System Design

The Process Instrumentation and Control (I&C) design consists of control and monitoring field instruments, Local Control Panel (LCP), Programmable Logic Controller (PLC), process control strategies, Supervisory Control and Data Acquisition (SCADA) communications, and SCADA integration associated with the Water Recycling Pump Station. The preliminary layout of these device interfaces is illustrated on Figures 24 and 25 – Preliminary Process and Instrumentation Diagram (P&ID) 1 of 2 and 2 of 2.

Primary criteria for the design of the electrical system are that it is safe, meets the capacity requirements of the pump station, reliable, provides desirable operational control, maintainable, and is economically reasonable. The following sections are a discussion of the codes and standards to be followed and individual electrical system elements as it relates to the primary design criteria listed above.

4.7.1 Codes and Standards

- ANSI 255.1, Gray Finishes for Industrial Apparatus and Equipment
- ICS 1, General Standards for Industrial Control and Systems
- IEEE Standard 142, Grounding
- IEEE C62, Transient Voltage Surge Suppression
- ISA S5.1, Instrumentation Symbols and Identification
- ISA S5.4, Standard Instrument Loop Diagrams
- ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves
- ISA S50.1, Compatible Analog Signals for electronic Industrial Process Instruments
- NEMA 250, Enclosures for Electrical Equipment (1,000 volts maximum)
- NEMA ICS-1, Industrial Control & Systems General Requirements
- NFPA 70, National Electrical Code
- NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- National Safety Fire Protection Code
- UL 508A, Standard for Safety, Industrial Control Panels
- UL 1449, UL Standard for Surge Protective Devices

4.7.2 Design Criteria

4.7.2.1 Field Instruments

The field instruments consist of a combination of components and devices specified under separate specification divisions and sections of the contract. Most field instruments will be specified under I&C sections and will follow the listed criteria under this Article. Other field instruments will be provided as part of packaged process systems such as the process surge system, individual process components such as valve actuators and electrical motor control equipment. During final design, the I&C design staff will work with engineers of these other systems so that their respective specifications is written around the criteria listed below for component specified as part of the I&C system. The instrumentation list will include as a minimum the following:

- Pressure Indicator – Pressure gauges will be provided in the design where shown on the P&ID and will include 4-1/2-inch diameter dial that is Glycerin filled for reduced pointer vibration al enclosed in a black thermoplastic housing. Pressure will be sensed using a Bourdon tube element to provide an accuracy of +/-0.50 percent. All wetted parts of the gauge will be stainless steel. The gauge will be stem mounted to the process piping using ½-inch male National Pipe Thread (NTP) and isolation ball valve.

- Pressure Indicating Transducer - with output of 4-20 maDC for full transducer's range, located on the pump station discharge header line for pressure monitoring. The sensing element will be 316 stainless steel diaphragm with integral temperature compensation. The instrument will be installed per the applicable mounting detail drawing. The transmitter will be loop-powered and shall have a local display calibrated in engineering units.

- Pressure Switch – monitor the pressure via a diaphragm actuated switch with a given pressure setpoint and switch reset when the pressure drops below the setpoint by either a fixed or adjustable deadband, depending on the specific application. The switch will be rated for 10 amps at 120 volt ac. The process connection will be a ¼-inch NPT female. The specification for the pressure switches will use Ashcroft, Type 400 B Series pressure switches as the basis of design.

    - Pump Discharge Valve Pressure Switch - This instrument will monitor the pressure between the pump and the pump discharge valve and provide a discrete signal via dry contacts to the respective pump motor controls to initiate the discharge valve to open as part of the pump start sequence. The instrument shall be installed per the applicable mounting detail drawing. In addition to the hardwired interlock, the switch shall provide a separate contact for tie-in to the PLC/RTU and local indication.

- Submersible Level transducer - Submersible level transmitters will be designed, manufactured, and tested according to the latest applicable sections of ANSI, ASTM, Hydraulic Institute, IEEE, ISA, NEC, NFPA, NEMA, UL and ISO9002 standards with an output of 4-20 ma DC for full transducers range and LCP mounted level indicator. The construction of the element will be specified to be able to withstand an overpressure event twice the full scale range of the installation.
    - Reservoir Level - This instrument shall be used to monitor the reservoir level. The sensing element shall be of the differential pressure type, ANSI 316SS construction. The instrument shall be installed per the applicable mounting detail drawing. The transmitter shall be loop-powered and shall have a local display calibrated in engineering units. The transmitter shall provide a 4-20mA signal for tie-in to the PLC/RTU.
    - Redundant Reservoir Level - In critical reservoir locations, a redundant reservoir level sensor and indicator shall be installed. This redundant level instrument shall be of the same type and construction as the standard reservoir level, but shall be installed in a physically separated location. The instrument shall be installed per the applicable mounting detail drawing.
- High Reservoir Level Alarm - A float will be used to detect high reservoir level. This instrument is in addition to the analog level alarm generated by the PLC. Tilting float level switches will use the tilting movement of a float whose specific weight is less than that of the process liquid, to actuate switches as the level changes. The switch(es) will be integrally mounted in the float and connected to a junction box by an appropriate waterproof cable. The float switches will not contain mercury. A movable weight is to be mounted on the cable to allow adjustments of the setpoint(s). Flow Element and Meter – The flow element shall be a venturi. The preferred venturi is Primary Flow Devices model HVT. The flow meter will be specified as a differential pressure transmitter with an output of 4-20 maDC for full transducer's and flow element range. The sensing element will be 316 stainless steel. The transmitter will be loop-powered and shall have a local display calibrated in engineering units.
    - Individual Pump Flow (for pumps with capacity above 1000 gpm) - This instrument shall measure the individual flow at the discharge of each pump. The transmitter's 4-20mA signal will tie directly to the PLC/RTU.
    - Station Flow Rate Meter - This instrument shall measure the combined flow out of the pump station. The transmitter's 4-20mA signal will tie directly to the PLC/RTU.

Some devices that will interface with the pump station control system and that are not being specified under the I&C specifications are listed below:

- MCC pump starter instrumentation - installed on the MCC pump starter control panel will include, but not limited to: Emergency Stop push button, hand switches, status and alarm lights.
- Pump Discharge Valve – Electrically Operated, Open / Close 480VAC with valve fully opened/ fully closed and 95-percent closed limit switches.
- Motor control equipment will be provided with the ability to monitor pump motor power via Modbus communications port on PLC. In addition, the power distribution system within the control panel will be provided phase failure monitoring for alarm and to disable pump operation.
- Pump Motor Vibration Transmitters (for pumps and motors above 100 HP) - These instruments shall monitor vibration of each individual pump. The vibration transmitter shall provide 4.20 mA output when vibration

exceeds preset/calibrated parameters. The velocity sensing element shall be integrated into the transmitter as recommended by the individual pump manufacturer. The instrument shall be installed per the applicable mounting detail drawings.

- Pump Motor Temperature Sensors (for pumps with motors greater than 100 HP) - These instruments shall monitor the temperature at selected locations of the individual pumps, such as bearing temperatures and motor winding temperatures. The temperature sensors shall be manufacturer installed, and shall monitor motor winding temperature and pump bearing temperature at a minimum. The sensing element shall be platinum; 100 ohms wire RTD's. A RTD measurement module shall be provided to monitor the installed RTD, and shall measure and transmit each measured temperature continuously. The measurement module shall have a local display calibrated in engineering units, capable of displaying each temperature measurement via operator selectable switches. The instrument shall be installed per the applicable mounting detail drawings.

- Station Power Monitoring (Indoor) - The preferred instrument shall be a member of the GE MultiLIN family, capable of measuring power consumption, energy consumption, and power factor (if applicable). The device will also provide indication of several alarm conditions. The instrument shall communicate with the Facility PLC via a dedicated Ethernet network. The instrument shall have a local display calibrated in engineering units.

- Individual Pump Power Monitoring - This instrument shall monitor the individual power consumption of each pump. The preferred instrument shall be a member of the GE MultiLIN family, capable of measuring power consumption, energy consumption, and power factor (if applicable). The device will also provide indication of several alarm conditions. The instrument shall communicate with the Pump PLC (or to Facility PLC if not using individual Pump PLCs) via a dedicated Ethernet network. The instrument shall have a local display calibrated in engineering units.

- Flood Switch - A tilt float switch shall monitor a high sump level and high-high sump level (where applicable), at installations where applicable. The float switch shall provide a dry contact alarm output when activated. The float switch shall be installed at a level above the normal sump pump on set point, and shall be installed per the applicable mounting detail drawing.

- Station Temperature Indicating Transducer - Provide an RTD temperature sensor that monitors building temperature and connect it to the PLC/RTU for remote monitoring.

- Security switches - Installed on each LCP cabinet door will be a security switch with a dry contact output for intrusion detection and alarming purposes.

- Security System - A common alarm (dry contact) will be provided and wired from the security system (panel) to the PLC/RTU as a back-up in the event of the network link to the security system fails.

4.7.2.2 Local Control Panel

The pump station design will be provided with a local control panel (LCP). The LCP will house the Local Operator Interface (LOI), the pump station master PLC, pump station emergency stop and reset and associated terminal blocks for the termination of field conductors in the panel.

The pump station will be designed to have all local monitoring and control of pumps and related equipment provided via an electronic LOI and will communicate with the local master PLC. The LOI will utilize graphic displays as the interface with the process equipment of the pump station. The design of the LOI will consist of a touch-screen interface to allow the operator to select objects on the screen, with a minimum of 120 pixel-based touch cells that supports a minimum of 256 colors, includes a library of graphic symbols to use for display generation, multi-level security password protection for configuration and operation and communicates over Modbus, and Modbus TCP Ethernet. The LOI will be specified around Schneider Electric’s 15” Magelis touch screen, Model XBT GT, with Vijeo Designer graphics software.

Graphics displays will be specified to be developed in order to allow a local operator to fully monitor and control the pump station the LOI display. The intent of the system displays is to provide a simple portrayal of system status, not to duplicate the OaSys displays. The development of all graphic screens will be required to follow the latest version of the City of Austin, Water Utility, Systems Integration Design Guide.

The specification for graphic displays will include requirements for a site overview, indicating instrumentation and equipment status and alarm conditions and popup displays for all controlled equipment; all local controls will be accomplished via the popup display. The site overview screen will provide a means for setpoint data entry, duplicating the remote supervisory set points provided by the SCADA system. Additionally, the LOI is to include displays for PLC status, as well as communications data between the operator interface display and the pump station master PLC (as Master or RTU Controller/data and communication concentrator), between the pump station master PLC and the PLCs installed with individual pump motor controls, and all pump station PLCs and the SCADA system.

4.7.2.3 Programmable Logic Control Equipment

PLCs specified for this project will be of Schneider Electric's Modicon product line. Per City standards, the PLC architecture of pump stations with pump motor greater than 200 horsepower will have a pump station master PLC located in the pump station LCP and individual PLCs install in each pump motor control enclosure. In general, Quantum PLCs will be specified for the master PLC and M340 PLCs for individual pump control. Guidelines for developing the specification of individual PLC modules are as follows:

- CPU: RTUs shall support not less than 48K sixteen bit words user memory. The actual amount of user memory provided shall be adequate for the specified functions plus an allowance of 100 percent for future expansion. Addressing capability will not be less than 1000 discrete and/or analog input/output points in any mix and located in up to 32 separate chassis. Individual dedicated power supplies will be specified for each CPU. The Executive program and instruction set will be held flash memory, with the capability to flash a new Executive into the CPU. The CPU shall use flash memory or battery-backed RAM to store application programs. The CPU module will be specified to include network connections for Modbus and Ethernet. The Modbus port for communicating to the SCADA system radio and the Ethernet port for communications to other pump station Ethernet-based equipment and devices.
- Input/Output (I/O) Modules: Each I/O assembly shall be an addressable unit complete with power supply, communication interface, and plug-in I/O modules. Each physical I/O drop shall be capable of containing a minimum of 30 input words and 30 output words. The actual number of fully operational I/O points and fully implemented spare I/O points will be based on the specific needs of the pump station and will be shown on the I/O List and on the drawings. All spare I/O will be specified to be completely wire out within the LCP. Spare I/O points, I/O card slots shall be specified with a minimum of 20 percent for each and power supplies will be sized to accommodate all spare capacity.
    - Discrete Isolated Inputs (DI) - The design of the I&C system will be based on the PLC monitoring status and alarm "dry" contacts. The wetting voltage will be provided from an independent sensing power supply in the LCP and the PLC will have DI modules which support the use of AC and DC sensing voltage. For DC sensing, the voltage applied across field device open contacts will be in a nominal range from 24 to 48 VDC. For AC sensing, the voltage applied across field device open contacts will be 120 VAC (nominal). The input module will have individual status light for each input and shall have barrier type terminal blocks for termination of the field wires. There shall be a minimum of 8 points per module. The module shall be constructed such that the field wires do not have to be removed while replacing the module. Surge protection shall meet ANSI/IEEE C62 requirements.

    - Isolated Contact Output (DO) - The discrete output cards will process the control commands from the PLC logic in the form of discrete outputs via isolated, double-ended, dry form C contacts or isolated, double-ended triac outputs. All discrete outputs will be rated for 120 VAC or 30 VDC, 5 amps, continuous at 60 Hz, 140 degrees F ambient. There shall be a minimum of 4 points per module.

- Analog Input (AI) and Analog Output (AO) – AI and AO signals will be specified as 4 to ma DC of the differential type capable of interfacing to two-wire loop power devices or four-wire field power devices. AO points will be capable of driving a minimum of 600 ohms. Analog modules will be specified to have a minimum digital resolution of 12 bits plus sign and a relative accuracy of 0.1 percent of full scale for AI and 0.2 percent of full scale for AO. The design will be based on a minimum of 4 AI points per module and 2 AO points per module.

4.7.2.4 Wire Tagging

All conductors will be identified by a system of unique numbers. In general, all wiring shall be tagged at all termination points and at all major access points in the electrical raceways. A termination point is defined as any point or junction where a wire or cable is physically connected. This includes terminal blocks and device terminals. A major access point to a raceway is defined as any enclosure; box or space designed for wire pulling or inspection and includes pull boxes, manholes, and junction boxes.

Wire tags shall show both origination and destination information to allow for a wire to be traced from point to point in the field. Information regarding its origination shall be shown in parenthesis.

Single conductor wire Tag format to use for single conductor wire tags. Tag information identified as Xs refers to the termination point where the tag is being read. Tag information identified as Ys in parenthesis refers to the location of the other end of the conductor or the point of origination.

XXXX XX (YYYY-YYYY-YYYYY /YYYYY YY)
Device Identifier, Terminal No. (Equipment Tag No.*/Device Identifier, Terminal No.)
*For wiring within a piece of equipment, control panel, junction box, etc., the Equipment Tag No. is not required, only the Device Identifier and Terminal Number from the point of origination.

Tag Example

For a wire connected from Terminal block 1 terminal 23 to relay CR1 terminal 9, the correct tag would be TB1-23(CR1-9) at the terminal block and CR1-9(TB1-23) at the relay.

The Device Identifier uniquely identifies a device within a piece of equipment. Examples are: TB1, for terminal block number 1 and CR02, for control relay # 02. For existing equipment, refer to existing device tags or labels and/or equipment documentation. For missing tags or new equipment, refer to the standards developed by EIC Division.

The Terminal Number along with the Device Identifier, identify which specific point in the equipment the wire must be terminated. For a terminal block, the terminal number is specific number of the terminal. For instruments and equipment, refer to manufacturer's labeling or record drawings for the specific terminal number or in some cases the terminal may be identified with a letter or letters.

The Equipment Tag Number is the physical tag attached to the equipment. For existing equipment, please refer to the Facility in question. New or missing equipment tags will utilize the City of Austin standard for equipment and instrument tagging.

The device identifier and terminal number is the same as in a single wire tag above and it describes what device and terminal number the wire is to be terminated to.

Wire tag specification will be based on the yellow heat shrink type "Raychem" with the tag numbers typed with an indelible marking process. Character size shall be a minimum of 1/8" in height. Hand written tags will not be acceptable. Tags will be specified to not be heat shrunk unless specifically authorized by owner.

4.7.2.5 Equipment and Instrument Tagging

Equipment and instrument tagging will follow the latest AWU tagging criteria. It is our understanding that present criteria are being updated.

4.7.2.6 Transient Voltage Surge Suppression

Surge Protective Devices (SPD) will be specified for the electrical distribution system including the main service, distribution, motor control equipment and branch circuit panelboards per the recommendations of IEEE C62.41.1, C62.41.2, and C62.45 and compliant with UL 1449. In addition, SPD associated with individual control and instrumentation devices will be specified for nearly all equipment that is located outside of a building and on circuits to some equipment that is located inside of the control system enclosures. Connection of the SPD equipment will be made to a low impedance grounding system and will be coordinated with the electrical system design. Coaxial cables shall be provided with lightning arrestor / surge protection as the cable enters the cabinet with Innovative Technologies surge protection devices being the basis of the specification.

4.7.3 Description of Design Concepts

4.7.3.1 Process Control Strategies

The primary control at the station is based around the monitoring and control of individual pumps and will require additional input and interlocks associated with control and monitoring of other devices at the pump station. These devices include tanks level monitoring, discharge valve control, discharge pressure, pump discharge flow, control signals for the SCADA system, pump and motor vibration, motor temperature and bearing temperature. These devices will affect the logic associated with the logic for starting, operating and shutdown of the pump motors.

Pump and pump motor operating characteristics and parameters will be monitored by a digital motor management relay, with the General Electric Multilin SR 469 as the basis of design. Control and other operator interface devices, including those listed below, will be mounted on an inner dead-front panel door of the soft start enclosure:

- Hand-Off-Auto (HOA) selector switch;
- Emergency Stop pushbutton;
- Red-Pump on indicating light;
- Green-Pump off indicating light;
- Yellow-High temperature alarm;
- Yellow-Over load alarm;
- Yellow-Moisture Detection alarm;

The Auto mode of operation is based on a RUN command provided through the SCADA system. Pump protective devices will be hardwired to the soft starter for equipment and personnel protection. These devices include Motor Overload, Emergency Stop, Valve Positions Not Confirmed, High Pump Vibration, High Motor Winding Temperature, High Pump or Motor Bearing Temperature and High Discharge Pressure. The Hand mode of operation will initiate the pump start sequence and the pump will continue to run until the selector switch is taken out of the hand position or a pump protective device has detected an adverse condition or the emergency stop button has been pressed.

When the run command is received or the selector switch has been placed in the hand position, the pump controls will start the pump motor if none of the protective devices have been tripped, and the pump discharge valve indicates full closed position. As the pump accelerates to rated speed and the discharge pressure switch closes, the pump discharge valve is given an OPEN command and begins to open. The pump controls will monitor the progress of the pump discharge valve opening and if the valve does not indicate fully opened within a predetermined time, the pump start sequence is stopped, pump motor RUN command is removed, the discharge valve is given a CLOSE command and an alarm is sent to the SCADA system.

When the run command is removed or the selector switch is taken out of the hand position, the pump controls will begin the shutdown sequence of the pump by commanding the discharge valve to close. The pump motor will continue to run as the discharge valve transitions close until the 5-percent open limit switch is reached and then the pump motor is shut off.

4.7.3.2 SCADA Communications

SCADA communication to the pump station will be based on the communication radio path study presently being performed. Radio equipment, antenna, antenna mast and cables will be provided based on the results of this study.

4.7.3.3 Security System

The security system will be designed in accordance to Austin Water Utility's general standards and specifications for pump station security systems. As described in the Utility's Pump Station Design Guide, an allowance will be provided in the bid documents that will be used by the general contractor to" hire a Security System Integrator, as directed by the Owner, to install turnkey the electronic security system based on the drawings and specifications that were developed separately."

4.8 Electrical Design

The electrical design consists of a power distribution system associated with the Montopolis WRI Pump Station. This includes an electric utility service, motor controls, power feeders, lighting, conduit, and conductors.

The design for electrical service feeder to the pump station will be undertaken by Austin Energy, the serving electrical utility. Some portion of Austin Energy's design will need to be provided by Austin Water Utility and included in the contract package for the construction of the pump station. The details of the division on equipment and services to be provided under this contract will be coordinated with Austin Energy early in the design phase of the project. For the preliminary engineering phase, it has been assumed that power can be made available at the pump station at 480 volts.

Because this is a reclaimed water system that will have the ability to feed the system from two sources, Walnut Creek WWTP pump station and SAR WWTP pump station, that have back-up power, the Utility has indicated that a back-up generator or power supply is not needed at the Montopolis pump station.

The pump station, from an electrical load prospective, consists of pumps, pump discharge valves, HVAC loads, discharge flow meter(s), discharge water pressure transmitter, reservoir level transmitter, lighting, security, and convenience receptacles. The power distribution and controls for the pump station will include the following elements to serve and control the described loads and transmit status to the SCADA system:

- Electrical Service Equipment
- Power Distribution Equipment
- Branch Circuits
- Motor Control Starter
- Raceway System
- Conductors
- Junction Boxes and Enclosures
- Lighting
- Wiring Devices
- Grounding
- Transient Voltage Surge Suppression

Primary criteria for the design of the electrical system are that it is safe, meets the capacity requirements of the pump station, is reliable, provides desirable operational control, is maintainable, and is economically reasonable. The following sections are a discussion of the codes and standards to be followed and individual electrical system elements as it relates to the primary design criteria listed above.

4.8.1 Codes and Standards

- ANSI C68.1, Techniques for Dielectric tests
- ANSI C80.1, Rigid Steel Conduit
- ANSI C80.4, Fittings and Supports for Conduit and Cable Assemblies
- ANSI C80.5, Rigid Aluminum Conduit

- ANSI/IEEE Std 141, Motor Control Equipment
- ANSI 255.1, Gray Finishes for Industrial Apparatus and Equipment
- IEEE Standard 142, Grounding
- IEEE C62, Transient Voltage Surge Suppression
- NEMA AB-1, Molded-Case Circuit Breakers, Molded Case Switches, And Circuit-Breaker Enclosures
- NEMA 250, Enclosures for Electrical Equipment (1,000 volts maximum)
- NEMA ICS-1, Industrial Control & Systems General Requirements
- NEMA RN 1, PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
- NEMA TC2, Electrical Plastic Tubing (EPT) and Conduit (EPC-40)
- NEMA TC3, PVC Fittings for Use with Rigid PVC Conduit and Tubing
- NFPA 70, National Electrical Code
- NFPA 820, Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- National Safety Fire Protection Code
- UL 98, Enclosed and Dead-Front Switches
- UL 489, Molded-Case Circuit Breakers, Molded-Case Switches And Circuit-Breaker Enclosures
- UL 5, Safety standard for Surface Metal Raceways and Fittings
- UL 614, Electrical Rigid Metal Conduit
- UL 360, Liquid-tight Flexible Steel Conduit
- UL 514A, Metallic Outlet Boxes
- UL7 514B, Conduits, Tubing and Cable Fittings
- UL 651, Schedule 40 Rigid PVC Conduit
- UL 845, Motor Control Centers
- UL 1449, UL Standard for Surge Protective Devices

4.8.2 Design Criteria

4.8.2.1 Electrical Service Equipment

The local electrical utility provider, Austin Energy, as discussed above, will provide electric service to the pump station at 480-volt, 3-phase to meet the voltage requirements of the selected pump motor. It is anticipated that the utility will distribute power to the site overhead and will provide an underground medium voltage lateral to a Utility owned pad mounted transformer and then a 480-volt service lateral from the pad mounted transformer to the electrical service equipment provided under this project. The electric service equipment will consist of a utility conductor landing section, metering section and a main breaker. All of these devices will be designed based on Austin Energy's electric service guidelines.

4.8.2.2 Power Distribution Equipment

The power distribution equipment will consist primarily of the main service disconnect breaker, power distribution switchboard, small power transformer and low voltage power distribution panel. The small power transformer is a 480-volt to 208Y/120 dry type transformer being fed from the switchboard to provide power to the low voltage power distribution panel (panel). The panel consists of 208/120-volt, 3-phase main breaker and individual branch circuit breakers sized to serve the loads of the lighting, field instrumentation, portions of the HVAC system and general receptacle loads.

The switchboard will be sized to provide power to the four recycled water pumps, HVAC equipment, the small power transformer and other ancillary loads requiring 480-volt, single- and three-phase loads. Breaker and feeder sizing will be based on the serving load and the associated recommendation of the manufacturers and NEC Articles 220, 225, 430, 440 and 450.

The panel will be installed as necessary to provide power to the 120-volt, single-phase and 208-volt, single- and three-phase loads. Branch circuit breakers will be sized in accordance with applicable paragraphs of Articles 210, 220, 225, and 430 of the NEC. Where Article 220 allows the use of demand factors, they will be used with caution. Demand factors may be used for feeder and transformer sizing calculations but not branch circuit calculations.

4.8.2.3 Branch Circuits

The load on branch circuits that supply pump motor, field instruments, HVAC, lighting and receptacles, where applicable, will be limited to 80 percent of the rating of the branch circuit protective device, per Article 220-3 of the NEC, because lighting and receptacle loads must be considered "continuous." Branch circuit breakers for instruments, instrumentation panels, etc. where the exact load is unknown but is small will be sized at 15 amps to allow installation of multiple conductors to be installed in the same conduit without the need for de-rating. In addition, these circuits may pass through an instrument panel and become No. 14 AWG control conductors.

A separate branch circuit will be provided for each instrument and instrumentation panel. Branch circuit protective devices will be rated 15 amps unless a larger size is required to supply the load. The design will make an effort to group circuits that perform a common function together within a panelboard (i.e., all lighting together, all receptacles together, etc.). In addition, three- and four-wire branch circuits will be utilized wherever they are appropriate to minimize the amount of conduit that is required. These circuits will be connected to adjacent circuit breakers in the panelboard. Where a common neutral is used for multi-wire branch circuits, the neutral size will be increased to account for third-harmonic, neutral-current generated by non-linear loads such as computers and other similar devices. Extra space and spare breakers will be provided in all 208/120-volt panelboards.

4.8.2.4 Motor Control Equipment

Motor starters can be broadly divided into two categories: full-voltage and reduced-voltage. The primary consideration for selecting either a full-voltage or reduced-voltage starter is the ability of the serving utility system to handle full-voltage starting of the pump motor. Based on the proposed pump motor ranging from 250 to 300-hp, it is anticipated that reduced-voltage motor starters will be required. At this time, the use of autotransformer type reduced-voltage starting (RVAT) is expected to be the basis of design. The specific pump-motor starting requirements and associated available short circuit current will be determined as part of the final design to account for any possible changes that take place in the utility's electrical distribution system between the completion of this preliminary design effort and the time of final design.

The control of the pump will require additional input and interlocks associated with control and monitoring devices at the pump station. These devices include tank level monitoring, discharge valve control, discharge pressure, control signals for the SCADA system, pump and motor vibration, motor temperature and bearing temperature. These devices will affect the logic associated with the hardwired logic for starting, operating and shutdown of the pump motor. Pump and pump motor operating characteristics and parameters will be monitored by a digital motor management relay and use the General Electric Multilin SR 469 as the basis of design. Control and other operator interface devices, including those listed below, will be mounted on an inner dead-front panel door of the soft start enclosure:

- Hand-Off-Auto (HOA) selector switch;
- Emergency Stop pushbutton;
- Red-Pump on indicating light;
- Green-Pump off indicating light;
- Yellow-High temperature alarm;
- Yellow-Over load alarm;
- Yellow-Moisture Detection alarm;

4.8.2.5 Raceway System

Because of the relatively small number of field devices and loads and physical nature of the pump station, the raceway system on this project will be a conduit system to protect electrical conductors between individual devices and loads. Conduit is available in a variety of materials, but the ones most often used for applications on this project are Schedule 40 PVC, galvanized rigid steel conduit (GRS), PVC-coated galvanized rigid steel conduit, intermediate metal conduit (IMC), rigid aluminum conduit, liquid-tight flexible metal conduit (flex), and liquid-tight flexible non-metallic conduit.

For the applications on this project, Schedule 40 PVC will be used for underground conduit. Where conduits transition from underground to above grade, the schedule 40 PVC conduit will transition to PVC-coated GRS conduits, including all bends 45-degrees and greater, vertical conduits and where conduits transition through concrete with a minimum of 24-inches on each side. Underground duct bank spacers will be specified every 5-feet or less along the entire length of the duct bank. A 6-inch wide metal detectable polyethylene tape will be installed 10-inches above the top of all duct banks.

GRS will be used in exposed conduit runs due to its ability to withstand physical abuse and the relative corrosion resistance needed at the site. Where additional corrosion resistance is needed for a specific application PVC-coated GRS conduit would be used, but based on the initial assessment, there are no areas that warrant this type conduit. Associated support of exposed conduit systems will be 316-stainless steel for GRS and PVC-Coated GRS conduits. In addition, connection to field devices and motor will be made with the use of liquid-tight flexible non-metallic conduit or liquid-tight flexible metal conduit (flex) with the lengths limited to 3-feet.

Conduits will be routed exposed or under the floor slab wherever possible. The use of conduits embedded in floor slabs will be avoided. Embedded conduits will be limited to small sizes, and only used when absolutely necessary. Layout of any embedded conduits will be coordinated with structural engineer. Articles 345, 346, 347, 348, and 351 of the NEC contain additional information pertaining to the installation of conduit systems and will be consulted during design. All duct systems will be designed with 20-percent spare conduit capacity sized similarly to other conduits making up the duct system.

Equipment mounting, raceway support, and support material will be made of 316 stainless steel, including support channel, anchors, fasteners, and clamps. Conduits will be supported every 8-feet or less and within 3-feet of all boxes, condulets and conduit material transitions.

4.8.2.6 Conductors

The minimum size conductor to be used for control circuit will be No.14 AWG. The minimum conductor size for lighting and receptacle circuits will be No. 12 AWG. All power conductors will be stranded copper conductors for all circuits except for grounding conductors where solid or stranded may be used. The conductors will be PVC insulated, and have a nylon jacket per UL 44, UL 1685 and NEMA WC70, type THWN-2/THHN-2/MTW. Where multiple control conductors are required between two devices, panels or terminal junction boxes, a multi-conductor control cable will be installed. Multi-conductor controls cables will be constructed using UL 44, UL 1685 and NEMA WC70, type THWN-2/THHN-2/MTW single conductors bound together in a single assembly with a PVC jacket. The assembly will be manufactured in accordance with UL 1277.

The minimum size conductor to be used for instrument analog signal circuits and other low voltage discrete dc circuits will be No. 16 AWG. These conductors will be installed as twisted shielded pairs (TSPs) and/or triads (TSTs) as may be required for the specific installation and application. A TSP will consist of two Number-16 stranded, 600 volt, copper conductors with PVC insulation and a bare copper drain wire twisted together within a conducting shield and a flame-retardant, sunlight and oil resistant, TC rated, 35 mil PVC jacket. A TST will be similar in arrangement except that it will contain three No. 16 insulated stranded conductors. Cables with 300-volt insulation may be used within control panels when the interior voltage is 208 volts to ground or less.

As a general rule, no conductor, regardless of voltage, should be spliced, but there are certain situations where splices and terminations will be required. Low-voltage power conductors in lighting and receptacle circuits may be spliced using UL-listed insulated, twist-on spring connectors (wirenuts). Connection of conductors to process equipments, control elements, and instruments will be made with approved compression type connectors when terminals are not included with the equipment. Final terminations at motors and similar equipment where removal of the equipment for maintenance can be expected should be made with approved bolted connection. All splices and termination will be insulated using heat-shrinkable sleeves that provide an insulation level at least equal to that of the conductor.

Splices will not be allowed in control and instrumentation circuit conductors. Where splices are required, they will be made on terminal strips in a junction box (terminal junction box). Control conductors and cables will be terminated at box lug type terminal blocks rated 600 volts. Instrumentation conductors and cables will be terminated using locking forked tongue lugs and screw type terminals as previously mentioned.

All conductors will be identified by a system of unique numbers. In general, all wiring shall be tagged at all termination points and at all major access points in the electrical raceways. A termination point is defined as any point or junction where a wire or cable is physically connected. This includes terminal blocks and device terminals. A major access point to a raceway is defined as any enclosure; box or space designed for wire pulling or inspection and includes pull boxes, manholes, and junction boxes.

Wire tags shall show both origination and destination information to allow for a wire to be traced from point to point in the field. Information regarding its origination shall be shown in parenthesis.

Single conductor wire Tag format to use for single conductor wire tags. Tag information identified as Xs refers to the termination point where the tag is being read. Tag information identified as Ys in parenthesis refers to the location of the other end of the conductor or the point of origination.

XXXX XX (YYYY-YYYY-YYYYY /YYYYY YY)

Device Identifier, Terminal No. (Equipment Tag No.*/Device Identifier, Terminal No.)
*For wiring within a piece of equipment, control panel, junction box, etc., the Equipment Tag No. is not required, only the Device Identifier and Terminal Number from the point of origination.

Tagging Example

For a wire connected from Terminal block 1 terminal 23 to relay CR1 terminal 9, the correct tag would be TB1-23(CR1-9) at the terminal block and CR1-9(TB1-23) at the relay.

The Device Identifier uniquely identifies a device within a piece of equipment. Examples are: TB1, for terminal block number 1 and CR02, for control relay # 02. For existing equipment, refer to existing device tags or labels and/or equipment documentation. For missing tags or new equipment, refer to the standards developed by EIC Division.

The Terminal Number along with the Device Identifier, identify which specific point in the equipment the wire must be terminated. For a terminal block, the terminal number is specific number of the terminal. For instruments and equipment, refer to manufacturer's labeling or record drawings for the specific terminal number or in some cases the terminal may be identified with a letter or letters.

The Equipment Tag Number is the physical tag attached to the equipment. For existing equipment, please refer to the Facility in question. New or missing equipment tags will utilize the City of Austin standard for equipment and instrument tagging.

The device identifier and terminal number is the same as in a single wire tag above and it describes what device and terminal number the wire is to be terminated to.

Wire tag specification will be based on the yellow heat shrink type "Raychem" with the tag numbers typed with an indelible marking process. Character size shall be a minimum of 1/8" in height. Hand written tags will not be acceptable. Tags will be specified to not be heat shrunk unless specifically authorized by owner.

4.8.2.7 Junction Boxes and Enclosures

Junction boxes and pull boxes will be provided to facilitate the combination of multiple circuits into a single conduit and the pulling of conductors and cables. They will be sized as required by the NEC to accommodate the conductors and cables being installed and should be constructed of a material suitable for the environment where they will be located. Two sizes of boxes are discussed: device boxes used as junction and pull boxes, and boxes that must be larger than device boxes. Junction and pull boxes will be shown on the drawings as required in the conduit system to group conductors, terminate cables, etc.

Junction boxes to be installed outdoors will be rated as NEMA 250, Type 4X constructed of 316 stainless steel or aluminum. The maximum aluminum box size shall be 12” X 12” X 6”. All junction boxes shall have piano hinged doors with quarter turn screw latch as provided with the Hoffman Concept series boxes. Small boxes will be cast metal with suitable accessories for wet locations. Boxes will be installed in such a way as to protect them from physical abuse either by locating them out of harm's way or installing them behind a removable barrier.

The term "terminal junction box" (TJB) will be a term applied to junction boxes that contain terminal strips for the termination of control conductors, small power conductors, or instrumentation cables. They will be constructed using a junction or pullbox that is suitable for the area where it is to be installed and contains terminal strips that are suitable for the conductors to be terminated. TJB cabinets shall have removable doors (lift-off) not more than 30 inches wide, and shall be equipped with a three point locking latch handle.

All outlet and switch boxes are to be one piece construction and be provided with covers of the same manufacture as the boxes. The type of cover selected must meet the conditions imposed in every case. Outdoor receptacle covers shall be While-In-Use Covers per N.E.C. Surface mounted or outdoor boxes shall be Die Cast Aluminum, 100% copper-free. The basis of design for these boxes will be “Crouse-Hinds” type FS-SA and FD-SA. Flush mounted boxes will be stamped metal masonry boxes sized with excess capacity of 1-gang of the number of devices installed. Extension ring covers will not be allowed.

4.8.2.8 Lighting

The area of the site will be illuminated with high-pressure sodium (HPS) area lighting fixture(s) with minimum levels of 0.2 to 2 foot-candles as recommended by the IES for security lighting. The specific objective is to provide appropriate lighting so that anyone moving in or around can be seen easily. The type light will be based around the “Hubble, Night Watchman” 250 watt, high pressure sodium with integral photo cell. Additional lighting will be provided within the pump building to achieve a minimum of 30 foot-candles to allow proper lighting for operations and maintenance personnel activities. Color-corrected lamps will be provided for all HPS light fixtures. In addition, where switchgear enclosures are greater than 18 cubic feet and larger will be provided a switch controlled internal fluorescent light.

4.8.2.9 Grounding

Electrical circuits, equipment, and equipment enclosures will be bonded and grounded as required by Article 250 of the NEC. References to be used in designing grounding systems should include the following:

- NFPA 70--The National Electrical Code
- IEEE Standard 142--IEEE Recommended Practices for Grounding of Industrial and Commercial Power Systems

Electrical distribution systems can be either ungrounded (no intentional ground) or grounded (intentionally grounded). All of the electrical system associated with this project will be grounded. For the purposes of this memo, a grounded system will be a system of conductors in which at least one conductor or point is intentionally solidly grounded. The basic reasons for system grounding are the following:

- To limit the difference of electric potential between all un-insulated conducting objects in a local area.
- To provide for isolation of faulted equipment and circuits when an electrical fault occurs.
- To limit over voltages appearing on the system under various conditions.

Low-voltage 480/277 and 208/120-volt, wye-connected three-phase and 120/240-volt, single-phase transformers must have their neutral solidly connected to ground. This ground connection should be of sufficient size and low enough impedance to effectively ground the low-voltage distribution system.

A grounding electrode system will be provided for the pump station as required by the NEC. The grounding electrode system will be used for grounding of the neutral of the low-voltage power supply and the equipment ground conductors. Each item within the electrical system will be bonded together by a bonding conductor sized in accordance with the requirements of the NEC. Where made electrodes are included in the grounding electrode system, they will be 3/4-inch by 10-foot (minimum) copper-plated steel rod (copperweld or equal). Grounding rings or loops will be provided around appropriate equipment and electrical system to assure the pump station is maintained upon an equal potential plane and will be construction of tin plated bare copper #3/0 or larger conductor. Article 250-81, of the NEC, requires that metal underground water pipes, metal frames of buildings (where effectively grounded), concrete-encased electrodes (embedded rebar), and grounding rings, in addition to any made electrodes, will be bonded together to form the grounding electrode system. The transformer associated with the low voltage power distribution panel will be connected to the grounding electrode system to create a separately derived source per Article 250 of the NEC.

The NEC requirement for equipment grounding is covered in Article 250. Noncurrent carrying metal parts of all fixed equipment likely to become energized will be grounded. The equipment grounding connection will be provided by an equipment grounding conductor sized in accordance with Table 250-95 routed with the phase conductors. Use of the raceway system for grounding will not be used and is not acceptable, but all metallic segments of the raceway system must be bonded to the equipment grounding conductor installed in it.

4.8.2.10 Transient Voltage Surge Suppression

Surge Protective Devices (SPD) will be specified for the electrical distribution system including the main service, distribution, motor control equipment and branch circuit panelboards per the recommendations of IEEE C62.41.1, C62.41.2, and C62.45 and compliant with UL 1449. The SPD will be designed for critical loads at service equipment (IEEE C62.41, Category C3/B3) or distribution panelboard (IEEE C62.41, Category C2/B3) locations. Unit will utilize voltage-matched Silicon Avalanche Suppressor Diode (SASD) technology. Unit will utilize modular type, plug-in suppressor design for ease of maintenance. The SPD equipment will limit the maximum clamp voltage line-to-line or phase-to-neutral per UL 1449 at 400 volts for 208Y/120 three phase and 120 volts single phase, and 800 volts for 480Y/277 and 240 volts three phase systems.

SPD associated with individual control and instrumentation devices will be specified by our I&C designers for nearly all equipment that they locate outside of a building and on circuits to some equipment that is located inside of the control system enclosures. Connection of the surge protection equipment to a low impedance ground is critical to its operation. Where multiple devices are located in close proximity, a common ground will be utilized to minimize potential differences between devices. Ground conductor length will be kept to a minimum and the conductor size will be the largest practical.

All equipment within close proximity that is equipped with surge protection will be grounded by a single ground conductor (single point) and a short length of larger ground conductor, # 6 AWG minimum, between the single point ground and the individual surge suppressors. The equipment ground conductor in the branch circuit supplying the equipment may not provide adequate grounding if the equipment is a long distance from the power supply.

4.8.3 Description of Design Concept

4.8.3.1 Preliminary Load Table

The Table 5 below establishes the power requirements for the pump station based upon the preliminary equipment components listed in section 5.6, Mechanical Design, and the building space layout:

Table 5. Preliminary Power Requirements.

Description	Size/Type	Voltage/Phase	Comments
Pump Motor	4 X 300-hp	480 volts, 3 phase	Motor horsepower is based on recent pump design information
Lighting	5.8 Kva	208 volts, 1 phase	General lighting
Field Instruments	2.2 Kva	120 volts, 1 phase	
HVAC (15 tons cooling)	62.0 Kva	480 volts, 3 phase	Building cooling
Receptacles	1.8 Kva	120 volts, 1 phase	General purpose 120V
Pump Station Control and Appurtenances	2.8 Kva	120 volts, 1 phase	Includes control panel, space heater, and ventilation

4.8.3.2 Montopolis WRI Pump Station Electrical One-Line Diagram

Figure 29 is a one-line diagram of the main electrical feed and distribution layout for the Montopolis reclaimed water pump station.

Project Cost

A preliminary engineering cost estimate has been conducted on the proposed project. The items and estimated quantities listed in Table 4 are the basis of the estimates along with the preliminary layouts in the Figures. The detailed estimate is included in Appendix F. Given the level of detail and definition of the project at this stage, a Class 4 estimate as standardized by the Association of the Advancement of Cost Engineering (AACE) International was completed. AACE International's classification system is described in Recommended Practice 17R-97, "Cost Estimate Classification System.", and supplemented by Recommended Practice 18R-97, "Cost Estimate Classification System—Applied in Engineering, Procurement, and Construction for the Process Industries." The level of accuracy is defined as -30% to +50%.

This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, final project costs, implementation schedule and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

The purpose of this Estimate of Construction Cost is to establish an Engineer's opinion of probable construction cost. It is intended to be used to determine economical and/or technical feasibility, preliminary budget approval and approval to start execution of the next phase of the project – the final design phase. This cost estimate has been prepared for guidance in project evaluation and implementation from the information available at the time of the estimate. The final costs of the project will depend on actual labor and material costs, competitive market conditions, final project costs, implementation schedule and other variable factors. As a result, the final project costs will vary from the estimate presented herein. Because of this, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions to help ensure proper project evaluation and adequate funding.

Table 6 below summarizes the Class 4 estimate. Table 7 provides more detail on assumed quantities and unit prices.

Table 6. Summary of Cost Estimate.

Description		Total w/Markups
02 Water Storage Tank		$3,836,411
01 Pump Station		$5,155,755
04 Site Civil		$4,486,369
	Grand Total w/Markups	**$13,478,535**

Table 7. Cost Estimate Summarizing Assumed Quantities and Unit Prices.

Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
03-10-02-12 Cast-In-Place Concrete, Continuous Footings, 12" thick	7.48 CY		182.60	140.63	6.00			329.23	2,463	$4,926
03-10-02-18 Cast-In-Place Concrete, Continuous Footings, 18" thick	59.84 CY		179.52	122.93	5.49			307.94	18,427	$36,862
03-10-05-08 Cast-In-Place Concrete, Slabs on Grade, 8" thick	87.39 CY		178.99	139.49	6.75			325.22	28,421	$56,855
03-10-05-12 Cast-In-Place Concrete, Slabs on Grade, 12" thick	45.84 CY		229.51	156.73	6.00			392.24	17,980	$35,968
03-10-06-08 Cast-In-Place Concrete, Straight Walls, 8" thick	42.92 CY		269.09	610.12	6.20			885.41	38,002	$76,021
03-10-06-10 Cast-In-Place Concrete, Straight Walls, 10" thick	4.16 CY		222.08	519.44	6.20			747.71	3,110	$6,222
03-10-06-12 Cast-In-Place Concrete, Straight Walls, 12" thick	49.87 CY		213.96	444.01	6.20			664.17	33,122	$66,259
03-10-13-12 Cast-In-Place Concrete, Equipment Pads, 12" thick	4.23 CY		183.13	253.26	2.14			438.53	1,855	$3,711
04-00-01-04 Masonry Brick, 4"	1.00 LS		55,277.85	100,525.22	78.10			155,881.17	155,881	$311,833
04-00-02-08 Masonry Concrete Masonry Units, 8"	1.00 LS		681.92	1,580.71	42.48			2,305.11	2,305	$4,611
04-00-02-12 Masonry Concrete Masonry Units, 12"	1.00 LS		65,554.59	115,732.79	981.28			182,268.66	182,269	$364,620
05-00-01-00 Metals, Structural Steel	1.00 LS		119,552.70	16,914.13	1,730.23			138,197.06	138,197	$276,457

Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
05-00-03-00 Metals, Metal Decking	1.00 LS		9,450.00	2,165.36	117.37			11,732.73	11,733	$23,471
05-00-08-00 Metals, Gratings	1.00 LS		43,064.47	8,869.68	962.23			52,896.38	52,896	$105,817
07-00-03-00 Thermal & Moisture Protection, Insulation	1.00 LS		11,214.00	4,726.75				15,940.75	15,941	$31,889
07-00-05-00 Thermal & Moisture Protection, Metal Roofing	1.00 LS		22,890.00	7,727.32				30,617.32	30,617	$61,249
07-00-99-00 Thermal & Moisture Protection, Other	1.00 LS		3,762.90	1,615.12				5,378.02	5,378	$10,758
08-00-01-00 Openings, Doors, Windows & Hardware	1.00 LS		17,746.55	4,643.45				22,390.00	22,390	$44,790
09-00-01-00 Finishes, Building Finishes	1.00 LS					25,000.00		25,000.00	25,000	$50,011
10-00-05-00 Specialties Fire Protection Specialties	1.00 LS		264.00	176.84				440.84	441	$882
10-00-07-00 Specialties Toilet & Bath Accessories	1.00 LS		1,698.90	430.02				2,128.92	2,129	$4,259
22-00-01-00 Mechanical, Plumbing	1.00 LS		25,000.00	13,926.20				38,926.20	38,926	$77,870
23-00-02-00 Mechanical, HVAC	1.00 LS					87,870.50		87,870.50	87,871	$175,781
41-00-02-01 Material Handling, Bridge Cranes	1.00 EA		51,419.90	6,529.40	155.01			58,104.31	58,104	$116,235
22-00-01-00 Mechanical, Plumbing	1.00 LS		2,281.90	1,714.01				3,995.91	3,996	$7,994
26-15-11-00 Process Electrical, Grounding	1.00 LS		2,660.70	4,468.70				7,129.40	7,129	$14,262
26-20-01-00 Facility Electrical, Complete $/SF Cost	1.00 LS					63,471.11		63,471.11	63,471	$126,971

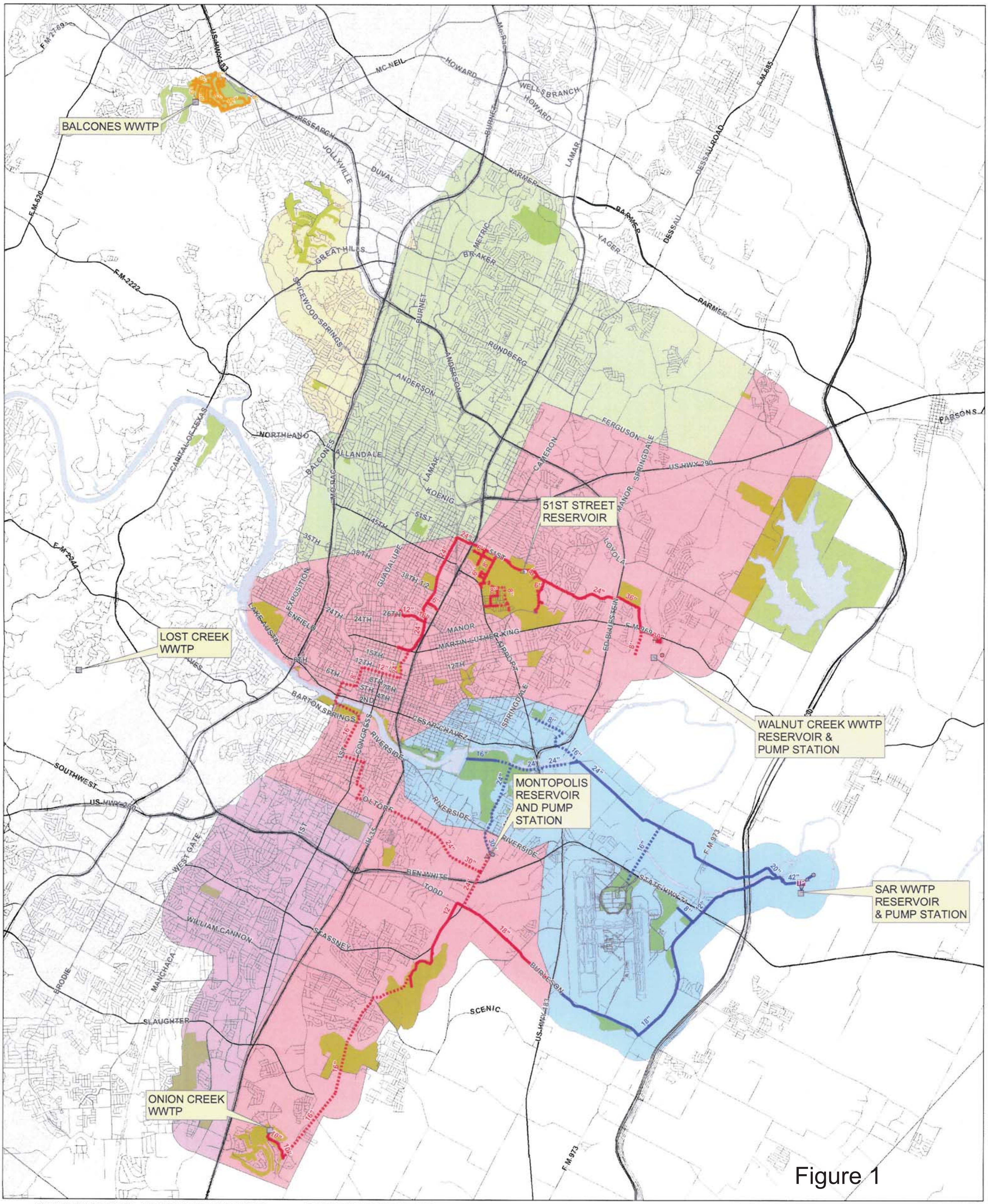
Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
26-25-03-00 Electrical Equipment, Switchgear - General	1.00 LS					200,000.00		200,000.00	200,000	$400,090
03-10-02-12 Cast-In-Place Concrete, Continuous Footings, 12" thick	3.67 CY		30.47	11.54	2.13			44.14	162	$324
03-10-02-18 Cast-In-Place Concrete, Continuous Footings, 18" thick	19.56 CY		30.49	11.55	2.13			44.17	864	$1,728
03-10-05-08 Cast-In-Place Concrete, Slabs on Grade, 8" thick	64.26 CY		30.50	11.55	2.13			44.17	2,839	$5,678
03-10-05-12 Cast-In-Place Concrete, Slabs on Grade, 12" thick	22.47 CY		30.50	11.55	2.13			44.17	993	$1,986
31-17-02-00 Earthworks, Caissons	1.00 LS		11,886.00	10,229.97	8,187.61			30,303.58	30,304	$60,621
40-10-01-10 Process Pipe, Ductile Iron, 10"	8.00 LF		310.82	586.74		20.25		917.81	7,342	$14,688
40-10-01-12 Process Pipe, Ductile Iron, 12"	115.75 LF		322.99	286.06		27.21		636.26	73,647	$147,327
40-10-01-16 Process Pipe, Ductile Iron, 16"	10.00 LF		429.05	786.73		31.50		1,247.27	12,473	$24,951
40-10-01-20 Process Pipe, Ductile Iron, 20"	28.00 LF		1,108.35	647.21		38.57		1,794.13	50,236	$100,494
40-10-01-36 Process Pipe, Ductile Iron, 36"	90.00 LF		2,067.49	595.02		50.00		2,712.51	244,126	$488,363
40-10-02-01 Process Pipe, Carbon Steel, 1/2" to 1"	4.00 EA		108.48	102.10				210.58	842	$1,685
40-10-03-01 Process Pipe, Stainless Steel, 1/2" to 1"	13.00 EA		85.60	83.15				168.75	2,194	$4,389
40-20-01-12 Gate Valves, 12"	3.00 EA		750.00	413.20				1,163.20	3,490	$6,981

Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
40-20-01-20 Gate Valves, 20"	4.00 EA		7,500.00	723.09				8,223.09	32,892	$65,800
40-20-01-36 Gate Valves, 36"	2.00 EA		27,500.00	1,129.40				28,629.40	57,259	$114,544
40-20-04-12 Ball Valves, 12"	5.00 EA		7,650.00	413.20				8,063.20	40,316	$80,650
40-20-08-12 Ball Check Valves, 12"	4.00 EA		2,088.00	413.20				2,501.20	10,005	$20,014
40-20-10-01 Air and Vacuum Relief Valves, 1/2" to 1"	8.00 EA		250.18	123.63		4.50		378.31	3,026	$6,054
40-20-13-12 Pressure Relief Valves, 12"	1.00 EA		17,500.00	1,652.78				19,152.78	19,153	$38,314
40-90-01-03 I&C, Flow / Indicators & Transmitters, Non MAG	5.00 LS		6,000.00	1,876.50				7,876.50	39,382	$78,783
40-90-01-01 I&C, Analyzers / Analyzers Transmitters	1.00 EA		9,000.00	343.04				9,343.04	9,343	$18,690
40-90-01-09 I&C, Pressure / Indicators & Transmitters	1.00 LS		7,660.00	2,292.87				9,952.87	9,953	$19,910
40-90-99-01 I&C, Other	1.00 EA					100,000.00		100,000.00	100,000	$200,045
44-05-40-24 Horizontal Split-Case Pump: 101hp-500hp	4.00 EA		1,500.00	382.15				1,882.15	7,529	$15,061
43-05-36-00 Expansion Tanks	1.00 LS			6,542.40	2,408.07		100,000.00	108,950.47	108,950	$217,950
44-05-40-24 Horizontal Split-Case Pump: 101hp-500hp	4.00 EA		935.00	1,494.08		1,900.00		4,329.08	17,316	$34,079
44-05-49-00 Submersible Pump: 1hp-5hp	4.00 EA		3,260.00	2,263.76			2,500.00	8,023.76	32,095	$62,249
44-05-40-24 Horizontal Split-Case Pump: 101hp-500hp	4.00 EA		50.00	3,395.64			100,000.00	103,445.64	413,783	$827,722
26-15-11-00 Process Electrical, Grounding	1.00 LS		2,357.30	1,893.49				4,250.79	4,251	$8,504
27-30-01-00 Communications Systems	1.00 LS		2,500.00	1,548.34				4,048.34	4,048	$8,099

Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
31-17-02-00 Earthworks, Caissons	1.00 LS		24,904.00	21,434.22	17,155.00			63,493.22	63,493	$127,015
33-70-01-01 Ground Water Storage Tank	1.00 LS						1,950,000.00	1,950,000.00	1,950,000	$3,608,382
40-90-01-03 I&C, Flow / Indicators & Transmitters, Non MAG	1.00 LS		3,800.00	573.21				4,373.21	4,373	$8,748
44-05-38-50 Submersible Mixers	1.00 EA			2,180.80	642.15		35,000.00	37,822.95	37,823	$75,663
03-10-05-24 Cast-In-Place Concrete, Slabs on Grade, 24" thick	204.00 CY		188.85	110.16	5.24			304.25	62,068	$124,163
03-10-06-18 Cast-In-Place Concrete, Straight Walls, 18" thick	148.18 CY		219.98	312.59	6.20			538.77	79,835	$159,706
26-10-06-00 Site Electrical, Lighting	1.00 LS		16,670.40	5,797.46	546.06			23,013.92	23,014	$46,038
28-35-01-00 Electronic Safety and Security	1.00 LS		32,497.50	6,366.69		25,000.00		63,864.19	63,864	$127,757
03-10-05-24 Cast-In-Place Concrete, Slabs on Grade, 24" thick	204.00 CY		7.48	2.83	0.52			10.83	2,209	$4,418
31-15-01-00 Site Preparation, Clearing and Grubbing	1.00 LS			9,525.21	6,709.85			16,235.06	16,235	$32,477
31-20-07-00 Earthworks, Sitework, Cut/Fill	1.00 LS		5,355.00	12,217.14	10,151.67			27,723.81	27,724	$55,460
31-25-01-00 Earthworks, Structural, Excavation	1.00 LS		2,201.50	13,188.07	12,063.59			27,453.16	27,453	$54,919
32-35-03-00 Site Improvements, Landscaping	1.00 LS					50,000.00		50,000.00	50,000	$100,023
32-45-01-00 Fencing, Chain Link	1.00 LS		22,374.00	4,899.18	1,230.97			28,504.15	28,504	$57,021

Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
32-40-06-00 Site Improvements, Flatwork, Sidewalk	1.00 LS		2,208.64	2,158.51	10.82			4,377.97	4,378	$8,758
32-50-06-00 Site Improvements, Other Improvements									50,000	$100,023
32-40-01-00 Site Improvements, Paving, Asphaltic Concrete	1.00 LS		68,870.00	7,125.66	4,961.19			80,956.85	80,957	$161,950
32-40-05-00 Site Improvements, Curbs and Gutters	1.00 LS		10,115.00	1,963.21	510.77			12,588.98	12,589	$25,184
33-15-01-06 Buried Structures, Manholes, 72" Dia	1.00 LS		3,833.00	3,900.44	310.88		10,000.00	18,044.32	18,044	$36,097
33-00-04-06 Buried Pipe, Ductile Iron, 6"	900.00 LF		34.77	41.91	17.69			94.37	84,931	$169,901
33-00-04-36 Buried Pipe, Ductile Iron, 36"	1,460.00 LF		441.07	95.95	45.61	3.43		586.06	855,640	$1,711,667
33-00-04-42 Buried Pipe, Ductile Iron, 42"	900.00 LF		517.50	105.32	47.92	5.56		676.29	608,661	$1,217,598
33-00-07-04 Buried Pipe, PVC, 4"	1,200.00 LF		8.60	24.48	5.30			38.37	46,049	$92,119
40-20-08-36 Check Valves, 36"	1.00 EA		39,000.00	2,279.12	275.55			41,554.67	41,555	$83,128
40-20-17-18 Control Valves, 18"	1.00 EA		17,525.00	2,347.79	646.33			20,519.12	20,519	$41,048
40-20-17-30 Control Valves, 30"	1.00 EA		34,200.00	3,330.52	917.70			38,448.22	38,448	$76,914
Grand Total										**$13,478,534**

Figures



City of Austin
Austin Water Utility
March 2011

Reclaimed Water System Near-Term Construction

Produced by GIS Services

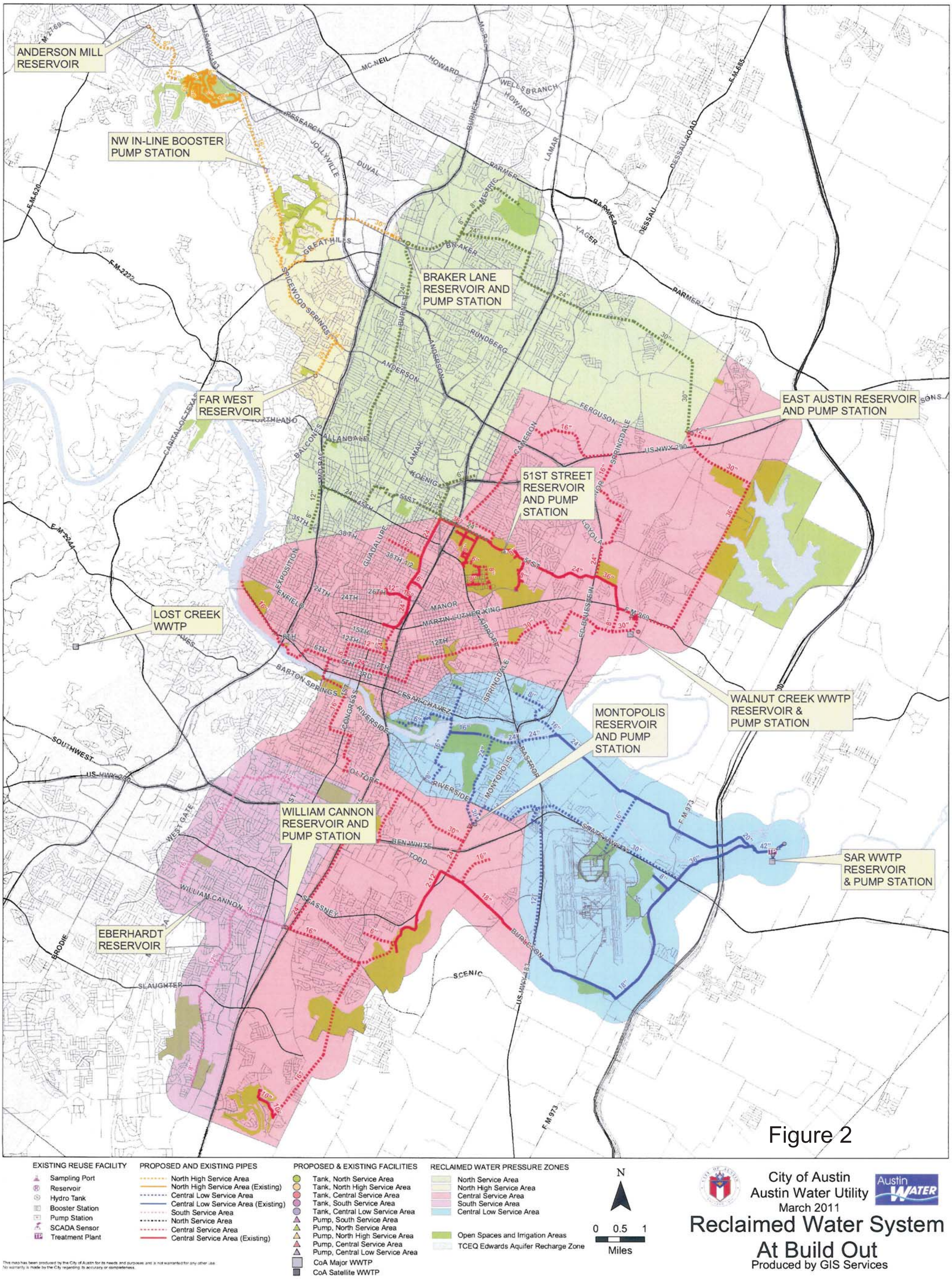
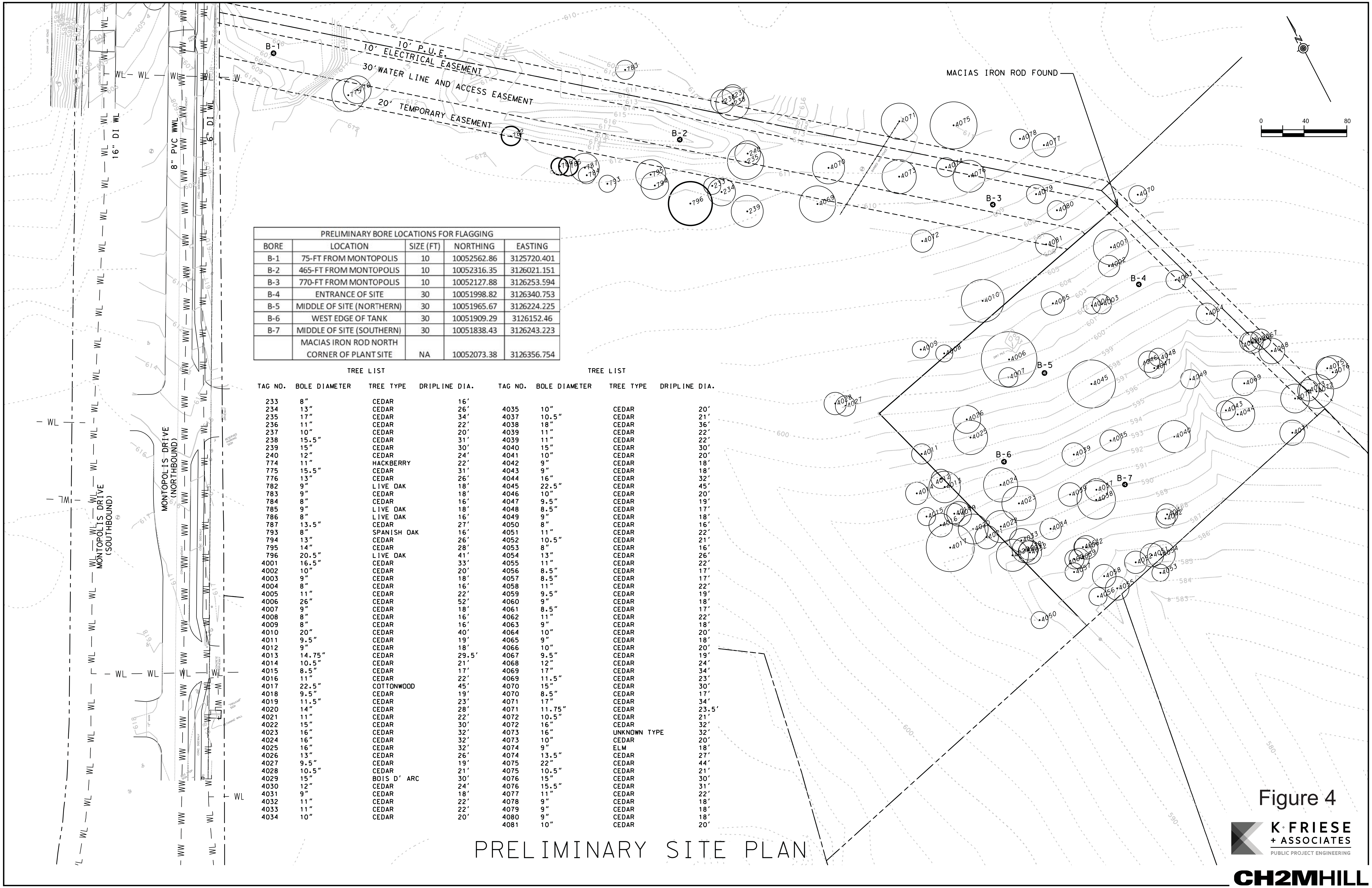


Figure 2

City of Austin
Austin Water Utility
March 2011

Reclaimed Water System At Build Out

Produced by GIS Services



PRELIMINARY BORE LOCATIONS FOR FLAGGING				
BORE	LOCATION	SIZE (FT)	NORTHING	EASTING
B-1	75-FT FROM MONTOPOLIS	10	10052562.86	3125720.401
B-2	465-FT FROM MONTOPOLIS	10	10052316.35	3126021.151
B-3	770-FT FROM MONTOPOLIS	10	10052127.88	3126253.594
B-4	ENTRANCE OF SITE	30	10051998.82	3126340.753
B-5	MIDDLE OF SITE (NORTHERN)	30	10051965.67	3126224.225
B-6	WEST EDGE OF TANK	30	10051909.29	3126152.46
B-7	MIDDLE OF SITE (SOUTHERN)	30	10051838.43	3126243.223
	MACIAS IRON ROD NORTH CORNER OF PLANT SITE	NA	10052073.38	3126356.754

TREE LIST

TAG NO.	BOLE DIAMETER	TREE TYPE	DRIPLINE DIA.
233	8"	CEDAR	16'
234	13"	CEDAR	26'
235	17"	CEDAR	34'
236	11"	CEDAR	22'
237	10"	CEDAR	20'
238	15.5"	CEDAR	31'
239	15"	CEDAR	30'
240	12"	CEDAR	24'
774	11"	HACKBERRY	22'
775	15.5"	CEDAR	31'
776	13"	CEDAR	26'
782	9"	LIVE OAK	18'
783	9"	CEDAR	18'
784	8"	CEDAR	16'
785	9"	LIVE OAK	18'
786	8"	LIVE OAK	16'
787	13.5"	CEDAR	27'
793	8"	SPANISH OAK	16'
794	13"	CEDAR	26'
795	14"	CEDAR	28'
796	20.5"	LIVE OAK	41'
4001	16.5"	CEDAR	33'
4002	10"	CEDAR	20'
4003	9"	CEDAR	18'
4004	8"	CEDAR	16'
4005	11"	CEDAR	22'
4006	26"	CEDAR	52'
4007	9"	CEDAR	18'
4008	8"	CEDAR	16'
4009	8"	CEDAR	16'
4010	20"	CEDAR	40'
4011	9.5"	CEDAR	19'
4012	9"	CEDAR	18'
4013	14.75"	CEDAR	29.5'
4014	10.5"	CEDAR	21'
4015	8.5"	CEDAR	17'
4016	11"	CEDAR	22'
4017	22.5"	COTTONWOOD	45'
4018	9.5"	CEDAR	19'
4019	11.5"	CEDAR	23'
4020	14"	CEDAR	28'
4021	11"	CEDAR	22'
4022	15"	CEDAR	30'
4023	16"	CEDAR	32'
4024	16"	CEDAR	32'
4025	16"	CEDAR	32'
4026	13"	CEDAR	26'
4027	9.5"	CEDAR	19'
4028	10.5"	CEDAR	21'
4029	15"	BOIS D' ARC	30'
4030	12"	CEDAR	24'
4031	9"	CEDAR	18'
4032	11"	CEDAR	22'
4033	11"	CEDAR	22'
4034	10"	CEDAR	20'

TREE LIST

TAG NO.	BOLE DIAMETER	TREE TYPE	DRIPLINE DIA.
4035	10"	CEDAR	20'
4037	10.5"	CEDAR	21'
4038	18"	CEDAR	36'
4039	11"	CEDAR	22'
4039	11"	CEDAR	22'
4040	15"	CEDAR	30'
4041	10"	CEDAR	20'
4042	9"	CEDAR	18'
4043	9"	CEDAR	18'
4044	16"	CEDAR	32'
4045	22.5"	CEDAR	45'
4046	10"	CEDAR	20'
4047	9.5"	CEDAR	19'
4048	8.5"	CEDAR	17'
4049	9"	CEDAR	18'
4050	8"	CEDAR	16'
4051	11"	CEDAR	22'
4052	10.5"	CEDAR	21'
4053	8"	CEDAR	16'
4054	13"	CEDAR	26'
4055	11"	CEDAR	22'
4056	8.5"	CEDAR	17'
4057	8.5"	CEDAR	17'
4058	11"	CEDAR	22'
4059	9.5"	CEDAR	19'
4060	9"	CEDAR	18'
4061	8.5"	CEDAR	17'
4062	11"	CEDAR	22'
4063	9"	CEDAR	18'
4064	10"	CEDAR	20'
4065	9"	CEDAR	18'
4066	10"	CEDAR	20'
4067	9.5"	CEDAR	19'
4068	12"	CEDAR	24'
4069	17"	CEDAR	34'
4069	11.5"	CEDAR	23'
4070	15"	CEDAR	30'
4070	8.5"	CEDAR	17'
4071	17"	CEDAR	34'
4071	11.75"	CEDAR	23.5'
4072	10.5"	CEDAR	21'
4072	16"	CEDAR	32'
4073	16"	UNKNOWN TYPE	32'
4073	10"	CEDAR	20'
4074	9"	ELM	18'
4074	13.5"	CEDAR	27'
4075	22"	CEDAR	44'
4075	10.5"	CEDAR	21'
4076	15"	CEDAR	30'
4076	15.5"	CEDAR	31'
4077	11"	CEDAR	22'
4078	9"	CEDAR	18'
4079	9"	CEDAR	18'
4080	9"	CEDAR	18'
4081	10"	CEDAR	20'

PRELIMINARY SITE PLAN

Figure 4

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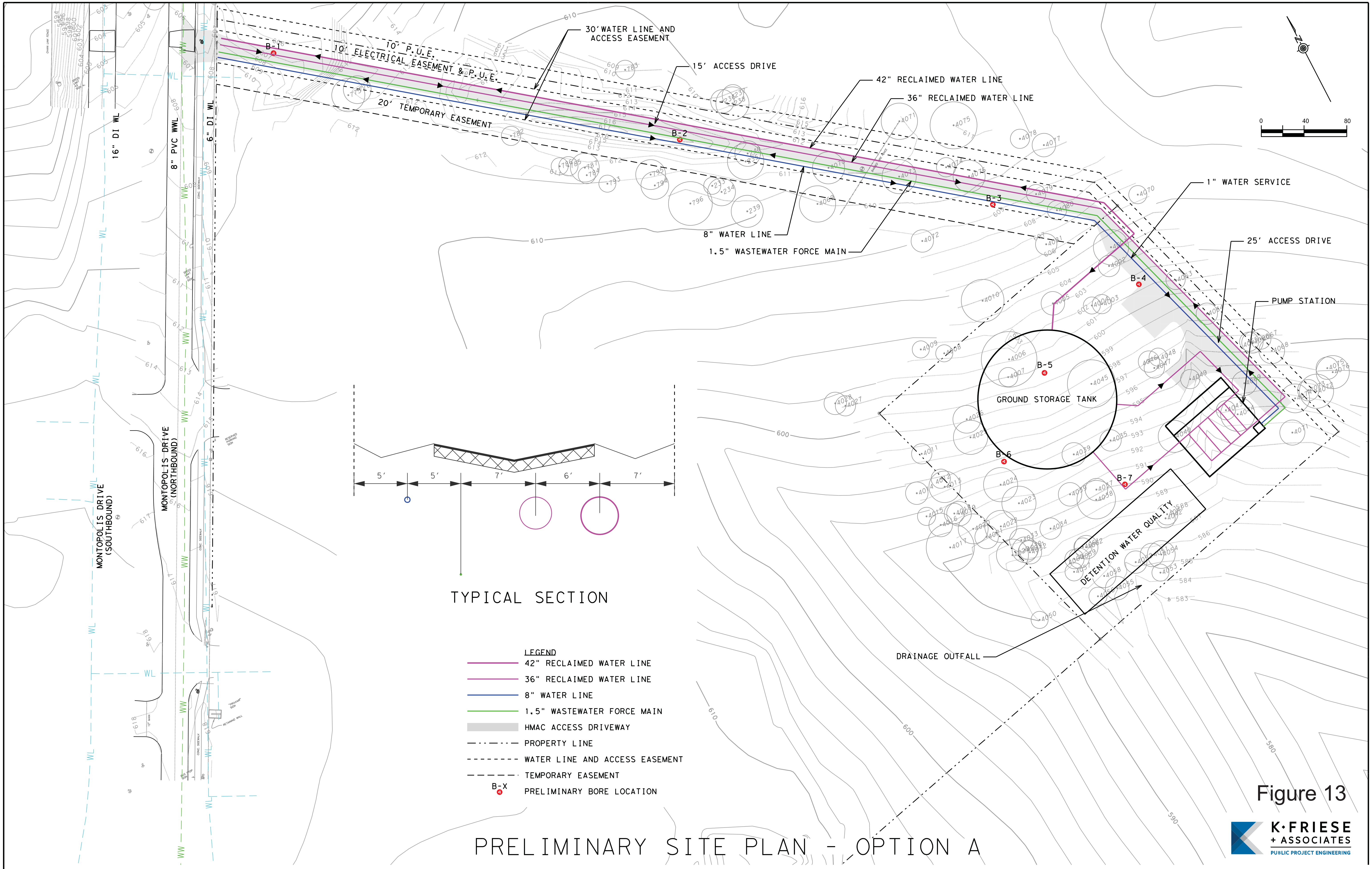

LEGEND

🟪	42" RECLAIMED WATER LINE
🟪	36" RECLAIMED WATER LINE
🟦	8" WATER LINE
🟩	1.5" WASTEWATER FORCE MAIN
▨	HMAC ACCESS DRIVEWAY
— · · —	PROPERTY LINE
- - - -	WATER LINE AND ACCESS EASEMENT
— — —	TEMPORARY EASEMENT
B-X ●	PRELIMINARY BORE LOCATION

PRELIMINARY SITE PLAN - OPTION A

Figure 13

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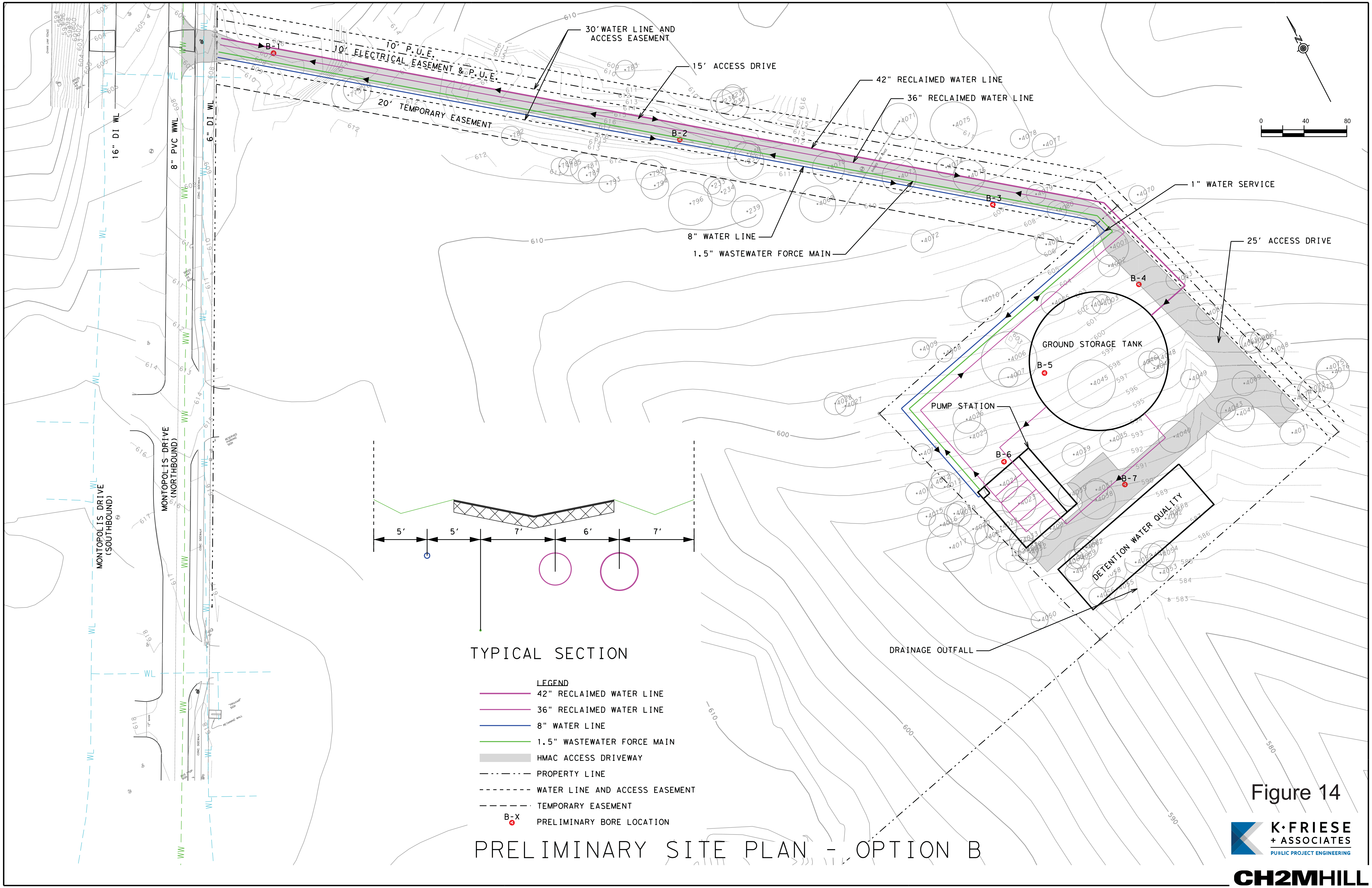

LEGEND

	42" RECLAIMED WATER LINE
	36" RECLAIMED WATER LINE
	8" WATER LINE
	1.5" WASTEWATER FORCE MAIN
▨	HMAC ACCESS DRIVEWAY
—·—·—	PROPERTY LINE
- - - -	WATER LINE AND ACCESS EASEMENT
— — —	TEMPORARY EASEMENT
B-X ●	PRELIMINARY BORE LOCATION

PRELIMINARY SITE PLAN - OPTION B

Figure 14

K·FRIESE + ASSOCIATES
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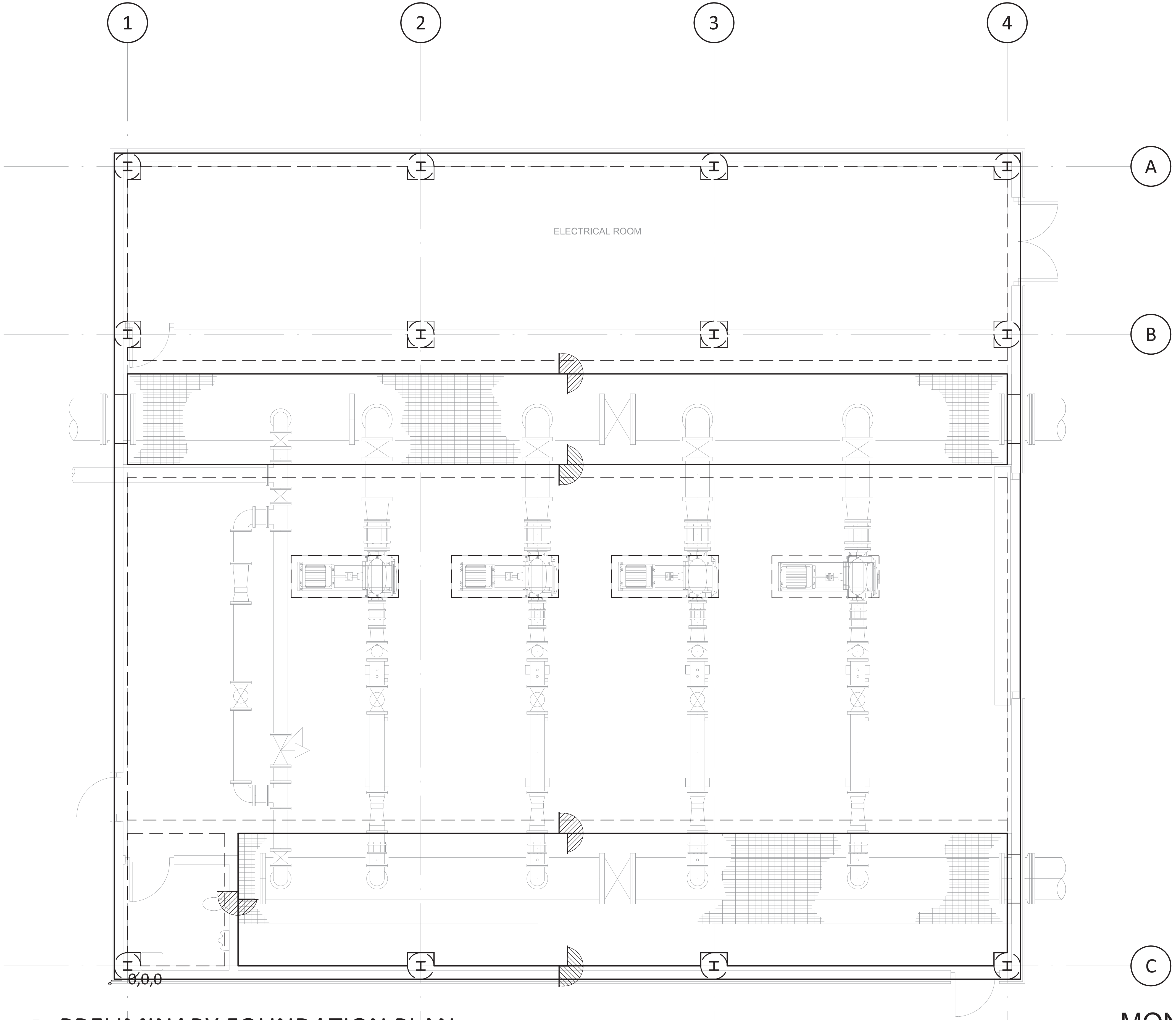

1 PRELIMINARY FOUNDATION PLAN

SCALE: 1/8"=1'-0"

Figure 15

CITY OF AUSTIN
MONTOPOLIS RECYCLED WATER
PUMP STATION
PRELIMINARY LAYOUT

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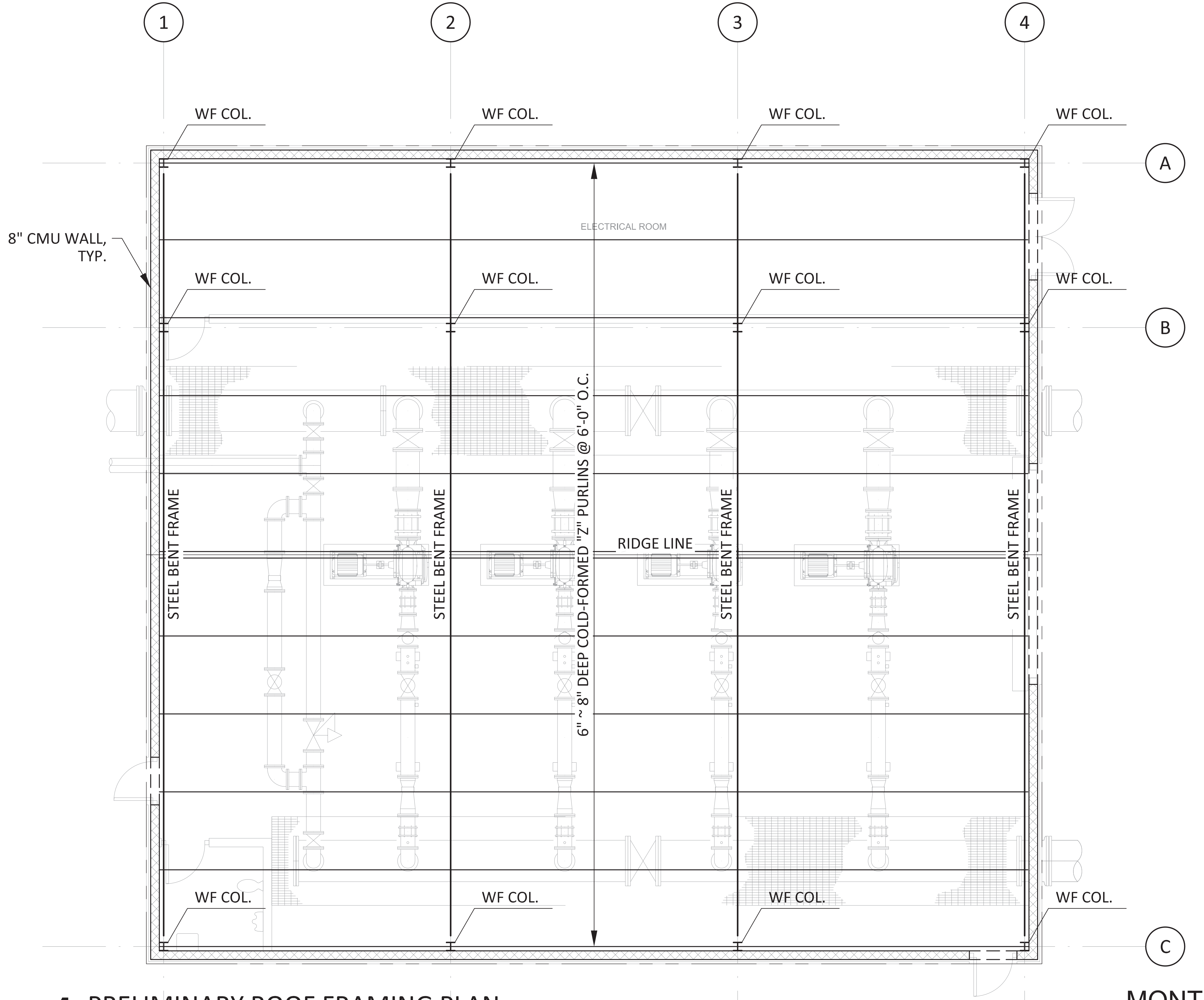

1 PRELIMINARY ROOF FRAMING PLAN

SCALE: 1/8"=1'-0"

Figure 16

CITY OF AUSTIN
MONTOPOLIS RECYCLED WATER
PUMP STATION
PRELIMINARY LAYOUT

13006.M.AUS

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CODE REVIEW DOCUMENT

2009 INTERNATIONAL BUILDING CODE

Project Summary

1. BUILDING HEIGHT: 25'-4"
2. BUILDING AREA: GROUND FLOOR 4,347 S.F.
3. NUMBER OF STORIES: ONE STORY
4. CONSTRUCTION TYPE: IIB
5. USE OF GROUP: F-2 FACTORY INDUSTRIAL LOW-HAZARD
6. EXIT WIDTH: 4,347/ 100 = 43.47 x 0.2 = 9 INCHES

PROVIDING: 72 INCHES

CHAPTER 3: USE AND OCCUPANCY CLASSIFICATION

306.3 FACTORY INDUSTRIAL F-2 LOW-HAZARD OCCUPANCY. FACTORY INDUSTRIAL USES THAT INVOLVE THE FABRICATION OR MANUFACTURING OF NONCOMBUSTIBLE MATERIALS WHICH DURING FINISHING, PACKING OR PROCESSING DO NOT INVOLVE A SIGNIFICANT FIRE HAZARD SHALL BE CLASSIFIED AS F-2 OCCUPANCIES.

CHAPTER 4: SPECIAL DETAILED REQUIREMENTS BASED ON USE AND OCCUPANCY

410.3.2 **GALLERIES,GRIDIRONS, CATWALKS AND PINRAIL** BEAMS DESIGNED ONLY FOR THE ATTACHMENT OF PORTABLE OR FIXED THEATER EQUIPMENT, GRIDIRONS, GALLERIES AND CATWALKS SHALL BE CONSTRUCTED OF APPROVED MATERIALS CONSISTENT WITH THE REQUIREMENTS FOR THE TYPE OF CONSTRUCTION OF THE BUILDING; AND A FIRE-RESISTANCE RATING SHALL NOT BE REQUIRED. THESE AREAS SHALL NOT BE CONSIDERED TO BE FLOORS, STORIES, MEZZANINES OR LEVELS IN APPLYING THIS CODE.

CHAPTER 5: GENERAL BUILDING HEIGHT AND AREAS

TABLE 503: TYPE IIB CONSTRUCTION/GROUP F-2 ALLOWS 3 STORIES AND 23,000 SQUARE FOOTAGE. HEIGHT OF 55 FEET.

ACTUAL SQUARE FOOTAGE:4,347

ACTUAL HEIGHT: 25' - 4"

CHAPTER 6: TYPES OF CONSTRUCTION

602.2 TYPES I AND II. TYPES I AND II CONSTRUCTION ARE THOSE TYPES OF CONSTRUCTION IN WHICH THE BUILDING ELEMENTS LISTED IN TABLE 601 ARE OF NONCOMBUSTIBLE MATERIALS, EXCEPT AS PERMITTED IN SECTION603 AND ELSEWHERE IN THIS CODE.

TABLE 601 FIRE-RESISTANCE RATING REQUIREMENTS FOR BUILDING ELEMENTS

	TYPE IIB
PRIMARY STRUCTURAL FRAME	0 HOUR
BEARING WALLS	
EXTERIOR	0 HOUR
INTERIOR	0 HOUR
NONBEARING WALLS AND PARTITIONS EXTERIOR	SEE TABLE 602
NONBEARING WALLS AND PARTITIONS INTERIOI	0 HOUR
FLOOR CONSTRUCTION AND SECONDARY MEMBERS	0 HOUR
ROOF CONSTRUCTION AND SECONDARY MEMBER	0 HOUR

TABLE 602 FIRE-RESISTANCE RATING REQUIREMENTS FOR EXTERIOR WALLS BASED ON FIRE SEPARATION DISTANCE

FIRE SEPARATION DISTANCE = X < 5/GROUP F-2 1 HOUR

X >10 1 HOUR

CHAPTER 7 FIRE AND SMOKE PROTECTION

705.1 GENERAL. EXTERIOR WALL SHALL COMPLY WITH THIS SECTION.

705.5 FIRE-RESISTANCE RATINGS EXTERIOR WALLS SHALL BE FIRE-RESISTANCE RATED IN ACCORDANCE WITH TABLE 601 AND 602 AND THIS SECTION. THE REQUIRED FIRE-RESISTANCE RATING OF EXTERIOR WALLS WITH A FIRE SEPARATION DISTANCE RATING OF EXTERIOR WALLS WITH A FIRE SEPARATION DISTANCE OF GREATER THAN 10 FEET SHALL BE RATED FOR EXPOSURE TO FIRE FROM THE INSIDE. THE REQUIRED FIRE RESISTANCE RATING OF EXTERIOR WALLS WITH A FIRE SEPARATION DISTANCE OF LESS THAN OR EQUAL TO 10 FEET SHALL BE RATED FOR EXPOSURE TO FIRE FROM BOTH SIDES..

705.8 OPENINGS OPENINGS IN EXTERIOR WALLS SHALL COMPLY WITH SECTIONS 705.8.1 THROUGHT 705.8.6 .

705.8.1 ALLOWABLE AREA OF OPENING THE MAXIMUM AREA OF UNPROTECTED AND PROTECTED OPENINGS PERMITTED IN AN EXTERIOR WALL IN ANY STORY OF A BUILDING SHALL NOT EXCEED THE PERCENTAGES SPECIFIED IN TABLE 705.8.

TABLE 705.8 MAXIMUM AREA OF EXTERIOR WALL OPENINGS BASED ON FIRE SEPARATION DISTANCE AND DEGREE OF OPENING PROTECTION

FIRE SEPARATION	**DEGREE OF OPENING PROTECTION**	**ALLOWABLE AREA**
25 TO LESS THAN 30	UNPROTECTED, NONSPRINKLERED	70%
30 OR GREATER	UNPROTECTED, NONSPRINKLERED	NO LIMIT

CHAPTER 9 AUTOMATIC SPRINKLER SYSTEMS

906.1 WHERE REQUIRED. PORTABLE FIRE EXTINGUISHERS SHALL BE INSTALLED IN THE FOLLOWING LOCATIONS.

1. IN NEW AND EXISTING GROUP A,B,F,H,I,M,R-1,R-2, R-4 AND S OCCUPANCIES,
5. WHERE REQUIRED BY THE INTERNATIONAL FIRE CODE SECTIONS INDICATED IN TABLE 906.1.

CHAPTER 10 MEANS OF EGRESS

1005.1 MINIMUM REQUIRED EGRESS WIDTH. THE MEANS OF EGRESS WIDTH SHALL NOT BE LESS THAN REQUIRED BY THIS SECTION. THE TOTAL WIDTH OF MEANS OF EGRESS IN INCHES SHALL NOT BE LESS THAN THE TOTAL OCCUPANT LOAD SERVED BY THE MEANS OF EGRESS MULTIPLIED BY 0.3 INCHED PER OCCUPANT FOR STAIRS AND BY 0.2 INCHES PER OCCUPANT FOR OTHER EGRESS COMPONENTS. THE WIDTH SHALL NOT BE LESS THAN SPECIFIED ELSEWHERE IN THIS CODE. MULTIPLE MEANS OF EGRESS SHALL BE SIZED SUCH THAT THE LOSS OF ANY ONE MEANS OF EGRESS SHALL NOT REDUCE THE AVAILABLE CAPACITY TO LESS THAN 50 PERCENT OF THE REQUIRED CAPACITY. THE MAXIMUM CAPACITY REQUIRED FORM ANY STORY OF A BUILDING SHALL BE MAINTAINED TO THE TERMINATION OF THE MEANS OF EGRESS.

TABLE 1016.1 EXIT ACCESS TRAVEL DISTANCE

OCCUPANCY GROUP F-2 WITHOUT SPRINKLER SYSTEM = 300 FT.

1021.1 EXITS FROM STORIES. ALL SPACES WITHIN EACH STORY SHALL HAVE ACCESS TO THE MINIMUM NUMBER OF APPROVED INDEPENDENT EXITS AS SPECIFIED IN TABLE 1021.1 BASED ON THE OCCUPANT LOAD OF THE STORY. FOR THE PURPOSES OF THIS CHAPTER, OCCUPIED ROOFS SHALL BE PROVIDED WITH EXITS AS REQUIRED STORIES.

TABLE 1021.1 MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

OCCUPANT LOAD (PERSONS PER STORY) : 1-500,

MINIMUM NUMBER OF EXITS (PER STORY): 2

PROVIDED EXITS: 2

Figure 17

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PUMP STATION
PRELIMINARY LAYOUT

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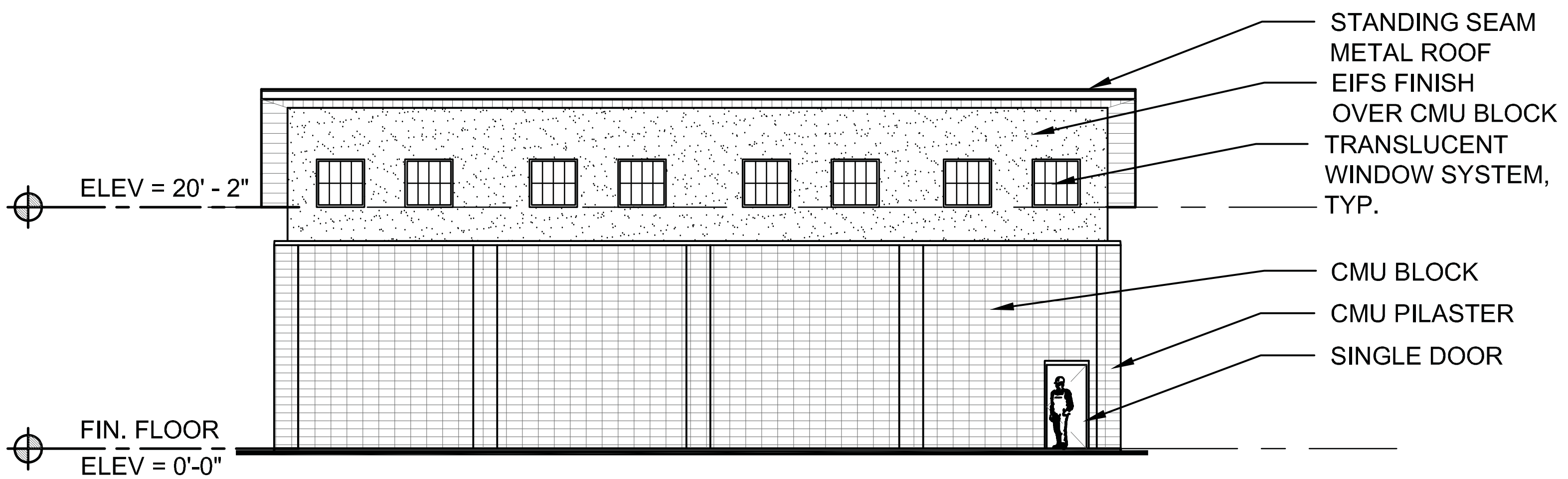
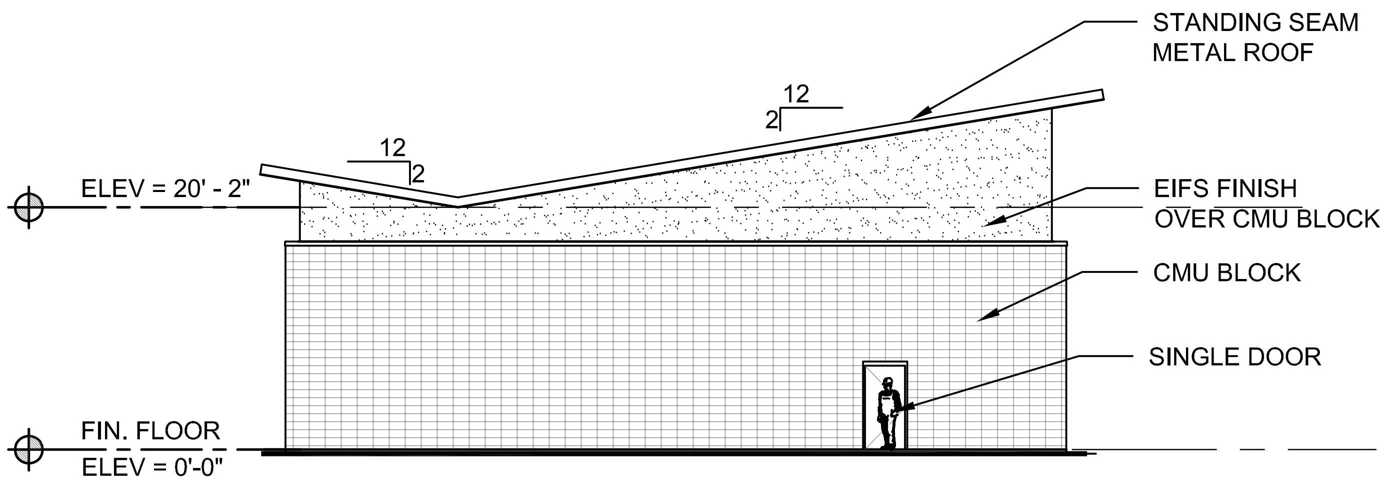


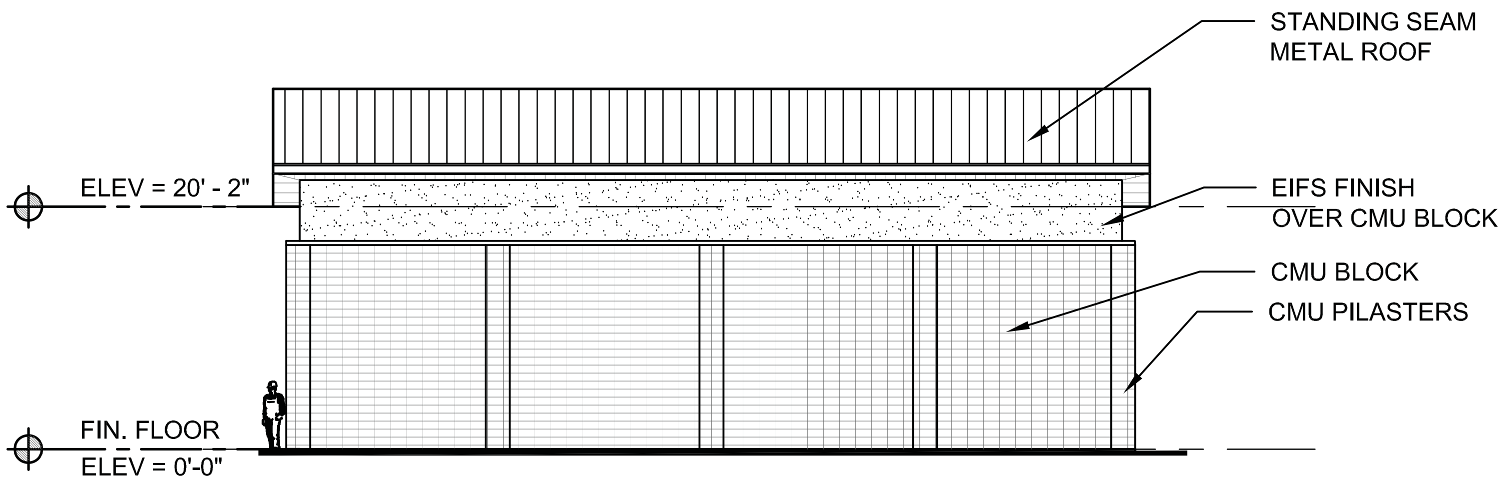
④ SIDE ELEVATION

SCALE: 1/16" = 1'-0"



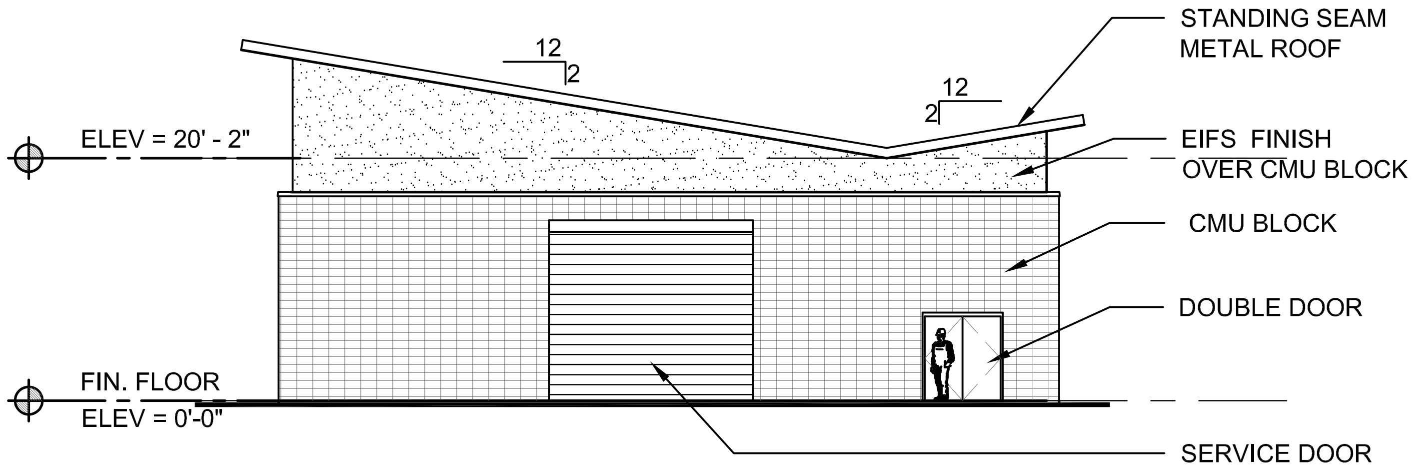
③ REAR ELEVATION

SCALE: 1/16" = 1'-0"



② SIDE ELEVATION

SCALE: 1/16" = 1'-0"



① FRONT ELEVATION

SCALE: 1/16" = 1'-0"

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Figure 18

CITY OF AUSTIN
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PUMP STATION
PRELIMINARY LAYOUT

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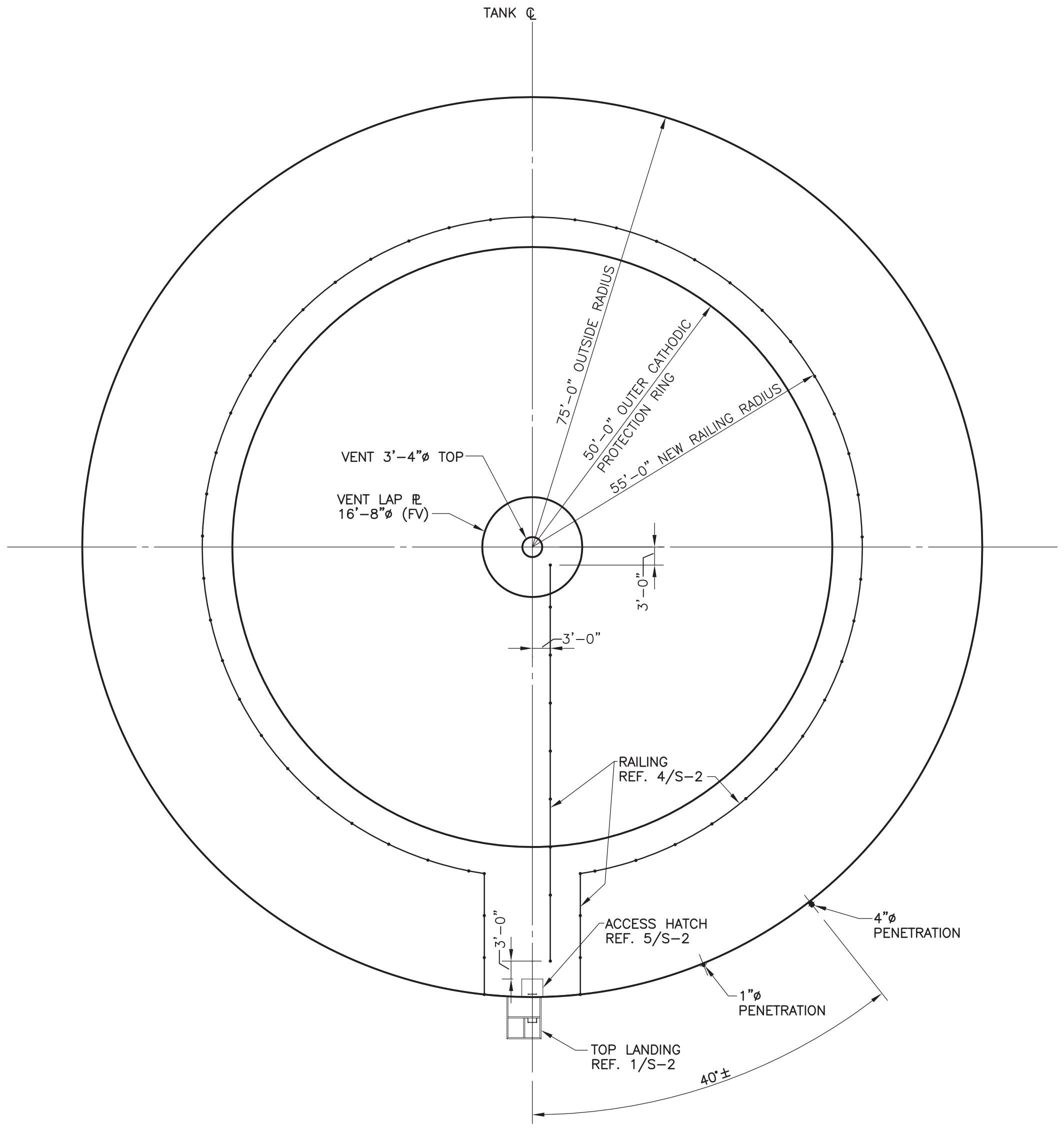
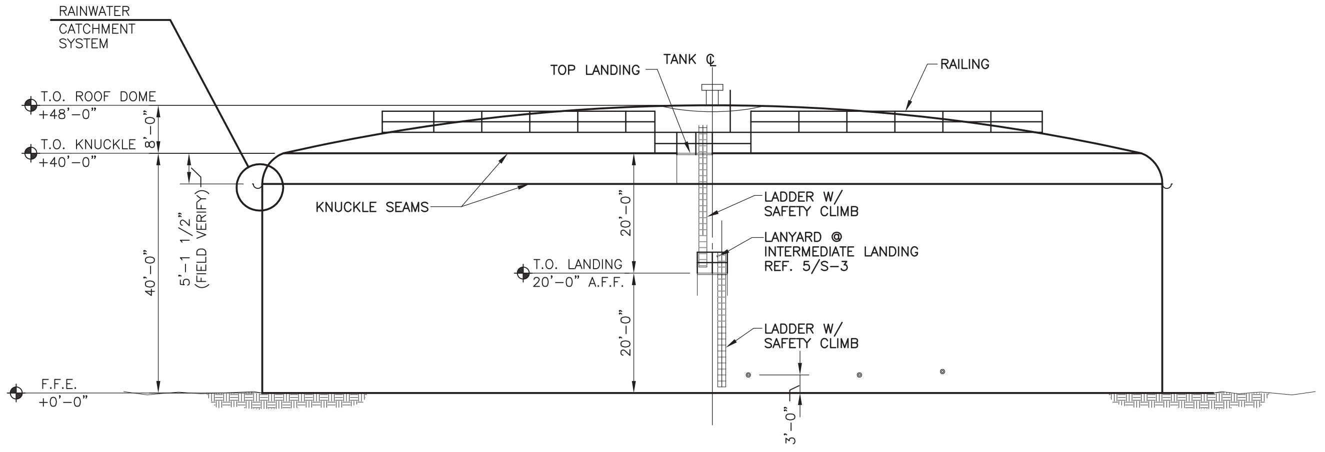


① ROOF PLAN
SCALE: 1/16" = 1'-0"



② ELEVATION
SCALE: 1/16" = 1'-0"

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Figure 20

ROOF PLAN &
ELEVATION

S-1

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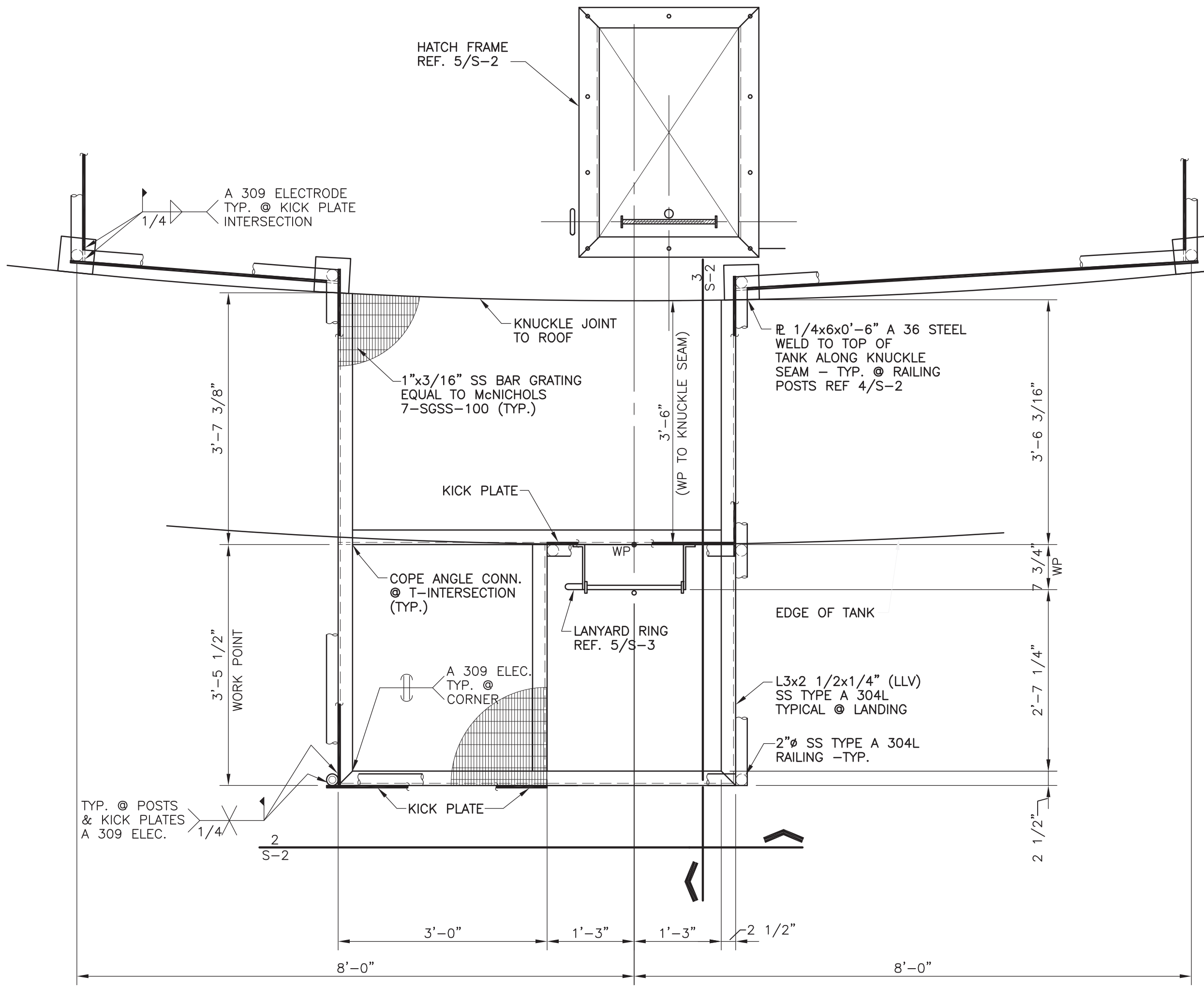
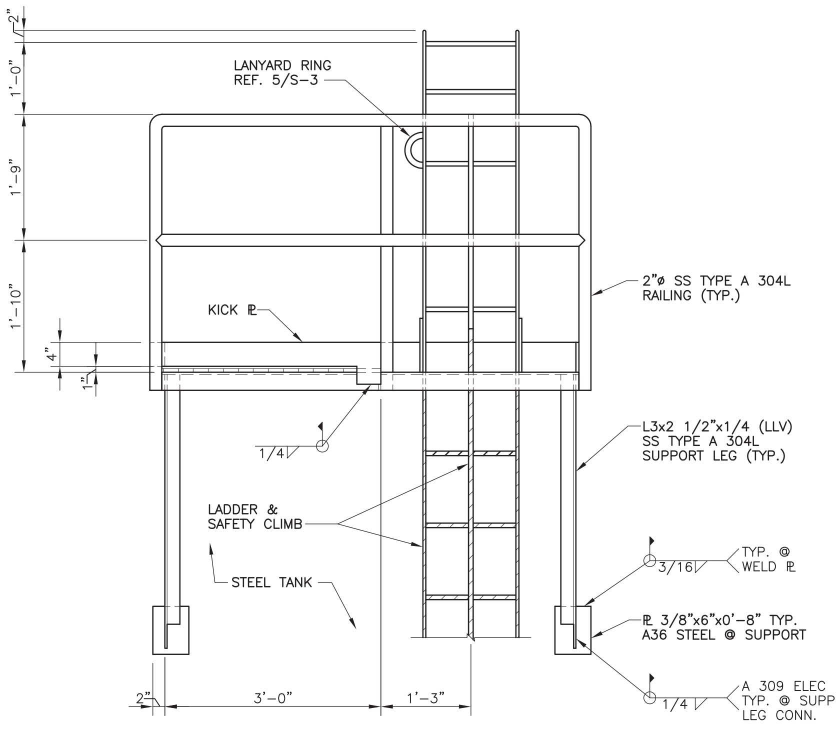


① TOP LANDING PLAN

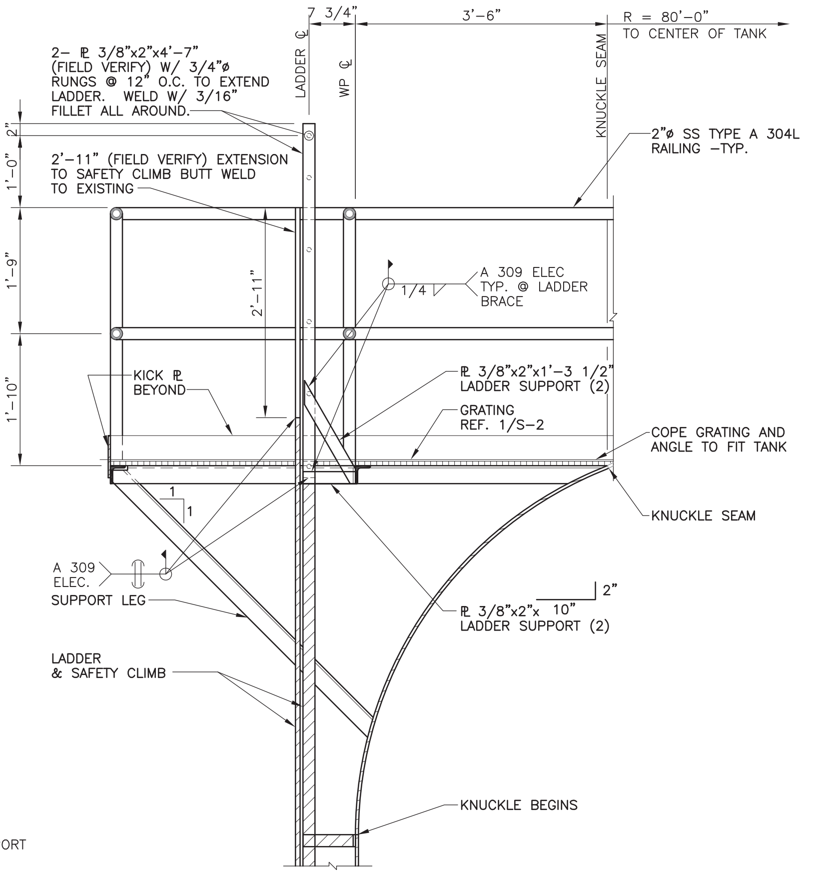
SCALE: 3/4" = 1'-0"

1. RAILING NOT SHOWN FOR CLARITY.
2. KICK PLATES SHOWN AT RAIL POSTS ONLY FOR CLARITY.



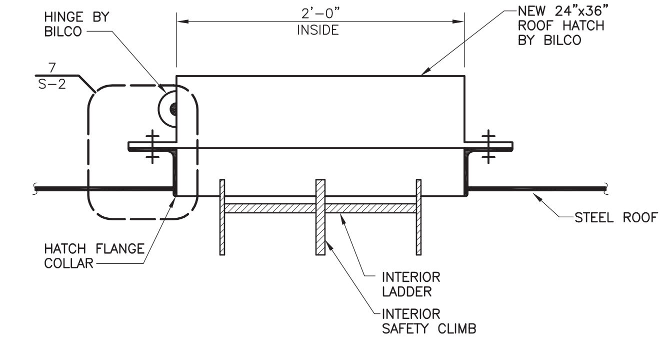
② LANDING ELEVATION

SCALE: 3/4" = 1'-0"



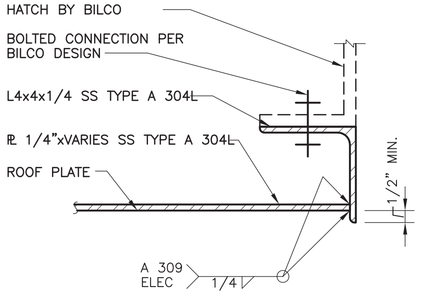
③ LANDING SECTION

SCALE: 3/4" = 1'-0"



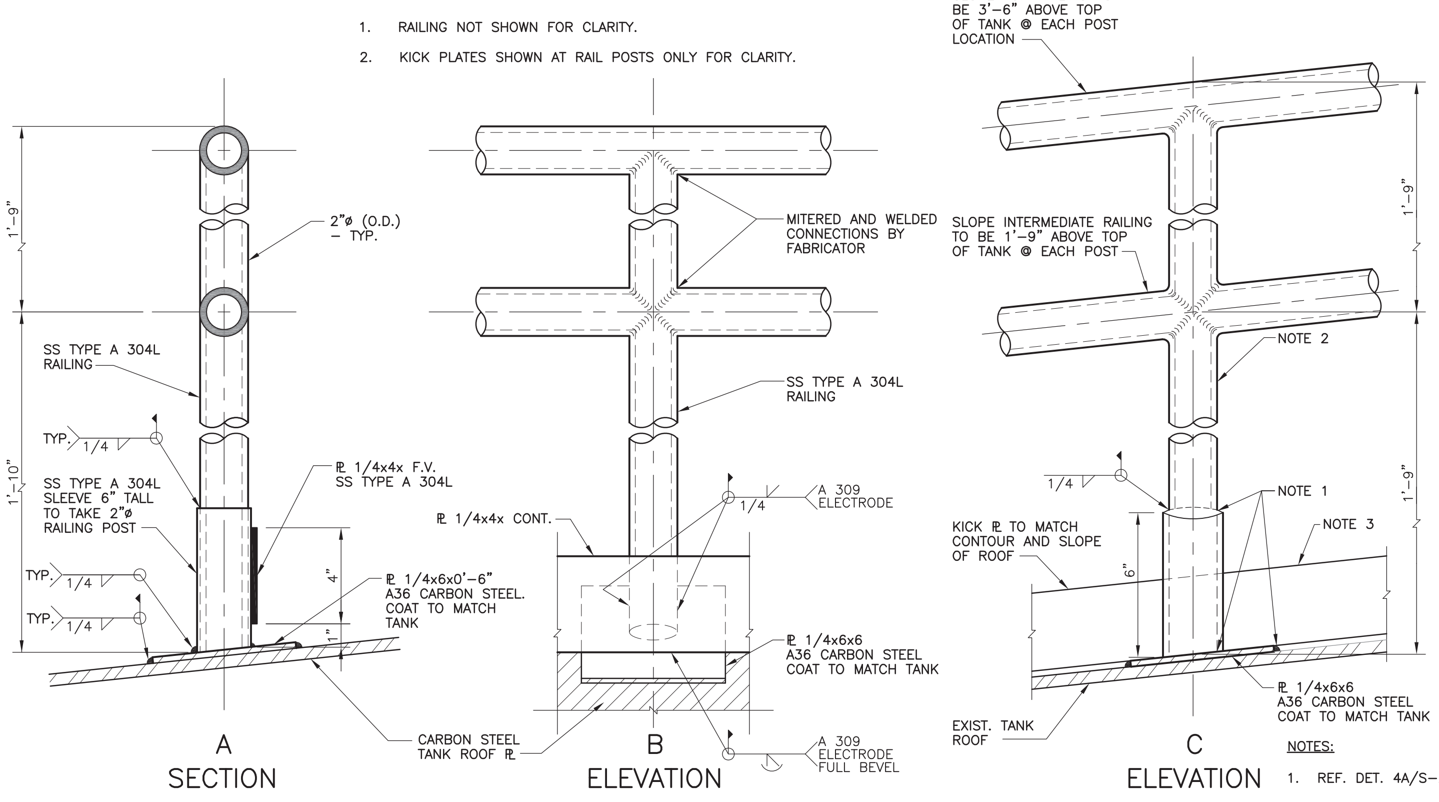
⑥ HATCH SECTION

SCALE: 1 1/2" = 1'-0"



⑦ DETAIL

SCALE: 3" = 1'-0"

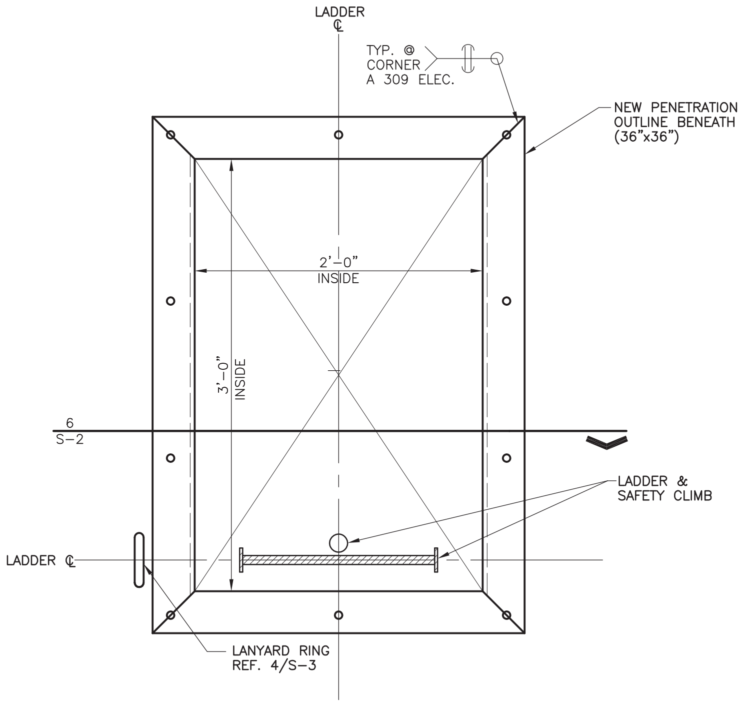


④ RAILING DETAILS

SCALE: 3" = 1'-0"

NOTES:

1. REF. DET. 4A/S-2 FOR WELDS.
2. POST SPACED NO MORE THAN 8'-0" O.C.
3. KICK PLATE NOT TO BE INSTALLED ON RAILING LEADING TO VENT.



⑤ ROOF HATCH PLAN

SCALE: 1 1/2" = 1'-0"

LANDING PLAN AND DETAILS

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S-2

Figure 21

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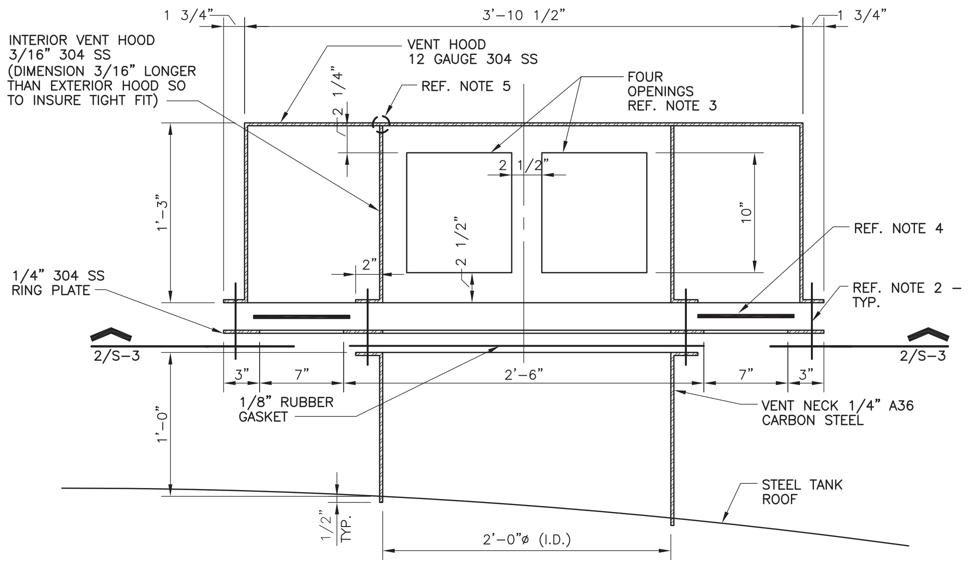
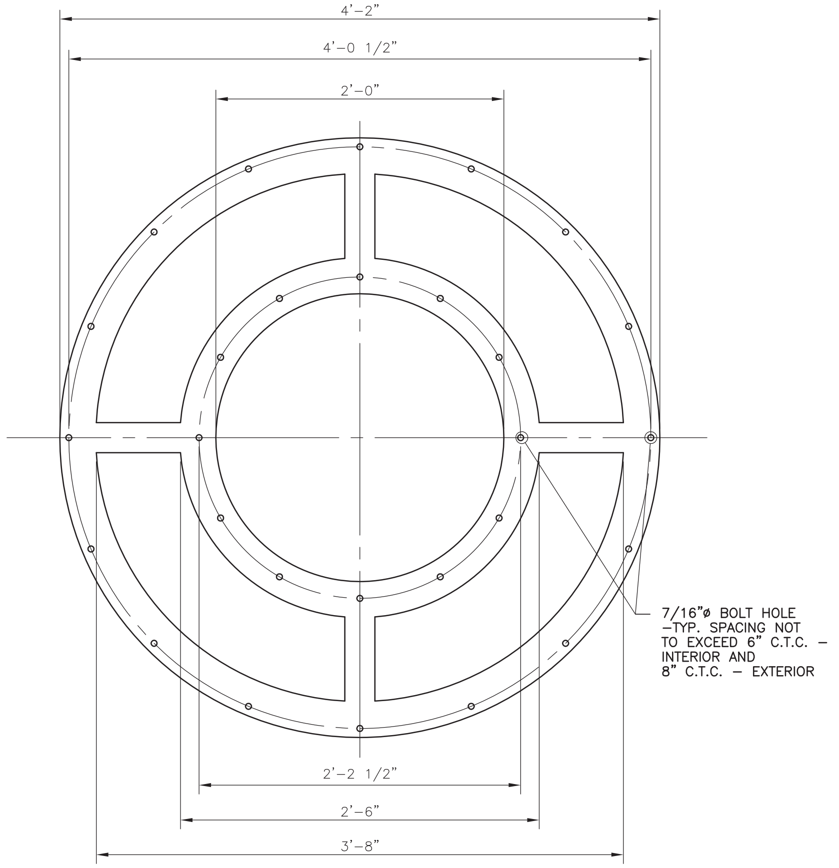


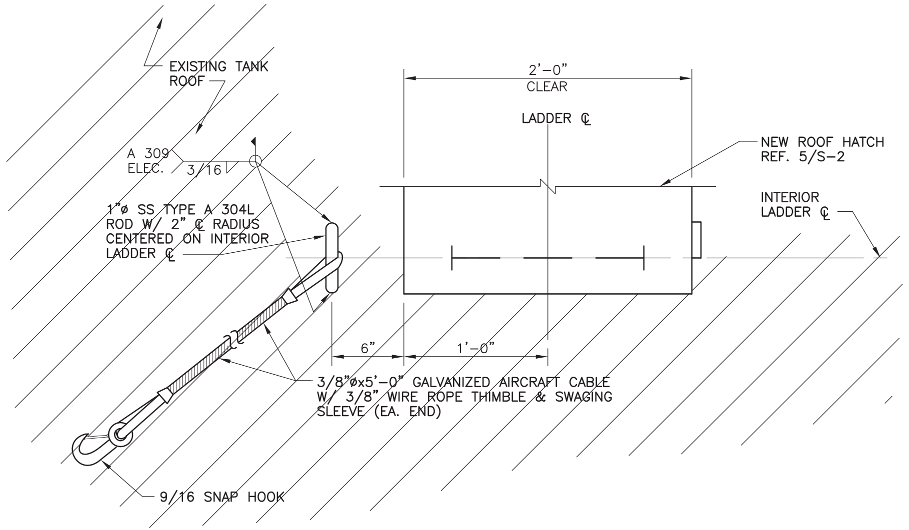
NOTES:

1. VENT NECK TO EXTEND 1/2" BEYOND TANK ROOF OR DOLLAR PLATE ON THE INTERIOR AND 12" MIN. ON THE EXTERIOR.
2. PROVIDE 3/8"ø STAINLESS STEEL BOLTS, FLAT WASHERS, DIELECTRIC WASHERS AND LOCK NUTS.
3. THESE FOUR OPENINGS ARE TO BE WRAPPED IN 16 MESH, 316 SS, 0.018" SCREEN, TO EXTEND 1 1/2" ABOVE AND BELOW THE OPENINGS. THE SCREEN SHOULD OVERLAP BY 3" AT ONE OF THE 4 VERTICAL MEMBERS. SCREEN TO BE STRAPPED DOWN WITH 1/2"x0.030" 316 SS BAND OR HOSE CLAMP AT TOP AND BOTTOM.
4. 10 GA., 2 MESH, LOCK CRIMP, 304 SS WIRE CLOTH. CUT INTO A RING THAT WILL OVERLAP OPENING IN RING PLATE 1/2" ALL AROUND AND IS WELDED ALL AROUND TO RING PLATE.
5. INSTALL U-CHANNEL EXTRUDED RUBBER GASKET BETWEEN INTERIOR AND EXTERIOR HOODS.

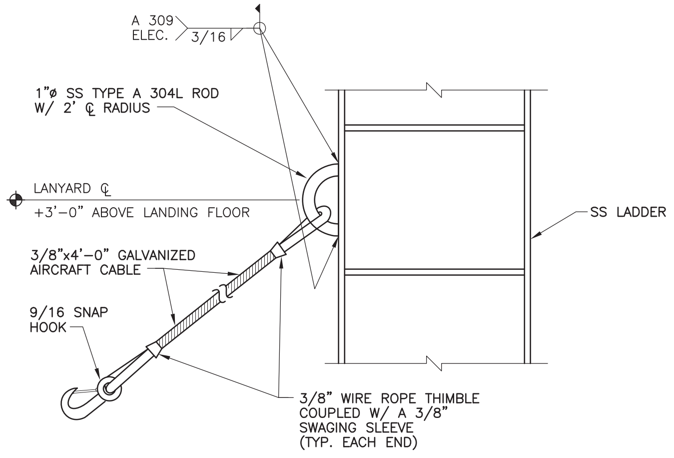
① VENT SECTION
SCALE: 1 1/2" = 1'-0"



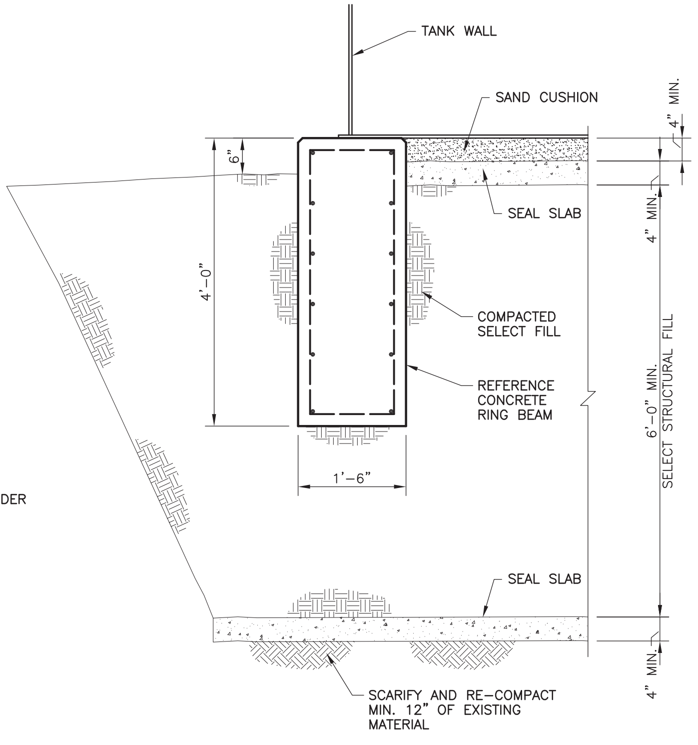
② RING PLATE PLAN
SCALE: 1 1/2" = 1'-0"



③ HATCH LANYARD PLAN
SCALE: 1 1/2" = 1'-0"



④ LANDING LANYARD DETAIL
SCALE: 1 1/2" = 1'-0"



⑤ FOUNDATION DETAIL
SCALE: 3/4" = 1'-0"

Figure 22

ROOF VENT & LANYARD HATCH DETAILS

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Consulting Engineers
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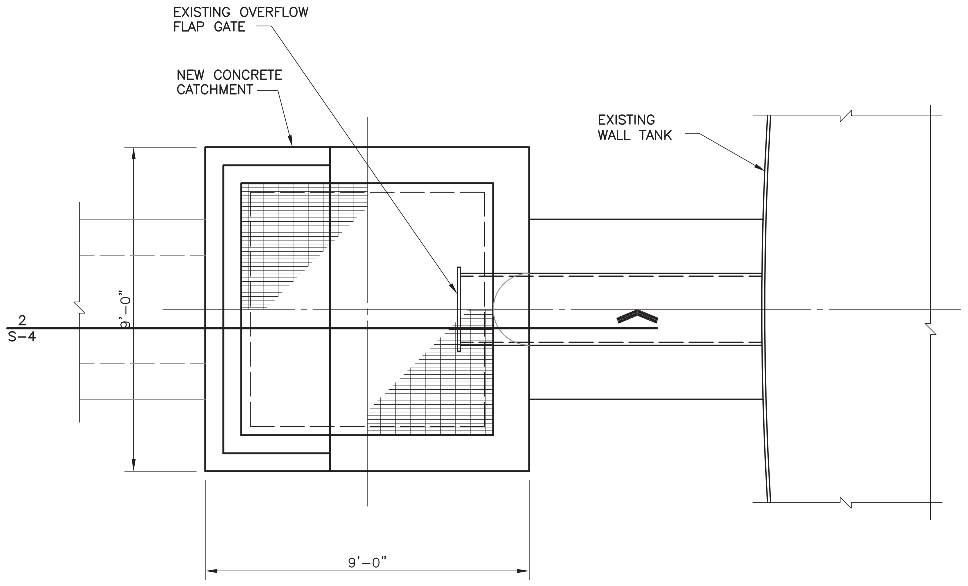
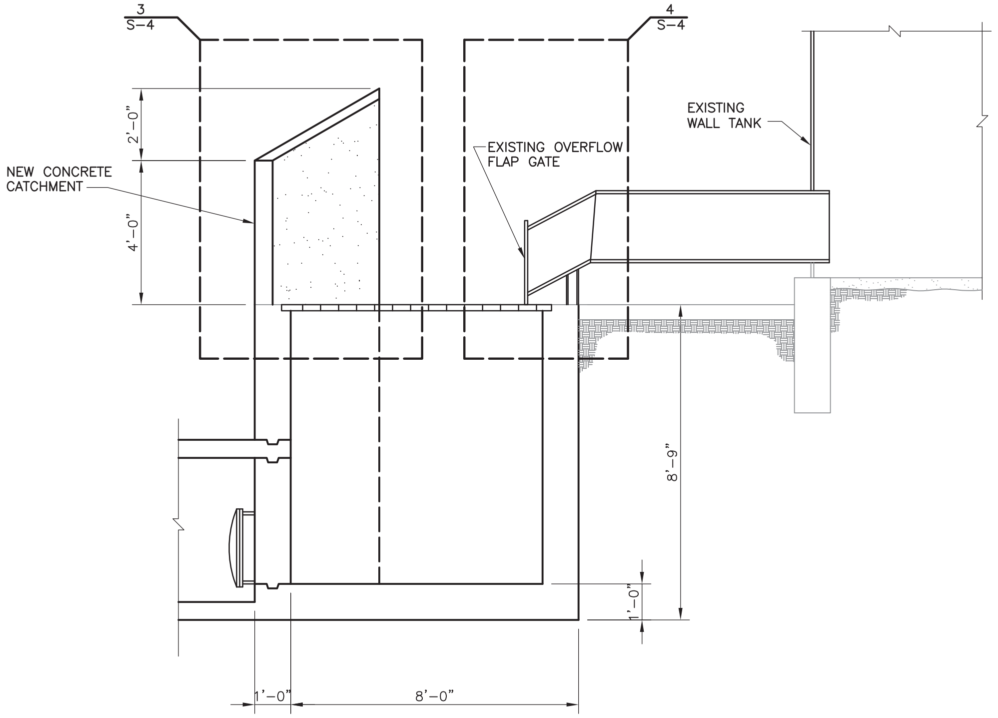
Structural ◆ Civil ◆ Mechanical ◆ Electrical
TBPE FIRM F-3

S-3

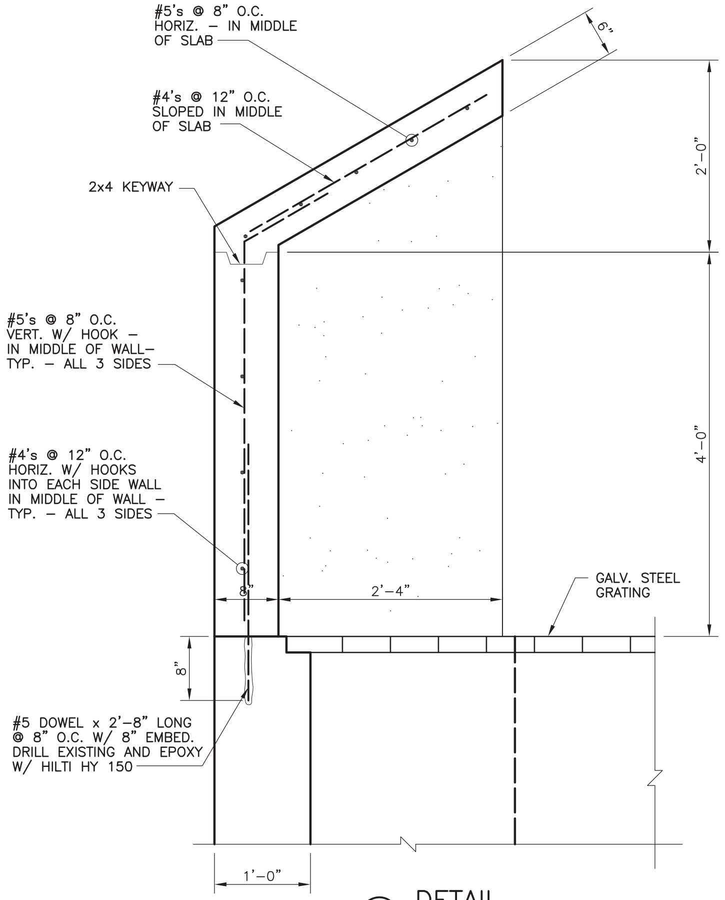
CH2MHILL



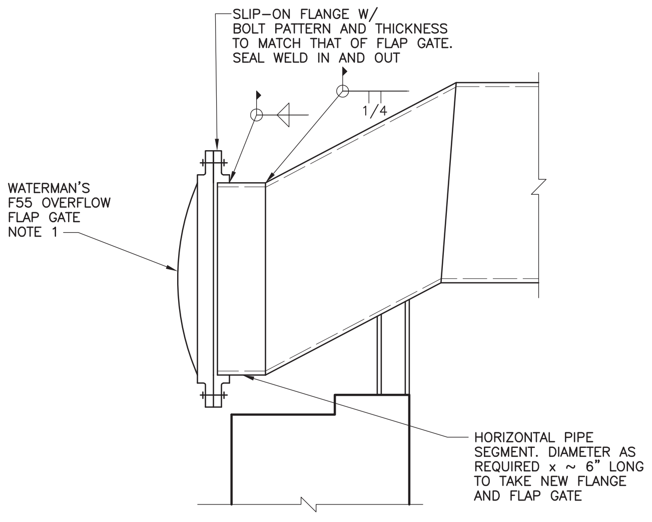
① CATCHMENT PLAN
SCALE: 3/8" = 1'-0"



② CATCHMENT SECTION
SCALE: 3/8" = 1'-0"



③ DETAIL
SCALE: 1" = 1'-0"



NOTE:
1. ASSUME 24"ø FLAP GATE REQUIRED.

④ OVERFLOW FLAP GATE
SCALE: N.T.S.

Jose I. Guerra, Inc.
Consulting Engineers
2401 South IH-35 Suite 210
Austin, Texas 78741
(512) 445-2090
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Figure 23

OVERFLOW CATCHMENT PLAN

S-4

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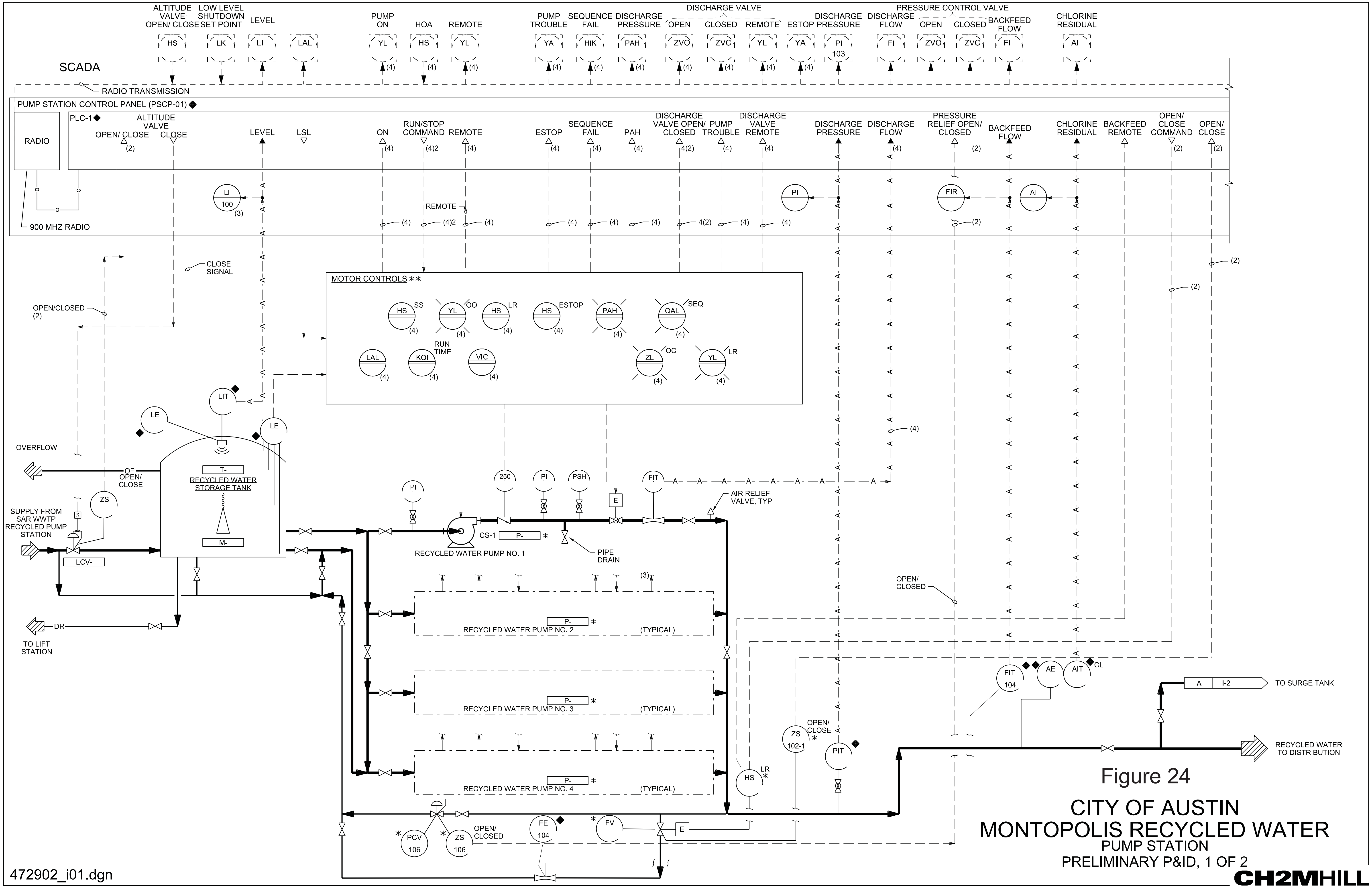


Figure 24

CITY OF AUSTIN
MONTOPOLIS RECYCLED WATER
PUMP STATION
PRELIMINARY P&ID, 1 OF 2

CH2MHILL

472902_i01.dgn

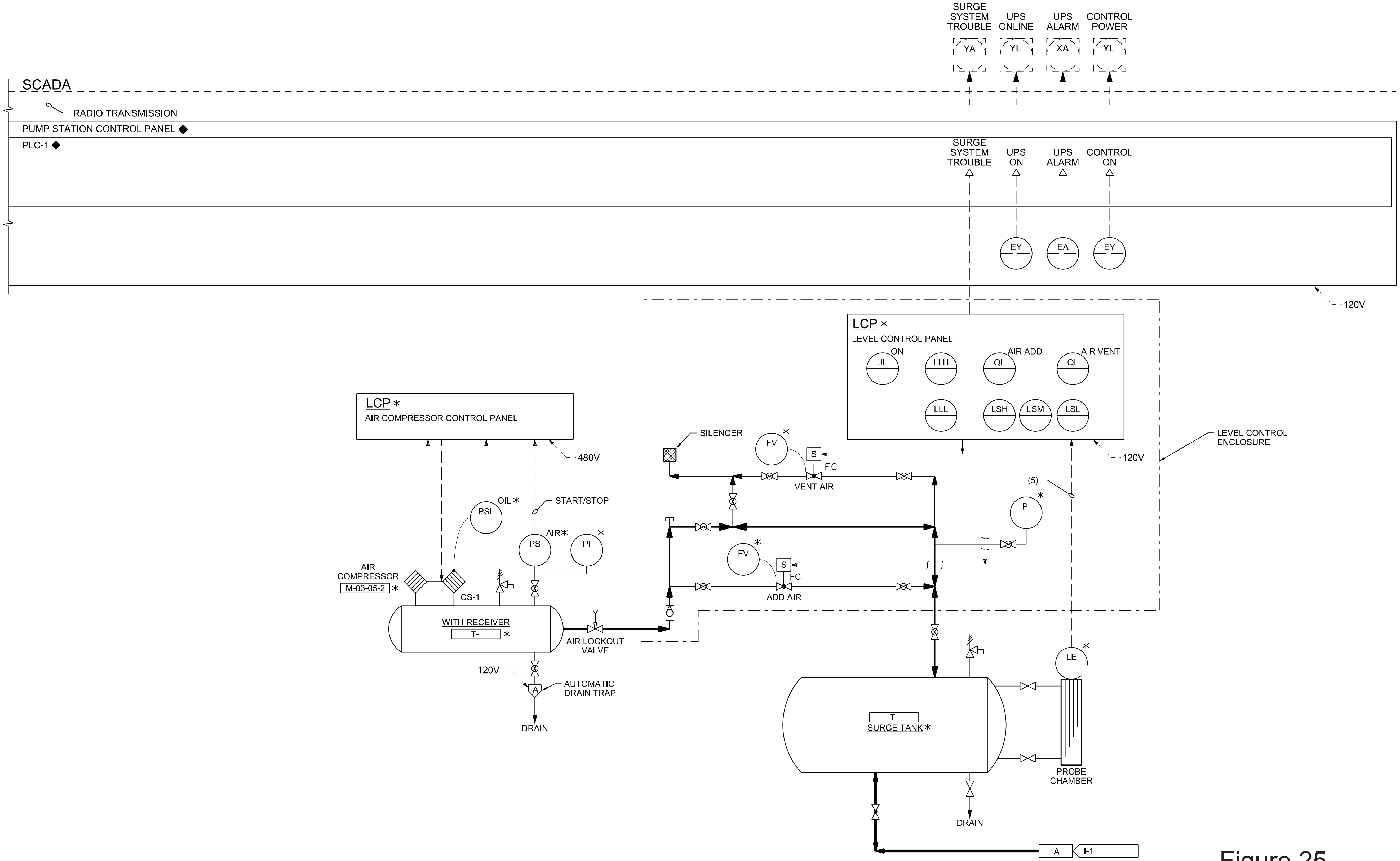
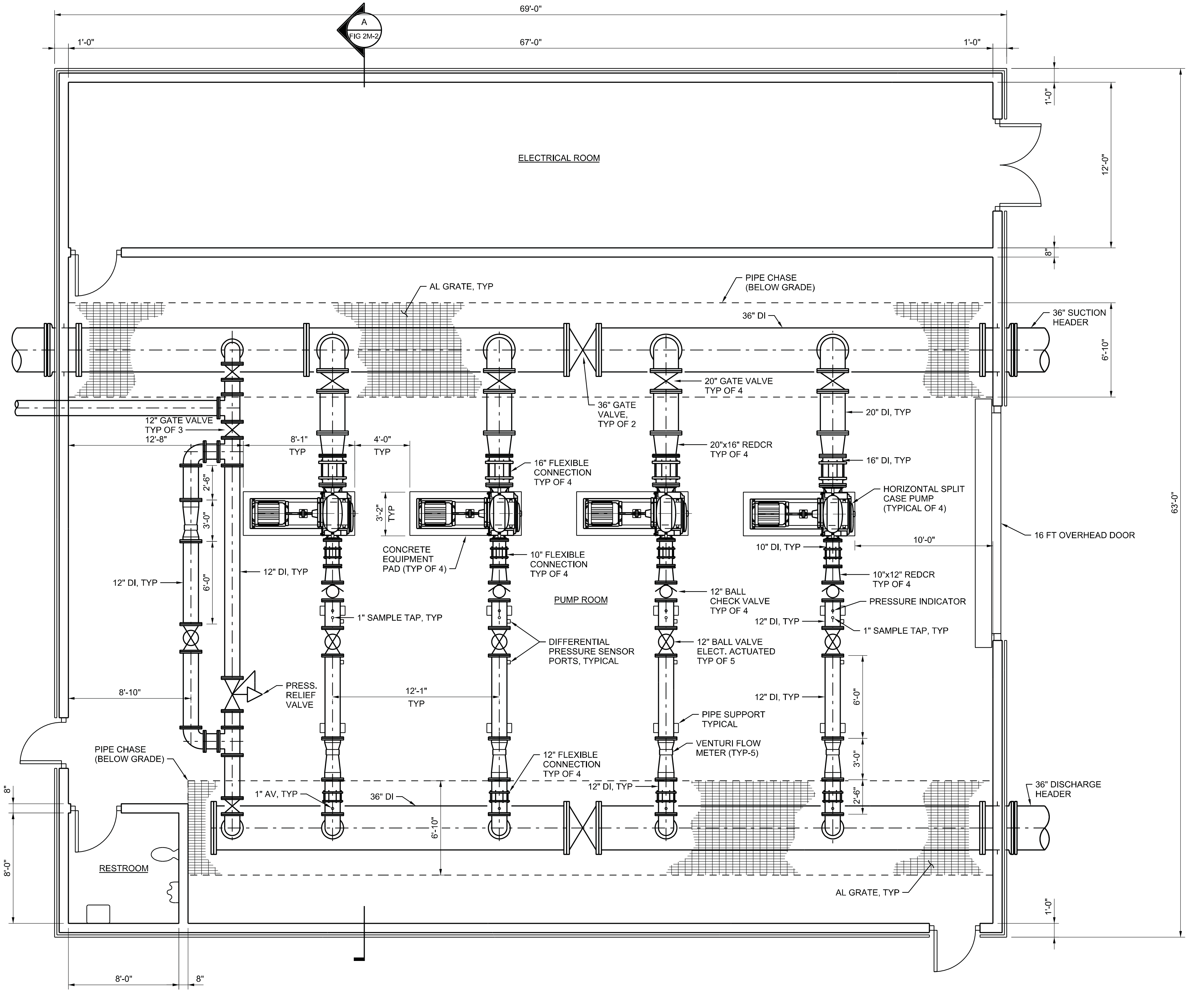


Figure 25

CITY OF AUSTIN
MONTOPOLIS RECYCLED WATER
PUMP STATION
PRELIMINARY P&ID, 2 OF 2

CH2MHILL

472902_i02.dgn



PUMP STATION FLOOR PLAN - MECHANICAL

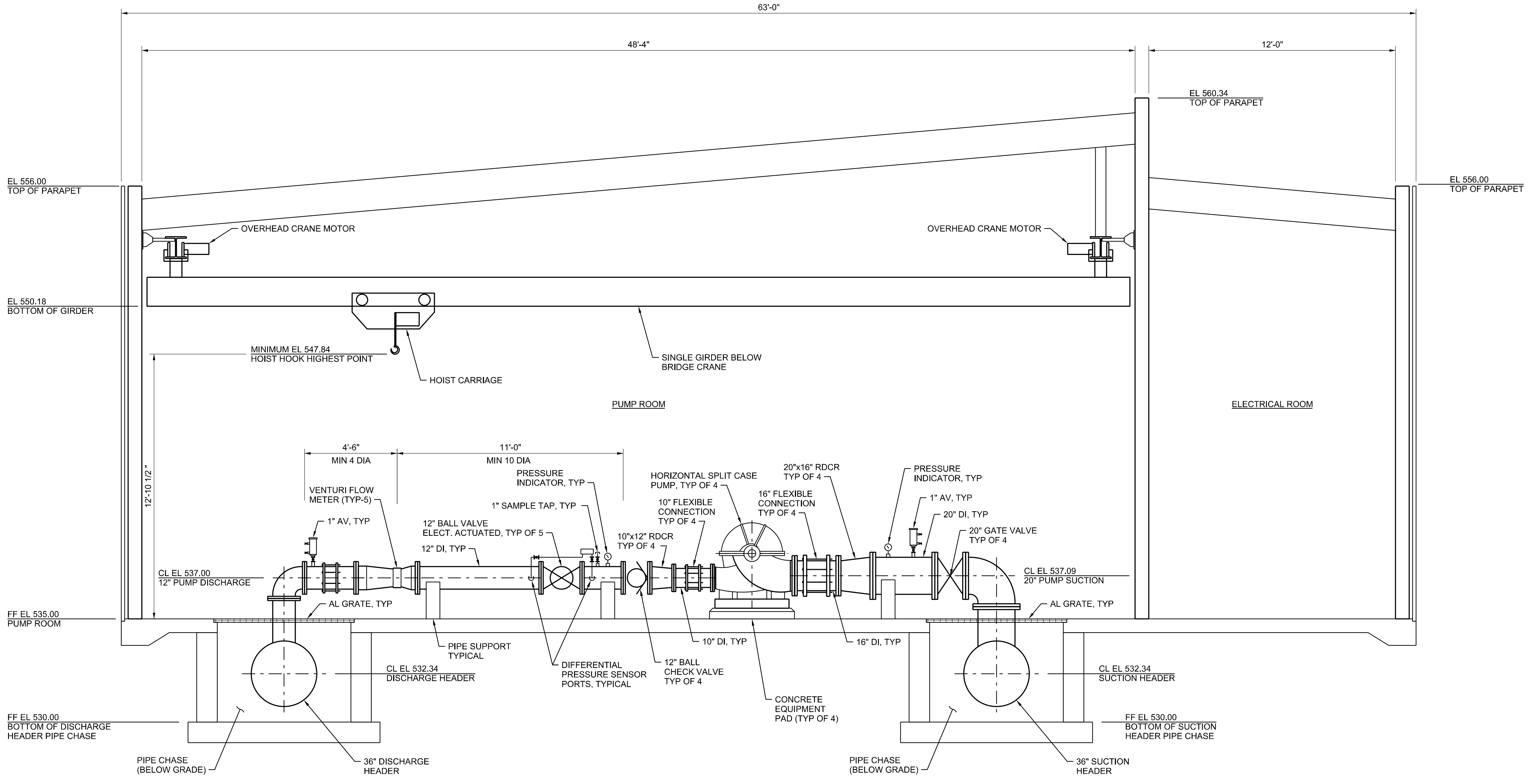
1/4" = 1'-0"

Figure 26

CITY OF AUSTIN
MONTOPOLIS RECYCLED WATER
PUMP STATION
PRELIMINARY LAYOUT

CH2MHILL

100-M-101_472902.DGN



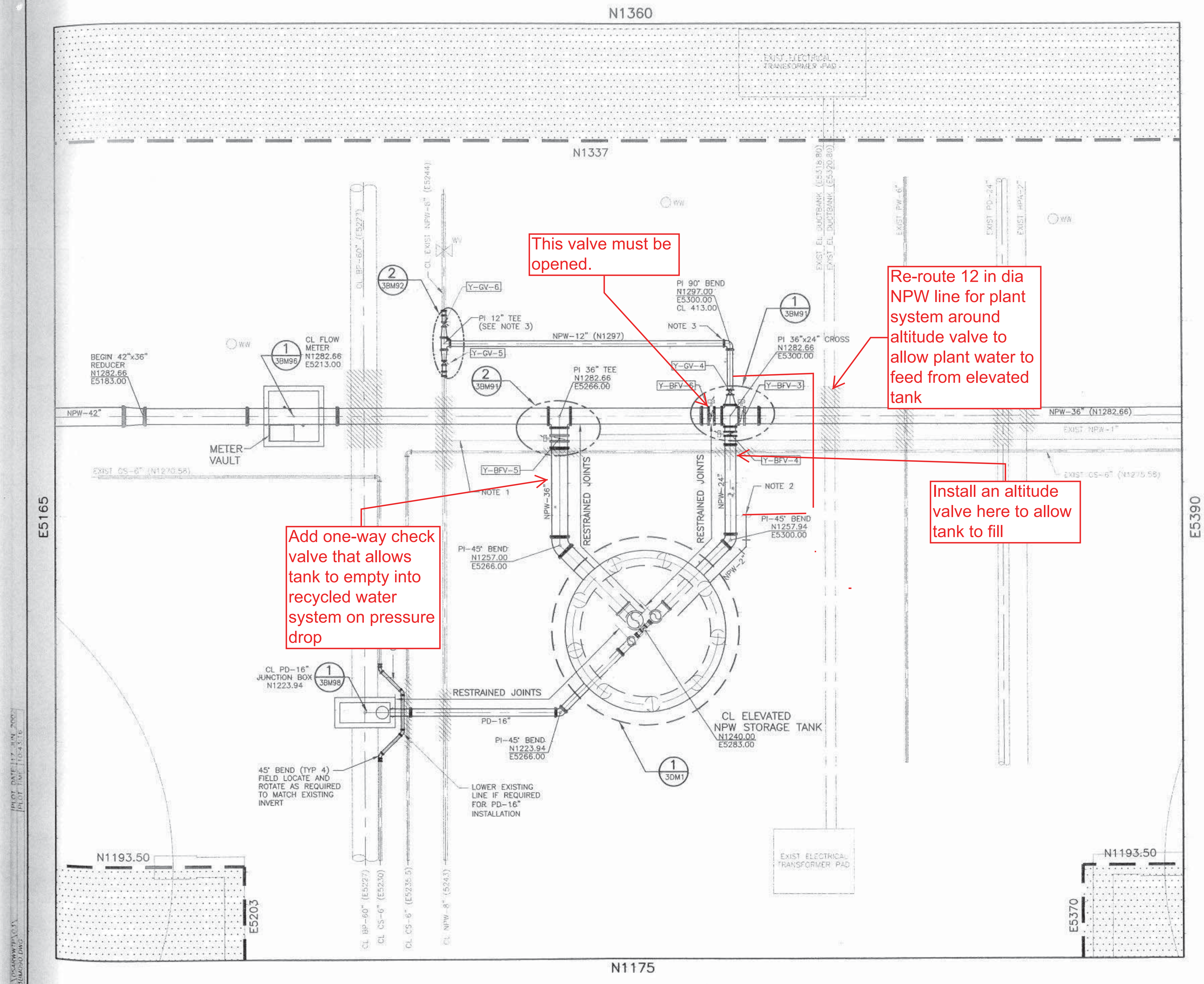
A **PUMP STATION SECTION - MECHANICAL**
3/8" = 1'-0"
FIG 1M-1

Figure 27

CITY OF AUSTIN
MONTOPOLIS RECYCLED WATER
PUMP STATION
PRELIMINARY LAYOUT

CH2MHILL

100-M-102_472902.DGN



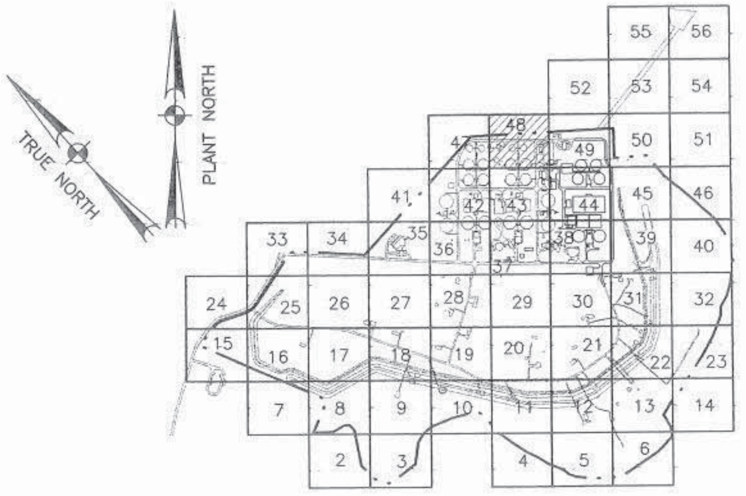
This valve must be opened.

Re-route 12 in dia NPW line for plant system around altitude valve to allow plant water to feed from elevated tank

Install an altitude valve here to allow tank to fill

Add one-way check valve that allows tank to empty into recycled water system on pressure drop

DETAIL ① SCALE: 1"=10'
3BM47
3BM48



KEY LOCATION MAP

PLANT COORDINATE GRID
PROPERTY LIMITS
PROJECT SHEET GRID
CONSTRUCTION LIMITS
BY OTHERS, UNLESS NOTED OTHERWISE
PROBABLE LOCATION OF EXISTING UTILITIES – SEE REFERENCE DRAWING

NOTES:

1. ABANDON EXISTING NPW-1". CAP EXISTING CONNECTION TO NPW-8" LINE. REFERENCE DETAIL 1/3BM97 FOR THE CONNECTION OF NPW-1" TO THE NPW-36" LINE.
2. INSTALL NPW-2" LINE PARALLEL TO NPW-24" AND NPW-36" LINE. LOCATE NPW-2" APPROXIMATELY 2 FT. NORTH OF NPW-36" ALONG THE ENTIRE ALIGNMENT. CONNECT NPW-2" TO NPW-24" ELEVATED TANK INLET PIPE PER SECTION A/3DM1. REFERENCE MECHANICAL DRAWING 3FM1 FOR THE CONNECTION OF NPW-2" LINE TO THE PUMP STATION. ANY OTHER CONNECTIONS TO THE NPW-2" LINE ARE STRICTLY PROHIBITED.
3. FIELD LOCATE EXISTING LINES, INSTALL AND ROTATE PROPOSED FITTINGS AS REQUIRED. FOR OFFSET MAKE-UP AND CONNECTION TO EXISTING PIPING.

Figure 28

NO.	DATE	REVISION	APPROV.
4			
3			
2			
1			

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

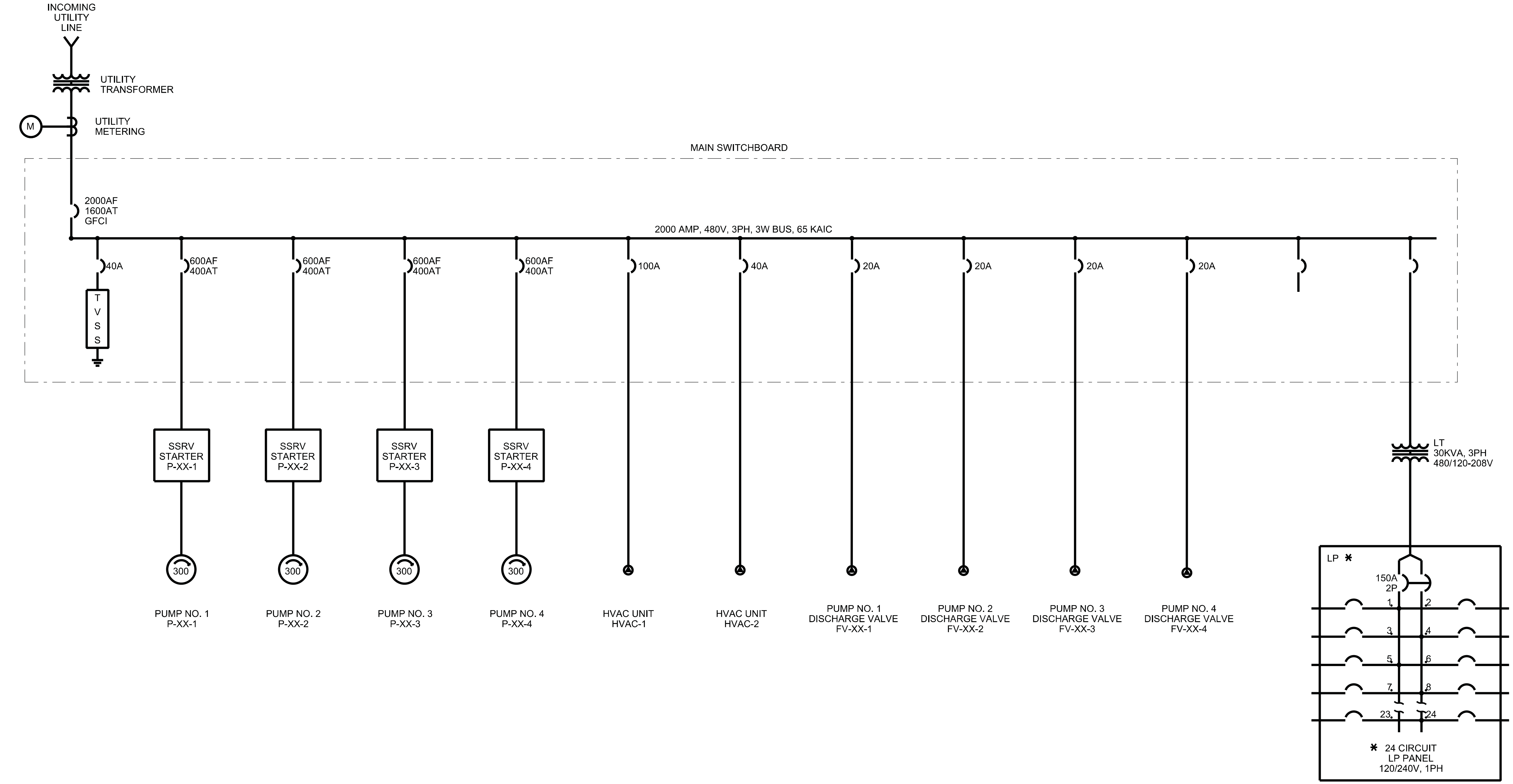
CHARLES N. HURST
82464
6/25/02

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT
WATER REUSE / NPW FACILITIES IMPROVEMENTS

SITE PIPING – DETAIL

Turner Collie & Braden Inc.
ENGINEERS • PLANNERS • PROJECT MANAGERS

Unit	PUBLIC WORKS	Scale	1"=10'	Date	MAY 2002
Designed	ICC	Checked	CNH/ICC	Job No.	72-07109-350
Drawn	PW	Approved	SGE	Dwg No.	3BM90



LEGEND:

SSRV = SOLID STATE REDUCED VOLTAGE
TVSS = TRANSIENT VOLTAGE SURGE SUPPRESSOR
PFR = PHASE FAILURE RELAY
LT = LIGHTING TRANSFORMER
LP = LIGHTING PANEL

PUMP STATION ONE-LINE DIAGRAM

Figure 29

Appendix A
Scope of Work

Scope of Work

1.4.1 Phase A: Preliminary Phase Services (03.35.05) The purpose of this Phase is to develop the basis of design documentation. The documentation will include the objectives, design criteria, design inputs, and design intent of all of the design disciplines - site/civil, architectural, structural, mechanical, building services (plumbing and HVAC), electrical, and instrumentation and controls. Site investigations and hydraulic modeling becomes part of the design inputs. An initial kick-off workshop is used to develop and evaluate alternative design concepts. . The end product from this task will include a Preliminary Engineering Report that combines and summarizes the findings of each investigation described in this section, including sketches and preliminary drawings which will provide sufficient information for Owner and agency review and design team coordination and review. CH2M HILL will conduct an interactive workshop with the Owner's personnel prior to the conclusion of this task. Specific work activities and deliverables from this task are as identified below.

1.4.1.2 Project Kickoff and Team Chartering Workshop (03.80.10)

1.4.1.2.1 Plan project kickoff and team chartering one-day workshop.

1.4.1.2.2 Conduct Team Chartering – half-day.

Includes team introductions, defining project purpose, identifying critical success factors, listing roles and responsibilities, defining operating guidelines for communications, change management, safety procedures, and document controls.

1.4.1.2.3 Conduct Project Kickoff – half day.

1.4.1.2.3.1 Define Client Objectives, Standards and Preferences.

The purpose of this subtask is to define design boundaries. Identify constraints for flow (current and future), operating pressures, customer pressures, water quality (chlorine disinfection mainly), reliability and redundancy of system.

1.4.1.2.3.2 Define External Constraints and Standards

The purpose of this task is to define the external standards and criteria that influence the project design work. The standards and criteria in the following areas will be considered:

1.4.1.2.3.2.1 <u>Regulatory Agencies:</u> Define the regulatory agencies with jurisdiction for this project and specific contact people. List all known permits required for construction and operation.

1.4.1.2.3.2.2 <u>Civil:</u> Identify local stormwater control agency, document restrictions as they pertain to the proposed project, define permitting requirements; identify any local public work standards as they pertain to roads, stormwater, sewer etc; any local restriction regarding dust control, demolition, construction traffic/noise, excess earthwork disposal, any existing floodplain restrictions, etc.

1.4.1.2.3.2.3 <u>Structural/Architectural/Mechanical:</u> Identify local permitting agency, obtain current local design codes and standards that are in effect, define permitting requirements.

1.4.1.2.3.2.4 <u>Electrical/I&C:</u> Define redundancy requirements, identify primary contact at local utility.

1.4.1.2.4 Owner to conduct plant tour for project team.

1.4.1.2.5 **Deliverable** – Charter Document that is endorsed by team members and meeting minutes from kickoff workshop in pdf electronic format.

1.4.1.3 Investigations (03.31)

1.4.1.3.1 Environmental Investigation includes Cultural Resources Assessment, endanger species, wetlands, and hazardous waste areas. (03.30.15.30)

1.4.1.3.2 Survey (03.31.25)

Per 1.4.2.3 of the Supplemental Terms and Conditions of the Agreement including a tree survey.

1.4.1.3.3 Geotechnical Investigation includes site soil borings and soil samples. Results and recommendations to be included in report as described in 1.4.1.8. (03.31.30)

Determine site specific geotechnical conditions for each facility and structure.

Develop specific foundation requirements.

Verify constructability (shoring and bracing requirements, dewatering issues).

Using existing geotechnical data and results of investigations, prepare foundation and corrosion control recommendations.

1.4.1.3.4 Hydraulic Model Review (03.31.50)

- Review Owner's hydraulic model of WRI piping network.
- Confirm pipeline sizing to new storage reservoir, reservoir floor elevation, reservoir height, and pump design points. Include piping improvements at SAR storage reservoir to prevent it from overflowing when setting new pump station storage reservoir levels.
- Conduct surge analysis on existing SAR pump station and reservoir supply pipeline and new pump station and pipeline. Determine air/vacuum relief requirements and pipe class requirements. Recommend surge protection measures.

5.1.1.1 Task 1 – EPANET Model Update

5.1.1.2 CH2M HILL will review and update the existing EPANET hydraulic model focusing on the sizing of the new storage at Montopolis and its elevation settings, the pump station capacity at Montopolis, and the piping at the SAR WWTP.

5.1.1.3 Task 2 – Data Preparation and Input

CH2M HILL will gather the data required for the surge analysis and input that data into the transient analysis software model. The updated EPANET hydraulic model will be utilized by CH2M HILL. CH2M HILL will also calculate the wave speed for all the pipelines based on the specific pipeline material and thickness or pressure class for each segment.

Assumptions:

Existing EPANET steady-state Hydraulic model, updated by CH2M HILL will be used as a starting point for the transient surge model input.

5.1.1.4 Task 3 – Transient Analysis for Two Models

CH2M HILL will perform the transient analysis of the following models:

1. Surge analysis on the existing 24-inch pipeline from SAR WWTP to the new Montopolis reservoir.
2. Surge analysis on the downstream side of the new pump station at Montopolis that feeds into the 51st Street elevated tank.

The transient surge will be generated by a rapid shutdown or startup of the all the pumps at the respective pumps stations including any future pumps that may be installed.

Assumptions:

Only these specific scenarios will be run and the associated deliverable graphics and summaries for these scenarios will be generated. Only the one pump station configuration will be analyzed for each scenario.

5.1.1.5 Task 4 – Surge Mitigation Recommendations

CH2M HILL will evaluate the results from Task 3 and provide recommendations on appropriate surge mitigation devices to prevent any damaging transient surge pressures. CH2M HILL will also provide details such as the recommended size and location of the surge mitigation devices. The surge mitigation device(s) configuration and details will be discussed with the City of Austin prior finalizing any recommendations. The models will be analyzed with the recommended surge mitigation devices and results presented.

5.1.1.6 Task 5 – Technical Memorandum

The technical memorandum will address the following objectives:

- Present the magnitudes of the transient surges for the different scenarios analyzed.
- Provide recommendations for surge mitigation device(s).
- Provide details on the surge mitigation devises including sizing and locations.
- Present the magnitudes of the transient surges for the different scenarios with the surge mitigation device(s) recommended in task 4.

Deliverables:

The technical memorandum with the following items:

- Envelope curves showing the maximum up-surges and maximum down-surges along the pipeline profile from the suction point to a significant discharge location or where the surge pressures have dissipated significantly. These envelope curves will be generated for all scenarios.
- Plan view, denoting graphical pressure surge results along pipeline routes for all scenarios. Areas of high pressure and negative pressure or column separation will be denoted in plan form.
- Pressure vs. time plots of the following locations:
  - Suction side of the HSJTEPS.
  - Discharge side of the HSJTEPS.
- Recommended configuration for surge mitigation device(s) including specific details of sizing and locations.

1.4.1.9 Preliminary Engineering and Investigations Report (PER) (03.35.10.65)

The purpose of this task is to prepare details and summaries of findings for the project in a report.

1.4.1.9.1 Civil and Site Development

- Review existing site mapping and survey information. Determine adequacy of existing topographical survey and boundary mapping.
- Identify environmentally sensitive areas, such as wetlands and hazardous waste areas.
- Determine zoning and local site development requirements.

Document site constraints.

- Document overall civil concepts.

1.4.1.9.2 Pump Station Architectural/Structural

- Identify proper address for site, lot and block information
- Obtain proper name of project and client’s facility number for each building if applicable.

- Identify the level of sustainability which will be utilized in the development of the project. Verify client's intent on available certifications like. LEED.
- Identify each building site locations and function of each building.
- Determine the size and general construction type for buildings in the project.
- Determine applicable Codes.
- Identify all entities which will be authorities having jurisdiction.
- Identify contact information for each authority having jurisdiction.
- Clearly establish the Architect and Engineer who will be sealing the documents for the project.
- Coordinate with the architect on the preliminary selection of structural systems and materials for buildings. Provide input to the discussion of architectural concepts as needed.
- Discuss preliminary foundation concepts with the geotechnical engineer, and define requirements for geotechnical information (boring locations, required design parameters, etc.).
- Prepare a description and/or sketches defining the new buildings and their functions as a part of the pump station.
- Document overall architectural concepts.
- Highlight special design solutions and elements of design which make proposed solutions unique.

1.4.1.9.3 Structural Storage Reservoir

- Identify the governing building code(s) and any local criteria and amendments or special project requirements.
- Discuss preliminary foundation concepts with the geotechnical engineer, and define requirements for geotechnical information (boring locations, required design parameters, etc.).
- Select preliminary structural gravity and lateral load resisting systems.
- Confirm if any special client-specific standards are required and available for drawings, specifications, etc.
- Document overall structural concepts.

1.4.1.9.4 Mechanical

- Perform review and document all applicable Codes, Regulations, and Standards to be used and referenced in the design. Identify Owner design Standards, standard specifications, and standard details to be used on the project.
- Identify authority having jurisdiction over the facilities, coordinate with Architectural, Structural and Building Mechanical.
- In conjunction with process engineers, develop process flow diagrams.
- Review and summarize Owner's preferences and specific requirement for blowers, pumps, valves, process equipment and other mechanical components and related appurtenances.
- Initiate development of corrosion control requirements for materials of construction of equipment, valves, and piping, including protective lining and coatings with the Lead Corrosion Technologist.
- Documentation of overall process design criteria, concepts, and considerations including summary of equipment selection
- Summarize and document required design parameters, processes, and conditions of service, including expansion requirements. Include all known boundary conditions, assumptions, and

variables. Summarize functional requirements for the facilities plan including flow rate, storage, and water quality requirements.

- Develop process flow diagrams (PFDs) for unit processes.
- Evaluate unit process alternatives including site, utility, manpower, etc requirements
- Define number, locations, and functions of buildings.
- In conjunction with the process mechanical engineers, develop basic process mechanical layouts to determine size of each building.
- Develop treatment process description and PFDs.
- Initial hydraulic profile.

1.4.1.9.5 HVAC/Plumbing

- With the project architect, identify and document the contacts for the official building code(s) and local design criteria governing the project.
- Establish ambient design conditions.
- Determine the Owner's requirements and/or preferences for indoor versus outdoor locations for equipment types and component systems.
- Coordinate with the process mechanical, I&C, and electrical Task Leaders to identify all heat-generating equipment that will contribute to the facility heat loads.
- Calculate preliminary heat loads for all heat generating equipment using the standardized Building Mechanical calculation template.
- Verify any special requirements around filtration of air to remove particulates or other contaminants that should be removed from outside ventilation air.
- Perform preliminary HVAC calculations to determine major equipment and duct work sizing.
- Coordinate in the development of architectural concepts and design criteria regarding preliminary equipment space requirements (e.g., size, location, and orientation) including volume provisions for routing ductwork.
- Document overall HVAC concepts.
- Coordinate with the local Fire Marshall and architect to determine overall requirements for sprinklers and fire protection water.
- Identify the Owner's preferred equipment and plumbing piping system requirements.
- Document sprinkler and fire protection design criteria and water needs.

1.4.1.9.6 Instrumentation and Controls

- In conjunction with process design engineers and the Owner, develop an overall control philosophy, including preferences for local versus central control and level of automation and basic architecture.
- In conjunction with the Owner, define the desired data flow and level of integration of ancillary I&C systems.
- Document overall control philosophy and basic design criteria and considerations

1.4.1.9.7 Electrical

- Identify electric utility and obtain contact name, address, and telephone number. For large or remote facilities, make initial contact with electric utility to establish general service requirements, service voltage, potential for alternate source if standby power is required, and basis for cost of service. Determine scope of work required to provide service to the site.

- Establish the need for stand-by power source.
- Identify the authority having jurisdiction for electrical and fire alarm systems
- Identify applicable local codes such as noise, light pollution, and energy codes.
- Determine protective device coordination and arc flash needs and responsibilities.
- Determine if additional ventilation or related changes are needed to meet NFPA 820 requirements in pump stations.
- Power and Lighting Concepts - Identify if any Owner design standards, standard specifications, or standard details.
- Identify any electrical sustainable development goals for the project.
- Determine if fire alarm, security, telephone and data, paging, CCTV, cable TV, or lightning protection systems are required.
- Document overall electrical concepts.

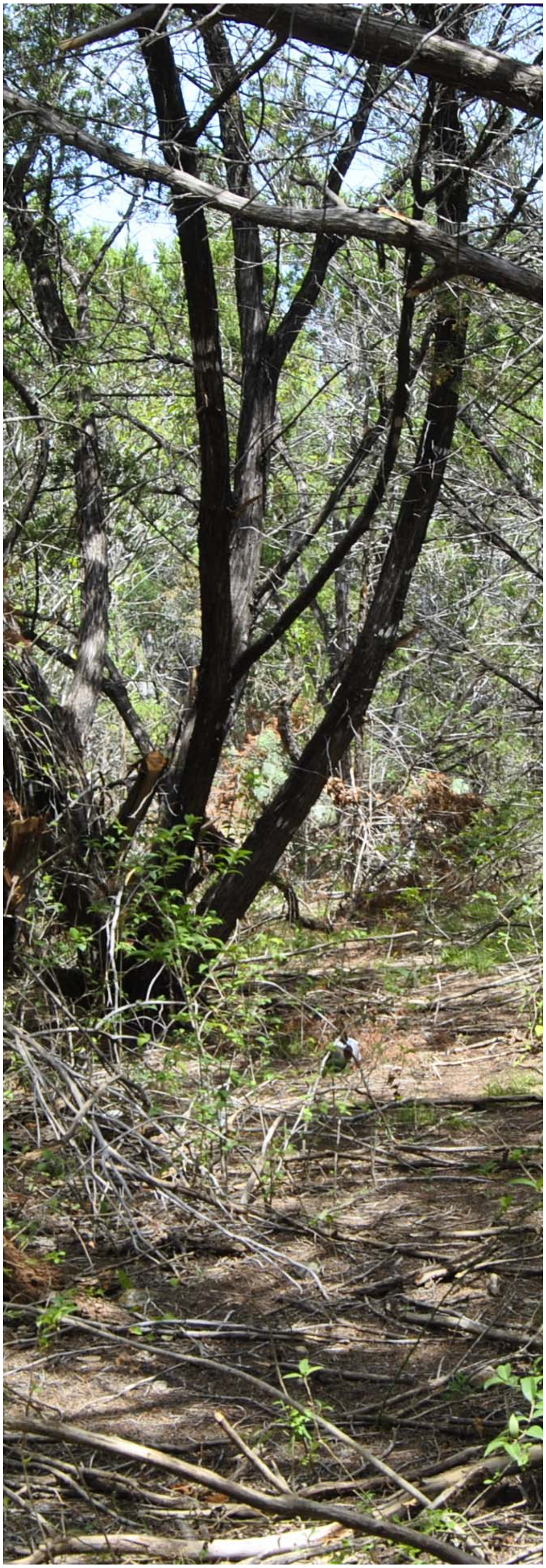
1.4.1.9.8 Preliminary Engineering Design Workshop

CH2M HILL will conduct a one-day workshop with the Owner's personnel to review the work products from subtasks 1.4.1.1 through 1.4.1.8 as defined above and in the Supplemental Terms and Conditions of the Agreement. The workshop will be held at the Owner's office. Final minutes from the workshop, and the work products as defined above will be assembled in the Preliminary Engineering Report and submitted to the Owner.

1.4.1.9.9 Preliminary Engineering Report

- Develop draft report and submit for review to senior technology team and City of Austin team.
- Finalize report. This report will define the scope items to be carried forward into final design in Phase B.
- **Deliverable** – Ten (10) hard copies and one electronic copy in pdf file format of final report.

Appendix B
Environmental Investigations



TECHNICAL MEMORANDUM

Environmental Constraints Evaluation, City of Austin Montopolis Water Reuse Storage Project

Prepared by

Hicks & Company
1504 West 5th Street
Austin, Texas 78703

July 8, 2013

HICKS & COMPANY
ENVIRONMENTAL
ARCHEOLOGICAL
AND PLANNING
CONSULTANTS

HICKS & COMPANY
ENVIRONMENTAL
ARCHEOLOGICAL
AND PLANNING
CONSULTANTS

1504 WEST 5TH STREET AUSTIN, TEXAS 78703 TEL: 512 / 478-0858 FAX 512 / 474-1849

TECHNICAL MEMORANDUM

TO: Joe Jenkins, P.E.
CH2M Hill

FROM: Roy Frye Roy G. Frye
Hicks & Company

DATE: July 8, 2013

RE: Environmental Constraints Evaluation, City of Austin Montopolis Water Reuse Storage Tank

---

1.0 Introduction

This Technical Memorandum documents the findings of an environmental constraints analysis conducted for a proposed water reuse storage tank site and associated water line near the intersection of Montopolis Drive and State Highway (SH) 71 in Austin, Travis County, Texas. The analysis was conducted to assist the engineering design consultant, CH2M Hill, in assessing the site for the presence of cultural resources, endangered species, and wetlands and to identify any associated environmental constraints or permitting issues. The project has been assigned under the City of Austin (COA) Water Utilities Rotation List.

The focus of the evaluation was to: 1) identify the occurrence of any waters of the U.S., including wetlands, potentially regulated by the U.S. Army Corps of Engineers (USACE) and any associated permitting requirements under Section 404 of the Clean Water Act; 2) determine the potential occurrence of federally and state-listed endangered species or their critical habitats; and 3) determine the potential for impacts to any archeological resources. This report contains a description of the existing conditions at the project site, including the presence of any critical environmental features as defined by the COA; results of an evaluation to delineate waters of the U.S., including wetlands, subject to regulation by the USACE; and results of endangered species and archeological resource investigations.

2.0 Project Description

The proposed project includes the construction of a water reuse storage tank and associated underground pipeline that would connect the storage tank to existing water reuse infrastructure (**Figure 1**). The site location for the storage tank is approximately 2.01 acres in size. The pipeline corridor includes a 30-foot water line access easement, 10-foot public utility easement, 10-foot electrical easement, and 20 foot temporary construction easement, all being used for the project and comprising a 70-foot corridor. The pipeline corridor to the tank site is approximately 850 feet long by 70 feet wide, or about 1.37 acres. The total footprint area for the project is about 3.44 acres. The area is densely vegetated as described in **Section 3.3** below and portrayed by **Figures 2** and **3**.

3.0 Affected Environment

3.1 Topography

The site is located in southeastern Austin, Travis County, Texas, within the Austin East 7.5-minute quadrangle map published by the U.S. Geological Survey (USGS). Topography in the project area is gently sloping from northwest to southeast, with the exception of an incised swale near the western terminus of the pipeline corridor within 150 feet of Montopolis Drive. This swale begins as a gentle depression within the alignment corridor (**Figure 4**) that runs down slope approximately 80 feet, where it changes to an incised rocky outcrop that is about seven feet high (**Figure 5**). Surface elevations decline from about 620 feet mean sea level (msl) near the middle of the pipeline corridor on the northwestern side of the project area to about 584 feet msl on the southeastern side of the area (COA 2013a).

3.2 Geology

The project area lies within portions of two geological formations: the high terrace deposits (Qht) dating to the beginning of the early Pleistocene, and the Ozan formation (Ko) that was laid down during the Upper Cretaceous Epoch between 72 and 100 million years ago (BEG 1981, 2007) (**Figure 6**). High terrace deposits in the Austin area are fluviatile formations representing former levels of the Colorado River and its tributaries. Commonly, the matrix is composed of gravel, silts, sands, and clays. The Ozan Formation (locally named the Sprinkle Formation) is comprised of clay and marl with calcareous content decreasing upwards through the formation, which is about 600+ feet in thickness. Characteristic nodules of hematite and pyrite and silt-size quartz and calcite fragments are common and become more abundant upward, where shape is blocky and fractures conchoidal (BEG 1981).

3.3 Soils

According to the United States Department of Agriculture's (USDA's) Web Soil Survey for Travis County (USDA 2012), soils within the proposed project area consist of Heiden clay (HeD2), 5 to 8 percent slopes, moderately eroded; Patrick soils (PaC), 2 to 5 percent slopes; Lewisville silty clay (LcB), 1 to 2 percent slops; and Houston Black soils (HsD) and Urban Land, 0 to 8 percent slopes (**Figure 6**). Heiden clay is derived from clayey residuum weathered from Eagleford shale or Taylor marl. Both the Patrick and Lewisville series are parented from quaternary alluvium derived from mixed sources typically located on terrace landforms. Houston Black soils and Urban land consist of 56 percent Houston Black clay, 30 percent Urban Land, and about 14 percent other soils including but not limited to Heiden and Burleson clay. This unit is located on ridges and foot slopes and in urban areas.

<u>Anticipated Impacts:</u> Adverse impacts to soils and geology from the proposed project would be negligible. Operations would not cause discernible alteration to geologic layers or surficial or shallow geology. This level of alteration to soils and geology would not affect the geology or soils' long-term ability to sustain biota, water quality, or hydrology. No reclamation would be expected to be necessary.

3.4 Vegetation in the Study Area

The project site occurs within a transition area between the Edwards Plateau (west of Austin) and the Texas Blackland Prairies (east of Austin) as mapped by Griffith et al. (2004) and USEPA (2003). These vegetation regions were originally described by Gould et al. (1960) and Gould (1975) and have been mapped in more detail by TPWD (2011).

A field evaluation of existing vegetation was conducted within the project area by Hicks & Company ecologists in June 2013. The site was characterized as Ashe juniper (*Juniperus asheii*)-dominated woods with a vegetation height averaging about 18-25 feet with a canopy coverage ranging between 75 and 100 percent (**Figures 2** and **3**). Within this community, a number of woody and herbaceous species were observed (**Table 1**).

Table 1 Plants Observed During Field Reconnaissance

Trees	Shrubs/Vines/Succulents	Grasses/Forbs/Herbaceous
Ashe juniper (*Juniperus asheii*)	Dewberry (*Rubus aboriginum*)	King Ranch bluestem (*Bothriochloa ischaemum*)
Live oak (*Quercus virginiana*)	Grape (*Vitis sp.*)	Texas grama (*Bouteloua regidiseta*)
Brazil (*Condalia hookeri*)	Poison ivy (*Toxicodendron radicans*)	Coreopsis (*Coreopsis tinctoria*)
Bumelia (*Bumelia lanuginosa*)	Greenbriar (*Smilax bona-nox*)	Prairie verbena (*Glandularia bipinnatifida*)
Mesquite (*Prosopis glandulosa*)	Prickly Pear (*Opuntia lindheimeri*)	Cedar sedge (*Carex planostachys*)
Ligustrum (*Ligustrum sinense*)	Skunkbush sumac (*Rhus aromatica*)	
Chinaberry (*Melia azedarach*)	Evergreen sumac (*Rhus virens*)	
Cedar elm (*Ulmus crassifolia*)	Elbowbush (*Forestiera pubescens*)	
Soapberry (*Sapindus saponaria*)	Yaupon (*Ilex vomitoria*)	
	Nandina (*Nandina domestica*)	
	Lantana (*Lantana horrida*)	

The overall habitat quality and diversity of the vegetation within the project area has been substantially influenced by a highly disturbed suburban landscape. Many areas within the site have been invaded by ligustrum and chinaberry and are being disturbed by trails, brush clearing for camping areas, and illegal trash disposal.

Tree Preservation

A tree survey performed for the project indicated eight species occurring with trunk (bole) sizes eight inches or greater: Ashe juniper, hackberry (*Celtis laevigata*), live oak, (*Quercus Virginiana*) Texas oak (*Quercus buckleyi*), cottonwood (*Populus deltoides*), Osage orange (*Maclura pomifera*), cedar elm (*Ulmus grassifolia*), and an unknown species. According to the COA Ordinance 20100204-038, a "protected tree" is one with a diameter of 19 inches or more measured 4.5 feet above natural grade. A “Heritage Tree” includes any of the following trees with a diameter of 24 inches or more measured 4.5 feet above natural grade: all oaks, Texas ash, bald cypress, American elm, cedar elm, Texas madrone, bigtooth maple, pecan, Arizona walnut, and eastern black walnut. Construction-related activities that result in impacts to such trees are generally prohibited without a permit issued by the COA Planning and Development Review Department.

Removal of trees may require mitigation, as stated in the COA Land Development Code (LDC) §25-8-604(B) and (C): “If development under a proposed site plan will remove a tree eight inches or larger in diameter, the City may require mitigation, including the planting of replacement trees, as a condition of site plan approval and may not release the site plan until mitigation requirements are satisfied. Waivers, variances, and modifications may apply under certain conditions.”

Anticipated Impacts: A total of 110 trees with trunk sizes 8'' or greater were located within the vicinity of the project. Of this number, six trees were categorized as "protected trees": four Ashe junipers, one live oak, and one cottonwood. No Heritage Trees were found within the project area. Construction of the project would require clearing of a number of existing trees and shrubs. The water storage tank site would require a permanent conversion of woody species to maintained grasses and forbs that would be periodically mowed. Construction of the water reuse line from the existing infrastructure connection to the storage tank would also require removal of a number of trees and shrubs, which could include one or more protected trees.

3.5 Wildlife Resources

Commonly occurring mammal species that would be expected in the project area include but are not limited to: the Virginia opossum (*Didelphis virginiana*), fox squirrel (*Sciurus niger*), cotton rat (*Sigmodon hispidus*), house mouse (*Mus musculus*), eastern cottontail (*Sylvilagus floridanus*), and raccoon (*Procyon lotor*). Common reptile species include the green anole (*Anolis carolinensis*), Mediterranean gecko (*Hemidactylus turcicus*), collared lizard (*Crotaphytus collaris*), and checkered garter snake (*Thamnophis marcianus*). Frequent bird species would include Northern Mockingbird (*Mimus polyglottos*), Northern Cardinal (*Cardinalis cardinalis*), Blue Jay (*Cyanocitta cristata*), Carolina Chickadee (*Parus carolinensis*), Tufted Titmouse (*Parus bicolor*), White-winged Dove (*Zenaida asiatica*), Mourning Dove (*Zenaida macroura*), Common Grackle (*Quiscalus quiscula*), Great-tailed Grackle (*Quiscalus mexicanus*) and Black Vulture (*Coragyps atratus*).

Anticipated Impacts: Anticipated direct impacts to wildlife resources would be minor. A few individual wildlife animals would potentially be locally affected by loss of denning or nesting sites or by increased competition for feeding within remaining habitat areas. However, this change would have barely perceptible consequences to the local species populations or habitat function. Sufficient habitat would remain functional for maintenance of short-term viability of all occurring populations. Future indirect and long-term cumulative impacts from the project would contribute to the continuing decline of some species not tolerant to urbanization, with likely increases of species that are tolerant to increased urban development.

3.6 Surface Waters

3.6.1 Drainage Patterns

The project lies within portions of two watersheds. The two-acre tank site and most of the pipeline corridor is located entirely within the Carson Creek watershed, while a portion of the western end of the pipeline corridor near Montopolis Drive is located within the Country Club East watershed. Carson Creek is a suburban watershed with a drainage area of six square miles and approximately eight miles of streams (COA 2013b). Carson Creek discharges into the Colorado River. Country Club Creek is about seven miles long and drains approximately five square miles before emptying into the Colorado River (COA 2011). No major or minor stream tributaries from either watershed cross the project area.

Anticipated Impacts: None.

3.6.2 Floodplain

The project site does not lie within any portion of the 100-year floodplain as designated by Federal Emergency Management Agency (FEMA).

<u>Anticipated Impacts:</u> None.

3.6.3 Springs

There are no seeps or springs documented by the COA (2013a) within or near the project area, and none were observed during field evaluations.

<u>Anticipated Impacts:</u> None.

3.7 Groundwater

The project area lies over the down dip (subsurface) of the Trinity Aquifer, a major aquifer that extends across much of Central and northeastern Texas. The thickness of this aquifer can be as much as 1,900 feet in Central Texas. The Trinity Aquifer is one of the most extensive and highly used groundwater resources in Texas. Groundwater is fresh but very hard, with total dissolved solids ranging between 1,000 to 5,000 milligrams per liter, with higher concentrations occurring as the depth of the aquifer increases (George et al. 2011).

<u>Anticipated Impacts:</u> None.

3.8 Critical Environmental Features

Critical Environmental Features (CEFs) are defined by Sections 25-8-1 and 30-5-1 of the COA LDC as “features that are of critical importance to the protection of environmental resources, and include bluffs, canyon rimrocks, caves, sinkholes, springs, and wetlands.” Pursuant to COA regulations, no construction is allowed within a 150-foot radius around a CEF (with exceptions). Investigations were performed to determine the presence of any CEFs within the project area. Results of these investigations are summarized in **Sections 3.6.1** through **3.6.6** below.

3.8.1 Springs

Springs are defined by COA Environmental Criteria Manual (ECM) 1.3.0 (B)(i)(a) as points or zones of natural groundwater discharge in upland and/or riparian zones which produce measureable flow down gradient of a source, a pool, or both, or an area characterized by the presence of a mesic plant community (during drought conditions).

Springs have been previously discussed in **Section 3.6.3**. No springs and/or seeps have been documented within the project area (Brune 2002; COA 2013a), and none were observed during field evaluations conducted in June 2013.

<u>Anticipated Impacts:</u> None.

3.8.2 Bluffs

Bluffs are defined by the COA LDC 25-8-1 as an abrupt vertical change in topography of more than 40 feet with an average slope of four feet of rise for one foot of horizontal travel or greater. No bluffs were identified in the project site.

Anticipated Impacts: None.

3.8.3 Canyon Rim Rocks

Canyon rim rock areas are defined as an abrupt vertical rock outcrop of more than 60 percent slope (31 degrees), greater than four feet vertically, and a horizontal extent equal to or greater than 50 feet. Canyon rim rock is common on the west side of Austin, especially along the major drainage paths that have dissected the underlying strata. No canyon rim rock areas were found in the project site.

Anticipated Impacts: None.

3.8.4 Karst Features

Karst features consisting of caves, solution cavities, and sinkholes are found throughout areas underlain by limestone strata. Large caves and solution cavities are predominantly found along fractures, fault trends, and/or within solutioned evaporate sections. The faults, fractures, and natural voids allow groundwater to move freely through the formation, which in turn promotes further solutioning of the limestone. Caves and solution features are found primarily in the area underlain by the Edwards limestone formation in the Austin area. Because the Edwards formation is located to the west of the project site approximately four miles, no karst features would be expected; and none were observed within the project area during the field visit.

Anticipated Impacts: None

3.8.5 Wells

Abandoned and unused wells, if not properly protected, can serve as an avenue for recharge to the underlying aquifer and therefore become a CEF. No abandoned or unused wells were found within the project area.

Anticipated Impacts: None

3.8.6 Wetlands

Wetlands are defined by the COA LDC (Section 25-8-282) as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. An area shall be classified as a wetland if it meets the U.S. Army Corps of Engineers (USACE) three-parameter technical criteria as outlined in the USACE Wetlands Delineation Manual (Section D Routine Determinations) (Environmental Laboratory 1987) and regional supplements.

Field reconnaissance to determine the presence of wetlands and other waters subject to regulation by the USACE was performed in the project area on June 12, 2013. No wetlands were identified within the project area.

Anticipated Impacts: None.

3.9 Critical Water Quality Zones

Critical Water Quality Zones (CWQZ) are designated by the COA under the LDC and impose development setbacks from major waterways. According to LDC Subsection 25-8-92(A)(1), the boundaries of the CWQZ for a major waterway typically coincide with the boundaries of the 100-year floodplain, except the boundaries of a CWQZ are located not less than 200 feet and not more than 400 feet from the centerline of the waterway. The Water Quality Transition Zone (WQTZ) is parallel to the outer boundary of the CWQZ and is 300 feet wide (LDC 25-8-93). The project site does not lie within a CWQZ or WQTZ.

Anticipated Impacts: None.

4.0 Project-related Effects to Waters of the U.S.

A determination of waters subject to regulation by the USACE was conducted following the methods outlined in the *USACE Wetlands Delineation Manual* (Environmental Laboratory 1987), which defines wetlands based on three criteria: hydrophytic vegetation, hydric soils, and wetland hydrology. In general, all three criteria must be present for an area to qualify as a wetland. Some exceptions occur in disturbed areas or in newly formed wetlands, where one indicator (such as hydric soils) might be lacking. These areas are dealt with on an individual basis as outlined in the *Field Guide for Wetland Delineation* (Wetland Training Institute 1995).

In addition to the jurisdictional wetlands defined above, the Clean Water Act regulates impacts to other waters of the United States. The term *waters of the United States* has broad meaning and incorporates both deepwater aquatic habitats and special aquatic sites, including wetlands, as listed below:

1. The territorial seas with respect to the discharge of fill material.
2. Coastal and inland waters, lakes, rivers, and streams that are navigable waters of the United States, including their adjacent wetlands.
3. Tributaries to navigable waters of the United States, including adjacent wetlands.
4. Interstate waters and their tributaries, including adjacent wetlands.

Prior to the initiation of the field visit, a number of sources were consulted in an effort to become familiar with the area and locate potential waters of the U.S., including wetlands. Sources included National Wetland Inventory (NWI) and National Hydrologic Database (NHD) maps, the Travis County Soil Survey (NRCS 2006), USGS 7.5-minute quadrangle sheet (Austin East sheet) and recent aerial photography. As previously mentioned in **Section 3.6.2**, above, the project area does not lie within the 100-year floodplain as mapped by the COA Geographic Information Systems (GIS) mapper (COA 2013a).

Activities resulting in the discharge of dredged or fill materials into waters of the U.S. are regulated by the USACE, pursuant to Section 404, subsection 330.5(a)(21) of the Clean Water Act. A field evaluation was conducted on June 12, 2013, to identify waters of the U.S. on the subject tract.

Section 10 of the Rivers and Harbors Act of 1899 authorizes the USACE to regulate any work in or affecting navigable waters of the United States. No navigable waters, as designated by the USACE, occur within the proposed project area.

Based on a review of maps, aerial photography, and on-site field reconnaissance completed on June 12, 2013, no waters or wetlands subject to regulation by the USACE were found within the project area.

Anticipated Impacts: Because no wetlands or other water subject to regulation by the USACE occur within the project area, no impacts would be expected.

5.0 Threatened and Endangered Species

The following section addresses the habitat suitability and known occurrences of threatened and endangered species of potential occurrence in Travis County and the likelihood of any occurrences within the vicinity of the proposed project.

5.1 Federal – U.S. Fish and Wildlife Service Regulatory Oversight

The U.S. Fish and Wildlife Service (USFWS) has regulatory authority to list and monitor the status of species whose populations are considered to be imperiled. This federal authority for the protection of vulnerable species was established by the Endangered Species Act (ESA) of 1973 and its subsequent amendments. Regulations supporting this act are codified and regularly updated in Sections 17.11 and 17.12 of Title 50 of the Code of Federal Regulations. Petitions for federal protection of species receive an initial review, and if the USFWS finds that listing may be warranted, the species undergoes a thorough status review. After the status review is complete, vulnerable species that qualify are either listed as threatened (T) or endangered (E) or categorized as candidates (C). Candidate species have been deferred from listing while the USFWS works on listing proposals for other species they determine are at greater risk. Vulnerability is determined based on many factors affecting the species within its range and is always linked to the best scientific data available to the USFWS. Fish and wildlife species listed as endangered or threatened by the USFWS are provided full protection. This protection includes a prohibition on direct take of the listed species in addition to indirect take such as destruction of habitat. Federal prohibition of take of listed plants is limited to federal lands; however, federal law federalizes state law prohibitions on the taking of plants. The ESA and accompanying regulations provide the necessary authority and incentive for the individual states to establish their own regulatory vehicle for the management and protection of threatened and endangered species.

5.2 State – Texas Parks and Wildlife Department Regulatory Oversight

The Texas Parks and Wildlife Department (TPWD) oversees endangered resources through the Wildlife Diversity Program. This program is responsible for maintaining county occurrence records of federally and state-listed threatened and endangered species. The program also maintains a Texas Natural Diversity Database (TxNDD) that provides specific site data and tracking information on occurrences of listed or rare animal and plant species, including unique or declining vegetation communities of concern. State-listed endangered species have limited regulatory protection. While these species cannot be taken, collected, held, or possessed without a permit, their habitat is afforded no regulatory protection, except on tracts managed by state, federal, or private interests for conservation purposes.

Evaluation methodology consisted of researching existing endangered species databases maintained by TPWD and USFWS. In addition, other substantial ancillary information was compiled from technical reports, published papers, and results of species surveys and investigations for other projects within the vicinity of the project area. Limited field investigations were performed. This section contains summary information (habitat assessments) from those efforts in both tabular and text formats. A summary of federally and state-listed endangered and threatened species, candidate species for listing, and those species that have been petitioned for listing that could potentially occur in Travis County are included in **Table 2**. A description of these species' habitats with assessment of impacts is also included.

A total of 11 species that are federally listed as endangered could potentially occur in Travis County, including four arachnids (Bone Cave harvestman [*Texella reyesi*], Bee Creek Cave harvestman/Reddell harvestman [*Texella reddelli*], Tooth Cave pseudoscorpion [*Tartarocreagris texana*], and Tooth Cave spider [*Neoleptoneta myopica*]), two insects (Kretschmarr Cave mold beetle [*Texamaurops reddelli*] and Tooth Cave ground beetle [*Rhadine persephone*]), one amphibian (Barton Springs salamander [*Eurycea sosorum*]), and four birds (Black-capped Vireo [*Vireo atricapilla*], Golden-cheeked Warbler [*Setophaga chrysoparia*], Interior Least Tern [*Sterna antillarum athalassos*], and Whooping Crane [*Grus americana*]). Eight additional species are candidates for federal listing, including one flowering plant (bracted twistflower [*Streptanthus bracteatus*]), four mollusks (false spike mussel [*Quadrula mitchelli*], Texas fatmucket [*Lampsilis bracteata*], Texas fawnsfoot [*Truncilla macrodon*], and Texas pimpleback [*Quadrula petrina*]), one arachnid (Wharton's cave meshweaver [*Cicurina wartoni*]), one fish (smalleye shiner [*Notropis buccula*]), and one bird Sprague's Pipit [*Anthus spragueii*]. In addition, two salamanders (Jollyville Plateau salamander [*Eurycea tonkawae*] and Austin blind salamander [*Eurycea waterlooensis*]) and one bird, (the Mountain Plover [*Charadrius montanus]*), have been proposed for listing as endangered.

A total of 13 species are state-listed as endangered or threatened including five mollusks (false spike mussel, Texas fatmucket, Texas fawnsfoot, Texas pimpleback, and smooth pimpleback [*Quadrula houstonensis*]), one amphibian (Barton Springs salamander [*Eurylea waterlooersis*]), one reptile (Texas horned lizard [*Phrynosoma cornutum*]), and six birds (American Peregrine Falcon [*Falco peregrines*], Bald Eagle [*Haliaeetus leucocephalus*]*,* Black-capped Vireo, Golden-cheeked Warbler, Interior Least Tern, and Whooping Crane). **Table 2** lists and describes each of these species and their listing status, indicates if habitat occurs in the project area, and provides a statement of project effects.

Table 2 Federal and State-Listed Endangered and Threatened Species of Potential Occurrence in Travis County With Anticipated Impacts

SPECIES	SPECIES/HABITAT DESCRIPTION	HABITAT PRESENT?	EFFECTS
FLOWERING PLANTS			
Bracted twistflower *Streptanthus bracteatus* FC	Texas endemic; shallow, well-drained gravelly clays and clay loams over limestone in oak juniper woodlands and associated openings, on steep to moderate slopes and in canyon bottoms; several known soils include Tarrant, Brackett, or Speck over Edwards, Glen Rose, and Walnut geologic formations; populations fluctuate widely from year to year, depending on winter rainfall; flowering mid-April late May, fruit matures and foliage withers by early summer	No	None

Table 2 Federal and State-Listed Endangered and Threatened Species of Potential Occurrence in Travis County With Anticipated Impacts

SPECIES	SPECIES/HABITAT DESCRIPTION	HABITAT PRESENT?	EFFECTS
MOLLUSKS			
False spike mussel *Quadrula mitchelli* ST	Possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site	No	None
Texas fatmucket *Lampsilis bracteata* FC, ST	Streams and rivers on sand, mud, and gravel substrates; intolerant of impoundment; broken bedrock and course gravel or sand in moderately flowing water	No	None
Texas fawnsfoot *Truncilla macrodon* FC, ST	Little known; possibly river and larger streams, and intolerant of impoundment; flowing rice irrigations canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows	No	None
Texas pimpleback *Quadrula petrina* FC, ST	Mud, gravel and sand substrates, generally in areas with slow flow rates	No	None
Smooth pimpleback *Quadrula houstonenisis* FC, ST	Small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins	No	None
ARACHNIDS			
Bone Cave harvestman *Texella reyesi* FE	Small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson Counties	No	None
Reddell harvestman *Texella reddelli* FE	Small, blind, cave-adapted harvestman endemic to a few caves in Travis County	No	None
Tooth Cave pseudoscorpion *Tartarocreagris texana* FE	Small, cave-adapted pseudoscorpion known from small limestone caves of the Edwards Plateau	No	None
Tooth Cave spider *Neoleptoneta myopica* FE	Very small, cave-adapted sedentary spider	No	None
Wharton’s cave meshweaver *Cicurina wartoni* FC	Very small, cave-adapted spider	No	None
INSECTS			
Kretschmarr Cave mold beetle *Texamaurops reddelli* FE	Small, cave-adapted beetle found under rocks buried in silt; small, Edwards limestone caves in the Jollyville Plateau	No	None
Tooth Cave ground beetle *Rhadine persephone* FE	Resident, small cave-adapted beetle found in small Edwards limestone caves in Travis and Williamson Counties	No	None
FISHES			
Smalleye shiner *Notropis buccula* FC	Endemic to upper Brazos River system and its tributaries (Clear Fork and Bosque); apparently introduced into adjacent Colorado River drainage; medium to large prairie streams with sandy substrate and turbid to clear warm water; presumably eats small aquatic invertebrates	No	None
AMPHIBIANS			
Jollyville Plateau salamander *Eurycea tonkawae* FPE	A small, lungless salamander with external gills known only from springs and waters of some caves north of the Colorado River	No	None

Table 2 Federal and State-Listed Endangered and Threatened Species of Potential Occurrence in Travis County With Anticipated Impacts

SPECIES	SPECIES/HABITAT DESCRIPTION	HABITAT PRESENT?	EFFECTS
Austin blind salamander *Eurycea waterlooensis* FPE	Mostly restricted to subterranean cavities of the Edwards Aquifer; dependent upon water flow/quality from the Barton springs segment of the Edwards Aquifer; only known from the outlets of Barton springs (Sunken Gardens [old Mill] Spring, Eliza Spring, and Parthenia [Main] Spring which forms Barton Springs Pool); feeds on amphipods, ostracods, copepods, plant material, and (in captivity) a wide variety of aquatic invertebrates	No	None
Barton Springs salamander *Eurycea sosorum* FE, SE	Dependent upon water flow/quality from the Barton Springs segment of the Edwards Aquifer; only known from the outlets of Barton springs; spring dweller, but ranges into subterranean water-filled caverns; found under rocks, in gravel, or among aquatic vascular plants and algae, as available; feeds primarily on amphipods	No	None
REPTILES			
Texas horned lizard *Phrynosoma cornutum* ST	Open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows in soil, enters rodent burrows, or hides under rock when inactive; breeds March-September	No	None
BIRDS			
American Peregrine Falcon *Falco peregrinus anatum* ST	Occupies a wide range of habitats during migration including urban, concentrations along the coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands	No	None
Bald Eagle *Haliaeetus leucocephalus* ST	Found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds	No	None
Black-capped Vireo *Vireo atricapilla* FE, SE	Oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; returns to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nests mid-April to late summer.	No	None
Golden-cheeked Warbler *Setophaga chrysoparia* FE, SE	Juniper-oak woodlands; dependent on Ashe juniper for long, fine bark strips, only available from mature trees, used in nest construction; nests placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nests late March to early summer	No	None
Interior Least Tern *Sterna antillarum athalassos* FE, SE	Listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also known to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans; when breeding forages within a few hundred feet of colony	No	None
Mountain Plover *Charadrius montanus* FP	Nests on high plains or shortgrass prairie, on ground in shallow depression; non-breeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous	No	None
Sprague's Pipit *Anthus spragueii* FC	Only in Texas during migration and winter, strongly tied to native upland prairie, common in coastal grasslands, uncommon and rare further west; sensitive to patch size and avoids edges.	No	None
Whooping Crane *Grus americana* FE, SE	Potential migrant; breeds in the wetlands of Wood Buffalo National Park, Northwest Territory, Canada, and winters in the coastal wetlands of the Aransas National Wildlife Refuge in Aransas, Calhoun, and Refugio Counties, Texas; only remaining natural breeding population of this species	No	None
MAMMALS			
Red Wolf *Canis rufus* FE, SE	Extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies	N/A	N/A

Sources:
Texas Parks and Wildlife Department, Wildlife Diversity, Diversity and Habitat Assessment Programs. County Lists of Texas' Special Species. Travis County, 10/2/2012. http://www.tpwd.state.tx.us/gis/ris/es/ Accessed February 27, 2013.
U.S. Fish and Wildlife Service. 2012. Endangered Species List for Travis, County http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=48453 Accessed February 27, 2013.

United States Fish and Wildlife Service Status

FE	Endangered (in danger of extinction throughout all or a significant portion of its range)
FC	Candidate for listing; information on threats and biological vulnerability supports listing
FPE	Proposed for listing as endangered, but has lower priority than candidate species
FP	Proposed for listing, but removed as candidate species.

Texas Parks and Wildlife Department Status

SE	Listed as Endangered in the State of Texas
ST	Listed as Threatened in the State of Texas

An additional 20 species that could occur in Travis County are considered rare or sensitive by TPWD but are currently not listed as endangered or threatened by that agency or the USFWS. These species and their likelihood of occurrence in the project area are summarized in **Table 3**, below.

Table 3 Species of Potential Occurrence in Travis County Considered Rare or Sensitive by TPWD With Anticipated Impacts

SPECIES	SPECIES/HABITAT DESCRIPTION	HABITAT PRESENT?	EFFECTS
VASCULAR PLANTS			
Basin bellflower *Campanula reverchonii*	Texas endemic; among scattered vegetation on loose gravel, gravelly sand, and rock outcrops on open slopes with exposures of igneous and metamorphic rocks; may also occur on sandbars and other alluvial deposits along major rivers; flowering May-July	No	None
Boerne bean *Phaseolus texensis*	Narrowly endemic to rocky canyons in eastern and southern Edwards Plateau, occurring on limestone soils in mixed woodlands, on limestone cliffs and outcrops; frequently along creeks	No	None
Correll's false dragon-head *Physostegia correllii*	Wet, silty clay loams on streamsides, in creek beds, irrigation channels and roadside drainage ditches; or seepy, mucky, sometimes gravelly soils along riverbanks or small islands in the Rio Grande; or underlain by Austin Chalk limestone along gently flowing spring-fed creek in central Texas; flowering May-September	No	None
Texabama croton *Croton alabamensis var texensis*	Texas endemic; in duff-covered loamy clay soils on rocky slopes in forested, mesic limestone canyons; locally abundant on deeper soils on small terraces in canyon bottoms, often forming large colonies and dominating the shrub layer; scattered individuals are occasionally on sunny margins of such forests; also found in contrasting habitat of deep, friable soils of limestone uplands, mostly in the shade of evergreen woodland mottes; flowering late February-March; fruit maturing and dehiscing by early June	No	None
Warnock's coral-root *Hexalectris warnockii*	In leaf litter and humus in oak-juniper woodlands on shaded slopes and intermittent, rocky creek beds in canyons; in the Trans Pecos in oak-pinyon-juniper woodlands in higher mesic canyons (to 2000 m [6550 ft]), primarily on igneous substrates; in Terrell County under *Quercus fusiformis* mottes on terrraces of spring-fed perennial streams, draining an otherwise rather xeric limestone landscape; on the Callahan Divide (Taylor County), the White Rock Escarpment (Dallas County), and the Edwards Plateau in oak-juniper woodlands on limestone slopes; in Gillespie County on igneous substrates of the Llano Uplift; flowering June-September; individual plants do not usually bloom in successive years	No	None
MOLLUSKS			
Creeper (squawfoot) *Strophitus undulatus*	Small to large streams, prefers gravel or gravel and mud in flowing water; Colorado, Guadalupe, San Antonio, Neches (historic), and Trinity (historic river basins)	No	None
CRUSTACEANS			
An amphipod *Stygobromus russelli*	Subterranean waters, usually in caves and limestone aquifers; resident of numerous caves in about 10 counties of the Edwards Plateau	No	None
Bifurcated cave amphipod *Stygobromus bifurcaus*	Found in pools within caves	No	None
Balcones Cave amphipod *Stygobromus balconis*	Found in pools within caves	No	None
ARACHNIDS			
Bandit Cave spider *Cicurina bandida*	A very small, subterrestrial, subterranean obligate	No	None

Table 3 Species of Potential Occurrence in Travis County Considered Rare or Sensitive by TPWD With Anticipated Impacts

SPECIES	SPECIES/HABITAT DESCRIPTION	HABITAT PRESENT?	EFFECTS
INSECTS			
Leonora's dancer damselfly *Argia leonorae*	South central and western Texas; small streams and seepages	No	None
Rawson's metalmark *Calephelis rawsoni*	Moist areas in shaded limestone outcrops in central Texas, desert scrub or oak woodland in foothills, or along rivers elsewhere; larval hosts are *Eupatorium havanense, E. greggii*	No	None
Tooth Cave blind rove beetle *Cylindropsis sp*	Only one specimen collected from Tooth Cave; only known North American collection of this genus	No	None
FISHES			
Guadalupe bass *Micropterus treculii*	Endemic to perennial streams of the Edwards Plateau region; introduced in the Nueces River system	No	None
AMPHIBIANS			
Pedernales River springs salamander *Eurycea sp 6*	Endemic; known only from vicinity of Pedernales Springs	No	None
REPTILES			
Spot-tailed earless lizard *Holbrookia lacerata*	Central and southern Texas and adjacent Mexico; moderately open prairie-brushland; fairly flat areas free of vegetation or other obstructions, including disturbed areas; eats small invertebrates; eggs laid underground	No	None
Texas garter snake *Thamnophis sirtalis annectens*	Wet or moist microhabitats, but not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August	No	None
BIRDS			
Western Burrowing Owl *Athene cunicularia hypugaea*	Open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows	No	None
MAMMALS			
Cave myotis bat *Myotis velifer*	Colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and in abandoned cliff swallow nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of the Edwards Plateau and gypsum caves of the Texas panhandle region during winter; opportunistic insectivore	No	None
Plains spotted skunk *Spilogale putorius interrupta*	Found in open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie	Yes	Impacts Possible

Source:
Texas Parks and Wildlife Department, Wildlife Diversity, Diversity and Habitat Assessment Programs. County Lists of Texas' Special Species. Travis County, 10/2/2012. http://gis.tpwd.state.tx.us/TpwEndangeredSpecies/DesktopDefault.aspx Accessed April 29, 2013.

The American Peregrine Falcon, Arctic Peregrine Falcon, and Whooping Crane are potential migrants through the proposed project area. The Bald Eagle could infrequently occur as a temporary transient. However, it is not anticipated that the proposed project would affect these species. It is not anticipated that there would be any effects on the threatened or endangered species dependent upon the Edwards Aquifer, juniper-oak woodlands, or open arid regions. The proposed project area lies outside the portion of Travis County that identifies Karst Zones on maps produced by Veni (1992), therefore, it is not anticipated that the proposed project would affect any of the listed threatened or endangered species occurring in karst (subterranean) formations.

Results of a search of TPWD's TxNDD were received on May 8, 2013. The data search indicated that no occurrences of threatened or endangered species have been documented within or adjacent to the project area. Although this does not conclusively support the absence of listed species, the information does corroborate habitat evaluations which indicate that suitable habitat does not occur for any of the listed species that could potentially occur in Travis County.

Anticipated Impacts: No adverse impacts to any endangered or threatened species would be expected from the project.

The Texas garter snake (*Thamnophis sirtalis annectens*), designated as rare but not listed as endangered or threatened by TPWD, has been documented within 0.46 mile of the project area (**Figure 7**). This species, along with the plains spotted skunk (*Spilogale putorius interrupta*) (also designated as rare), may occur in the project area. Direct injury or harm can be avoided by allowing escape of any animals encountered with minimal or no disturbance. Impacts to habitat would be minor, as disturbed areas would be revegetated following construction, and would not be expected to affect overall population numbers or distribution.

6.0 Cultural Resources

Following initial coordination with the Texas Historical Commission (THC) (**Attachment 1**), archeological resource investigations were conducted under Texas Antiquities Committee (TAC) Permit #6565 in accordance with the THC and the Council of Texas Archeologists (CTA) guidelines for intensive linear surveys with archeologists from Hicks & Company surveying 100 percent of the proposed project area on foot. During survey, a total of nine shovel tests were excavated, and one prehistoric-age lithic scatter was encountered and recorded as Site 41TV2438. The observed artifact assemblage of this surficial, upland site consisted of a biface, two cores, a few tested cobbles, and small amounts of lithic debitage. Shovel tests conducted at Site 41TV2438 were negative, and no buried cultural deposits or features were noted. Due to a lack of chronological or cultural diagnostics, the lack of datable components that would add valuable data to the archeological record, and a small assemblage size that is very typical of the area, Site 41TV2438 is recommended as ineligible for listing as a State Archeological Landmark (SAL). Following survey, Hicks & Company recommended that the proposed undertaking should be allowed to proceed to construction with no further archeological investigations required. Comment by the THC is forthcoming.

Anticipated Impacts: No impacts to archeological deposits considered eligible for listing as SALs or on the National Register of Historic Places (NRHP) would be expected as a result of this project.

7.0 Summary

Impacts to geology and soils within the project area would be negligible. Adverse impacts to existing vegetation would be expected as some trees and shrubs would be cleared during construction of the water reuse line and tank. Specific impacts to protected trees are currently not known. This information could be determined by the results of a tree survey, which was not included in this scope of services.

Minor direct impacts would be expected to some individual wildlife species, but impacts would be very localized and would not affect overall habitat function for occurring species in general. Future indirect and cumulative effects would vary according to the species affected, with expected increases in populations of wildlife species tolerant of urbanization and decreases in populations of species not tolerant to urbanization.

No impacts to federally or state-listed endangered or threatened species would be expected.

No impacts to surface water or groundwater would be expected. No waters of the U.S., including wetlands, subject to regulation by the USACE under Section 404 of the Clean Water Act would be impacted by the proposed project.

No impacts to COA designated CEFs would be expected from the project.

No impacts to prehistoric or historic-age archeological resources would be expected from the project.

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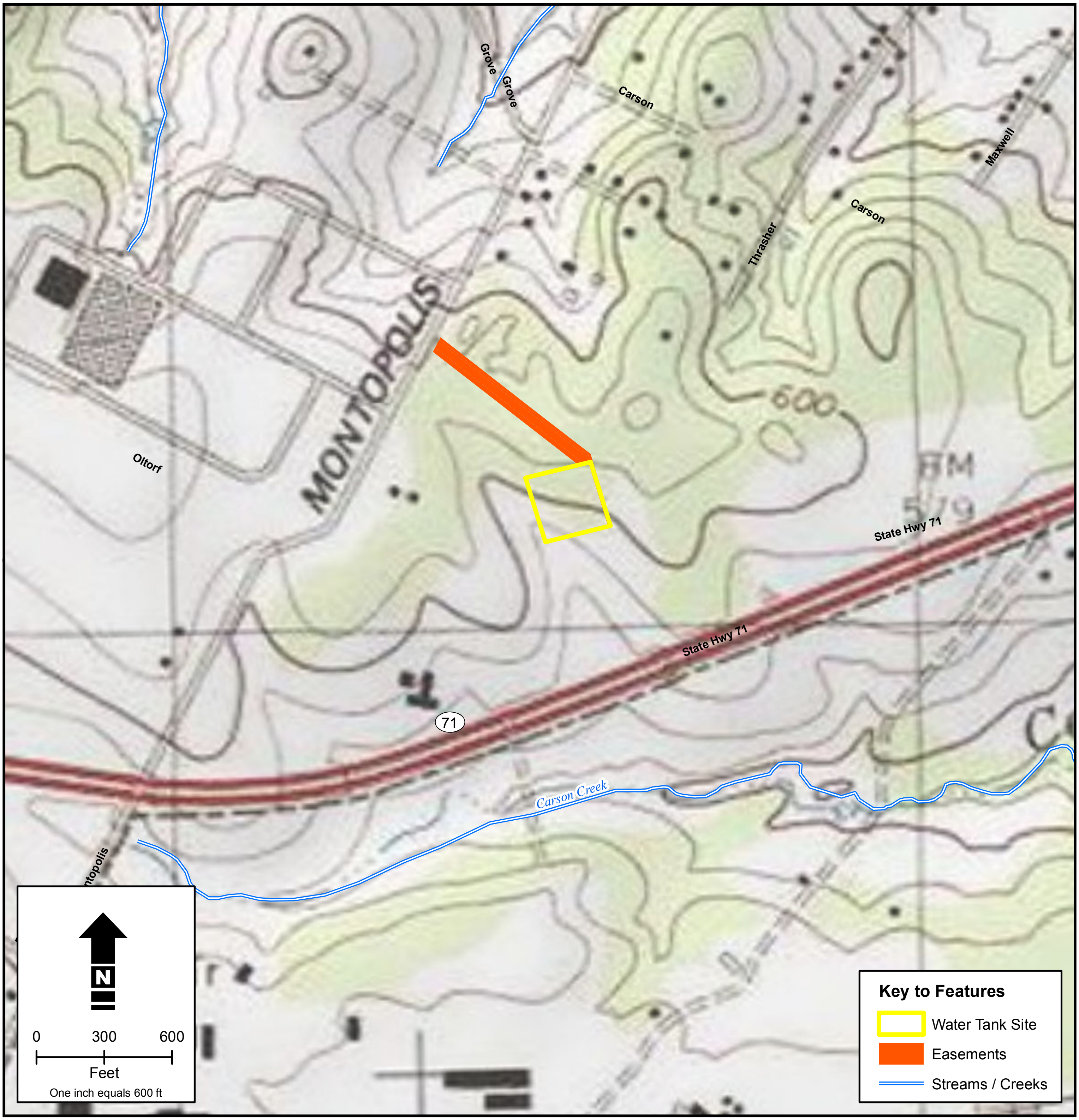
FIGURES



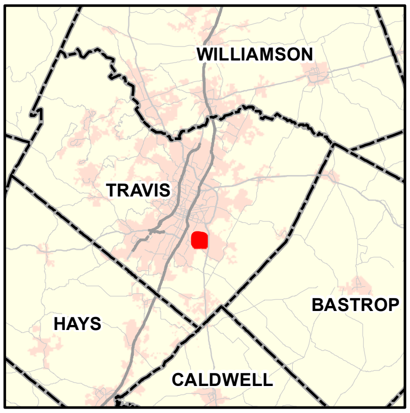


Figure 1

Project Location

Montopolis Water Reuse Site

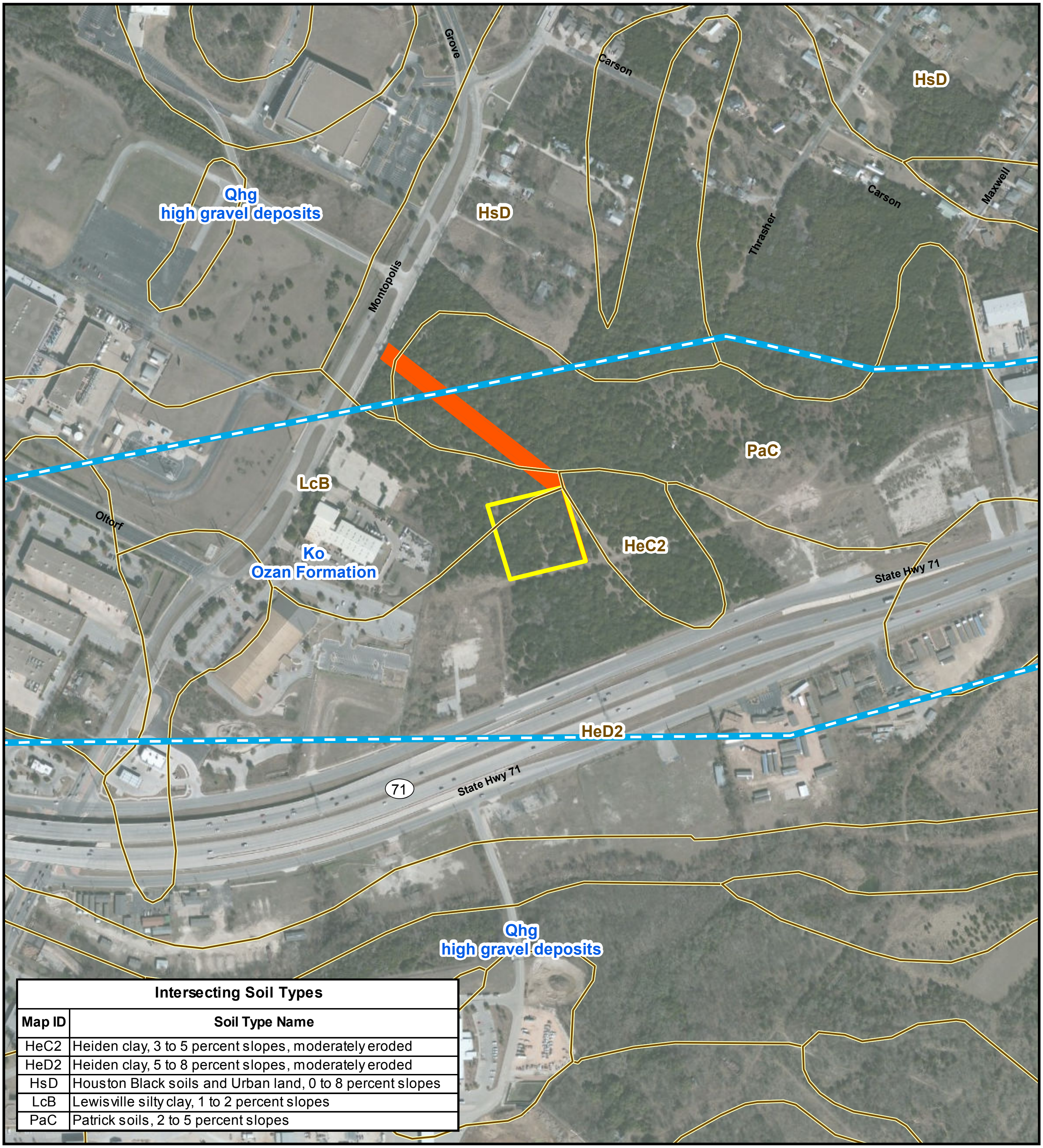
USGS 7.5-minute Topographic Quadrangle:
Montopolis, TX

Figure 2. Looking northwest along transmission line corridor.

Figure 3. Looking northwest toward center of water reuse tank site.

Figure 4. Upper end of swale looking down slope.

Figure 5. Looking down slope toward incised rocky outcrop within pipeline line corridor.



Intersecting Soil Types

Map ID	Soil Type Name
HeC2	Heiden clay, 3 to 5 percent slopes, moderately eroded
HeD2	Heiden clay, 5 to 8 percent slopes, moderately eroded
HsD	Houston Black soils and Urban land, 0 to 8 percent slopes
LcB	Lewisville silty clay, 1 to 2 percent slopes
PaC	Patrick soils, 2 to 5 percent slopes

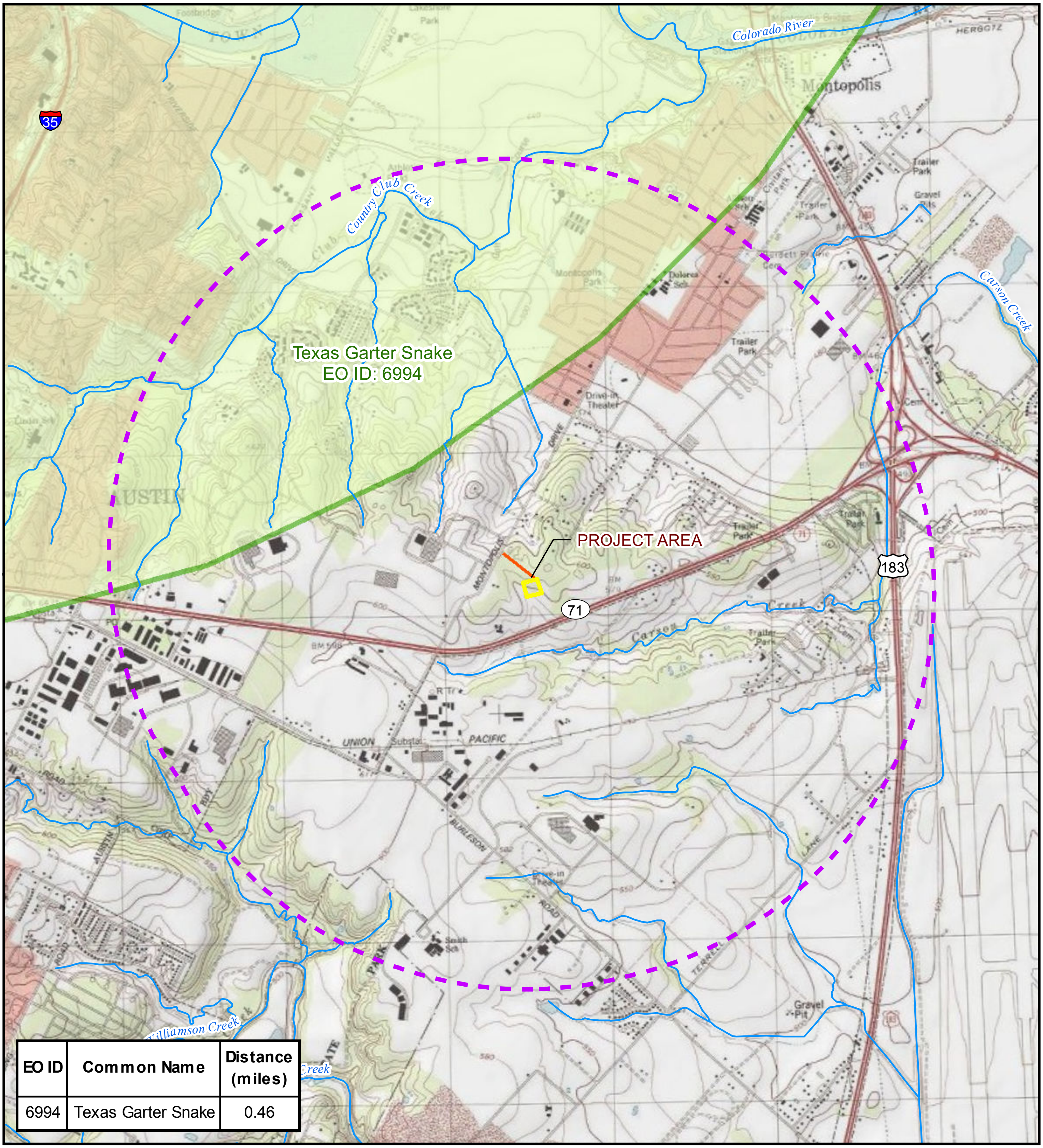
Figure 6

Geology and Soils

Montopolis Water Reuse Site

Key to Features

▭	Geology Boundaries
▭	Soil Type Boundaries
▭	Water Tank Site
🟥	Easements



EO ID	Common Name	Distance (miles)
6994	Texas Garter Snake	0.46

N

0 0.25 0.5

Miles

One inch equals .5 miles

Figure 7

TxNDD Occurrences

Montopolis Water Reuse Site

USGS 7.5-minute Topographic Quadrangle:
Montopolis, TX

Key to Features

- ▭ 1.5 Mile Search Radius
- 🟩 TxNDD Occurrences
- 🟨 Water Tank Site
- 🟧 Easements

ATTACHMENT 1

TEXAS HISTORICAL COMMISSION COORDINATION

HICKS & COMPANY

ENVIRONMENTAL
ARCHEOLOGICAL
AND PLANNING
CONSULTANTS

May 3, 2013

Mark Wolfe
State Historic Preservation Officer
Attn: Mark Denton
Texas Historical Commission
P.O. Box 12276 – Capitol Station
Austin, Texas 78711

RE: Antiquities Code of Texas Coordination for the City of Austin's Proposed Montopolis Tank Site, Travis County, Texas

Dear Mr. Wolfe,

The City of Austin (the City) is currently proposing to construct a new water reuse storage tank and pump station between Montopolis Drive and State Highway (SH) 71 on a to-be-purchased lot approximately two acres in size (**Figure 1**). Additionally, 1.2 acres of easements, required for a water reuse line and an associated access road, are proposed as part of this project. Hicks & Company has been contracted by CH2M Hill Corporation to conduct cultural resource background investigations, identify known resources, and assess the potential for unrecorded cultural resources to occur within and adjacent to the project area, and present this information to the Texas Historical Commission (THC), requesting recommendations regarding any need for archeological survey prior to construction. The proposed project will occur on land to be owned by the City and, as such, is subject to the Antiquities Code of Texas (ACT).

According to the THC Online Sites Atlas (the Atlas) accessed on May 1, 2013, there have been no previous archeological surveys within the proposed project area (**Figure 1**). The nearest recorded survey, located adjacent to the proposed project's western terminus, is an unnamed survey of the Montopolis Road alignment. Other surveys documented within one kilometer of the proposed project include a linear survey conducted on behalf of the State Department of Highways and Public Transportation in 1986 and an areal survey conducted by the LCRA in 2001 under Texas Antiquities Permit #2537. During this survey, Site 41TV1951 was recorded. Located adjacent to a previously undocumented spring, this prehistoric site is described by Prikryl (in the Atlas) as one of "two of the most significant prehistoric cultural resource sites discovered in recent years during LCRA surveys." Additionally, although no details of its components are available on the Atlas, archeological Site 41TV1697 is located approximately 720 meters southeast of the proposed project location.

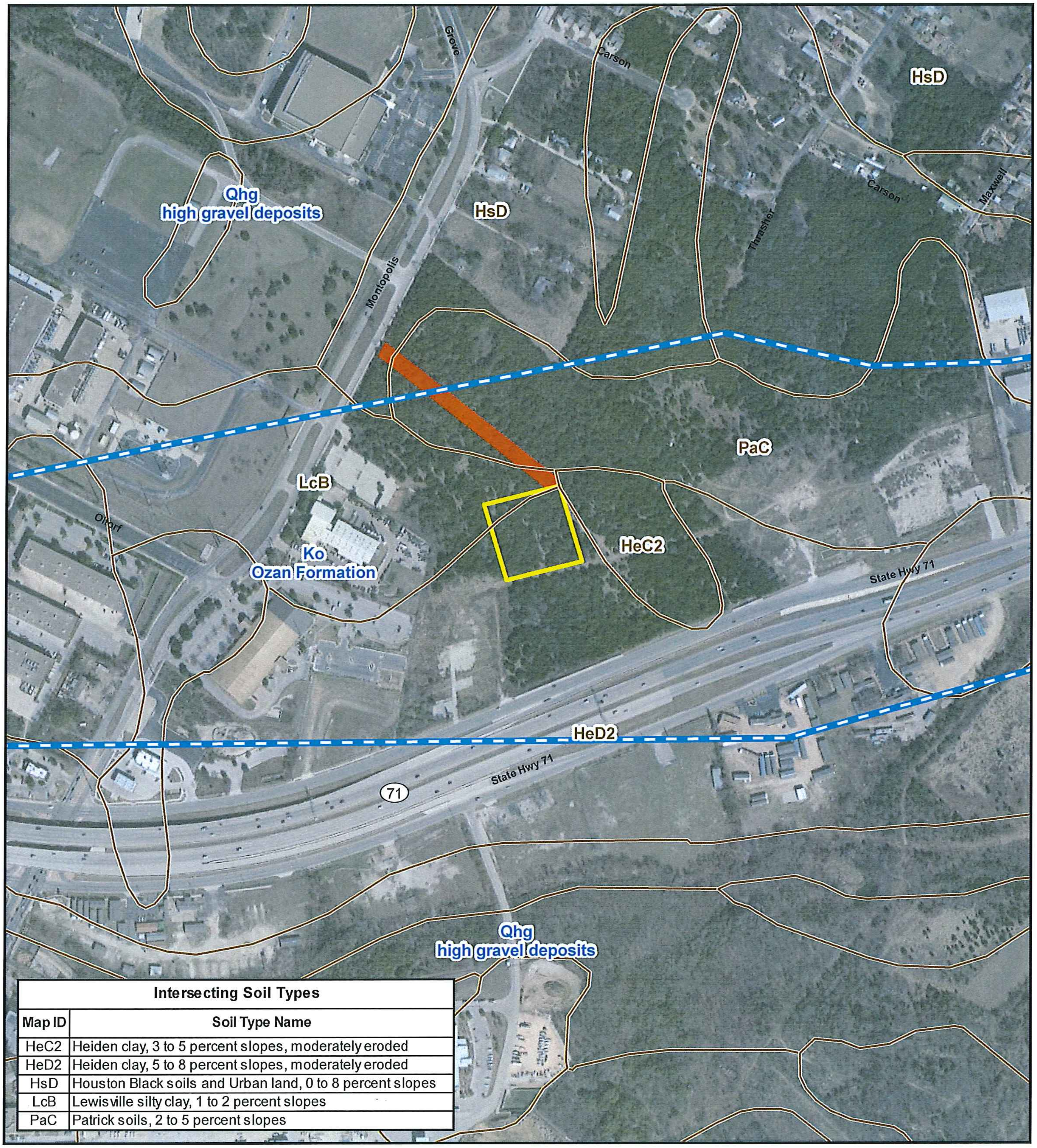
Geologically, the proposed project area is situated above the Ozan Formation (Oz) dating to the Cretaceous and, at its northern terminus, high gravel deposits (Qhg) dating to the beginning of the Early Pleistocene (**Figure 2**). The Ozan Formation is comprised of clay, marly, calcareous content that decreases upward. Characteristic nodules of hematite and pyrite and silt-size quartz and calcite fragments abound and become more abundant upward where shape is blocky and fractures conchoidal. This geologic formation predates the arrival of humans in the Americas; as such cultural deposits in these areas would likely be close to the surface in overlying sediment or on the surface itself. High gravel deposits in the Austin area are fluviatile terrace formations representing former levels of the Colorado River and its tributaries. Commonly, the matrix can be composed of gravel, silts, sands, and clays. This geologic formation coincides with the arrival of humans in the Americas; as such, cultural deposits in these areas could be buried below the surface. However, artifacts located within the gravel beds of the high terrace deposits would not likely be in- situ.

According to the United States Department of Agriculture's Web Soil Survey for Travis County, soils within the proposed project area consist of Heiden clay, 5 to 8 percent slopes, moderately eroded; Patrick soils, 2 to 5 percent slopes; Lewisville silty clay, 1 to 2 percent slops; and Houston Black soils and urban land, 0 to 8 percent slopes (**Figure 2**). Heiden clay is derived from clayey residuum weathered from Eagleford shale or Taylor marl. Both the Patrick and Lewisville series are parented from quaternary alluvium derived from mixed sources typically located on terrace landforms. As deposits potentially formed during the Prehistoric Period, these soils have potential to contain intact archeological sites or features. Houston Black soils and urban land, 0 to 8 percent slopes, in approximation, consists of 56 percent Houston Black clay, 30 percent urban land, and about 14 percent other soils, including but not limited to Heiden and Burleson clay. This unit is located on ridges and foot slopes and urban areas.

On behalf of the City of Austin, Hicks & Company presents this letter to the THC to inform your office of the proposed project and to request THC's concurrence that intensive archeological survey, supplemented with shovel testing, is warranted for regulatory compliance under the ACT prior to construction.

Sincerely,

Josh Haefner
Senior Archeologist



Intersecting Soil Types

Map ID	Soil Type Name
HeC2	Heiden clay, 3 to 5 percent slopes, moderately eroded
HeD2	Heiden clay, 5 to 8 percent slopes, moderately eroded
HsD	Houston Black soils and Urban land, 0 to 8 percent slopes
LcB	Lewisville silty clay, 1 to 2 percent slopes
PaC	Patrick soils, 2 to 5 percent slopes

Figure 2

Geology and Soils

Montopolis Water Reuse Site

Key to Features

- ▭ Geology Boundaries
- ☐ Soil Type Boundaries
- ☐ Water Tank Site
- 🟥 Easements

1504 WEST 5TH STREET AUSTIN, TEXAS 78703 TEL: 512 / 478.0858 FAX: 512 / 474.1849

HICKS & COMPANY

ENVIRONMENTAL
ARCHEOLOGICAL
AND PLANNING
CONSULTANTS

LETTER OF TRANSMITTAL

DATE: May 31, 2013

TO: Mark Wolfe
Attn: Mark Denton
Texas Historical Commission

RE: **Antiquities Code of Texas Coordination for the City of Austin's proposed Montopolis Water Reuse Tank**

Enclosed please find the following items:

# of Items	Description
1	Permit Application for Intensive Archeological Survey
1	SOW, outlining methodology for Intensive Archeological Survey

Signed: ______________________
Josh Haefner
Senior Archeologist

TEXAS HISTORICAL COMMISSION

ANTIQUITIES PERMIT APPLICATION FORM ARCHEOLOGY

GENERAL INFORMATION

I. PROPERTY TYPE AND LOCATION

Project Name (and/or Site Trinomial) Montopolis Water Reuse Site
County (ies) Travis County
USGS Quadrangle Name and Number Montopolis (USGS#: 30097-B6)

UTM Coordinates Zone 14 E 624499 (Centroid) N 3343368 (centroid)
Location East Austin, Travis County
Federal Involvement Yes XX No
Name of Federal Agency
Agency Representative

II. OWNER (OR CONTROLLING AGENCY)

Owner City of Austin
Representative Dan W Pedersen, PE
Address 625 E 10th Street, Suite 100
City/State/Zip ~~Austin TX 78745~~ Austin, TX 78701
Telephone (include area code) 512-972-0074 Email Address dan.pedersen@austintexas.gov

III. PROJECT SPONSOR (IF DIFFERENT FROM OWNER)

Sponsor same as above
Representative
Address
City/State/Zip
Telephone (include area code) Email Address

PROJECT INFORMATION

I. PRINCIPAL INVESTIGATOR (ARCHEOLOGIST)

Name Josh Haefner
Affiliation Hicks & Company
Address 1504 W. 5th Street
City/State/Zip Austin, Tx. 78703
Telephone (include area code) 512-478-0858 Email Address jhaefner@hicksenv.com

(OVER)

ANTIQUITIES PERMIT APPLICATION FORM (CONTINUED)

II. PROJECT DESCRIPTION

Proposed Starting Date of Fieldwork June 28, 2013
Requested Permit Duration 3 Years ________ Months (1 year minimum)
Scope of Work (Provided an Outline of Proposed Work) Intensive Survey (see attached scope of work)

III. CURATION & REPORT

Temporary Curatorial or Laboratory Facility Hicks & Company
Permanent Curatorial Facility Texas Archeology Research Laboratory (TARL) or Center for Archeological Studies (CAS) at Texas State University

IV. LAND OWNER'S CERTIFICATION

I, Dan W Pedersen, as legal representative of the Land Owner, City of Austin, do certify that I have reviewed the plans and research design, and that no investigations will be preformed prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Owner, Sponsor, and Principal Investigator are responsible for completing the terms of the permit.
Signature Dan W Pede Date 5/31/13

V. SPONSOR'S CERTIFICATION

I, Dan W Pedersen, as legal representative of the Sponsor, City of Austin, do certify that I have review the plans and research design, and that no investigations will be performed prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Sponsor, Owner, and Principal Investigator are responsible for completing the terms of this permit.
Signature Dan W Pede Date 5/31/13

VI. INVESTIGATOR'S CERTIFICATION

I, Josh Haefner, as Principal Investigator employed by ________ Hicks & Company (Investigative Firm), do certify that I will execute this project according to the submitted plans and research design, and will not conduct any work prior to the issuance of a permit by the Texas Historical Commission. Furthermore, I understand that the Principal Investigator (and the Investigative Firm), as well as the Owner and Sponsor are responsible for completing the terms of this permit.
Signature ________ Date 5/30/13

Principal Investigator must attach a research design, a copy of the USGS quadrangle showing project boundaries, and any additional pertinent information. Curriculum vita must be on file with the Division of Antiquities Protection.

FOR OFFICIAL USE ONLY

Reviewer ________ Date Permit Issues ________
Permit Number ________ Permit Expiration Date ________
Type of Permit ________ Date Received for Data Entry ________

Texas Historical Commission
Archeology Division
P.O. Box 12276, Austin, TX 78711-2276
Phone 512/463-6096
www.thc.state.tx.us

TEXAS HISTORICAL COMMISSION
The State Agency for Historic Preservation

HICKS & COMPANY
ENVIRONMENTAL
ARCHEOLOGICAL
AND PLANNING
CONSULTANTS

Hicks & Company's Scope of Work
for the
City of Austin's Proposed Montopolis Tank Site Project
Travis County, Texas
May 31, 2013

Pursuant to the Texas Historical Commission's (THC) recommendation regarding the City of Austin's responsibilities for the above referenced project (letter, Martin to Haefner, May 3, 2013), this scope of work describes an intensive archeological survey of the proposed **Montopolis Tank Site, Travis County, Texas**. The proposed project consists of constructing a new water reuse storage tank and pump station between Montopolis Drive and State Highway (SH) 71 on a lot approximately two acres in size (**Figure 1**). Additionally, 1.2 acres of easements, required for a water reuse line and an associated access road, are proposed as part of this project. The project is being funded by the City through the Austin Water Utility department and, as such, is subject to the Antiquities Code of Texas (ACT).

Since the proposed project overlays geological formations that predate the arrival of humans in the Americas, cultural deposits in these areas would likely be close to the surface in overlying sediment or on the surface itself (**Figure 2**). Therefore Hicks & Company is proposing that pedestrian survey supplemented with shovel testing as an adequate methodology to assess the proposed project's potential to impact undocumented archeological resources/sites. The project area will be tested at a rate of no less than three subsurface tests per acre, in accordance with the THC's minimum standards for intensive areal archeological surveys. Investigators will record their observations and the results of shovel tests through notes, standardized shovel test forms, and photographs. Shovel tests will be excavated to a depth of one meter, bedrock, or culturally sterile soils, whichever is encountered first. Sediment from all shovel tests will be screened through ¼-inch hardware cloth, and cultural material will be recorded but returned to the hole once the test is complete. Shovel test locations will be recorded utilizing GPS technology. The survey will follow a no-collection policy in which artifacts will be recorded, identified, and quantified in the field but returned to their find location.

Any archeological sites identified during the survey will be investigated by means of no fewer than six shovel tests in order to define site boundaries relative to the project area. Identified sites will be recorded in accordance with the THC's standards for site investigation. Subsurface tests within sites will be excavated at a frequency and arrangement appropriate for assessing site size, depth, and significance. Site locations will be recorded utilizing GPS technology, and data will be recorded on standardized forms. Documented sites will be recorded at the Texas Archeological Research Laboratory (TARL) and new trinomials will be assigned.

The results of the investigation will be compiled into a professional report as required under Chapter 26 of the THC's Rules of Practice and Procedure. The report will include a summary of background information, results of field investigations, and recommendations about the need for further investigations (if any) with respect to both historic and prehistoric sites and will be submitted to THC for review and comment. In accordance with revised ACT requirements, hard copies and digital files of the final report will be submitted to the THC and other recommended libraries and repositories across Texas. Additionally, if sites are recorded within the study corridor, all project-generated forms, notes, photographs, etc. will be formally curated at TARL.

REPORT ON THE ARCHEOLOGICAL INVESTIGATIONS OF THE MONTOPOLIS WATER REUSE SITE, TRAVIS COUNTY, TEXAS

Principal Investigator:
Josh Haefner

Written by:
Josh Haefner and Gregg Cestaro

TAC Permit #6565

Submitted to:
City of Austin

Hicks & Company Archeology Series #248

August 2013

HICKS & COMPANY
ENVIRONMENTAL
ARCHEOLOGICAL
AND PLANNING
CONSULTANTS

ABSTRACT

In June of 2012, Hicks & Company archaeologists completed a 100-percent archaeological survey of the proposed City of Austin's Montopolis Water Reuse Site project, located in southeastern Travis County, Texas. The survey was conducted for CH2M Hill on behalf of Travis County and the City of Austin Waterworks Department for Antiquities Code of Texas compliance and was coordinated with the Texas Historical Commission under Texas Antiquities Code Permit #6565. The proposed project includes the construction of a water reuse storage tank and an associated underground pipeline that will connect the storage tank with existing water reuse infrastructure located along Montopolis Drive. The site location for the storage tank is approximately 2.01 acres in size. The pipeline corridor is approximately 260 meters long by 20 meters in width for a total of 1.225 acres. The total footprint area for the project is approximately 3.24 acres. The survey consisted of pedestrian surface inspection supplemented by shovel testing (*n*=9) within the proposed project's footprint, resulting in the recordation of one new prehistoric site, Site 411TV2438. This small upland, surficial lithic scatter consists of a 3-4 cores, 2-3 tested cobbles, and very small amounts of debitage, loosely scattered along a slight slope at the northeast corner of the proposed water tank location. Site 41TV2438 is not eligible for listing as a State Archaeological Landmark. The survey followed a no-collection policy, and all artifacts were returned to their find location.

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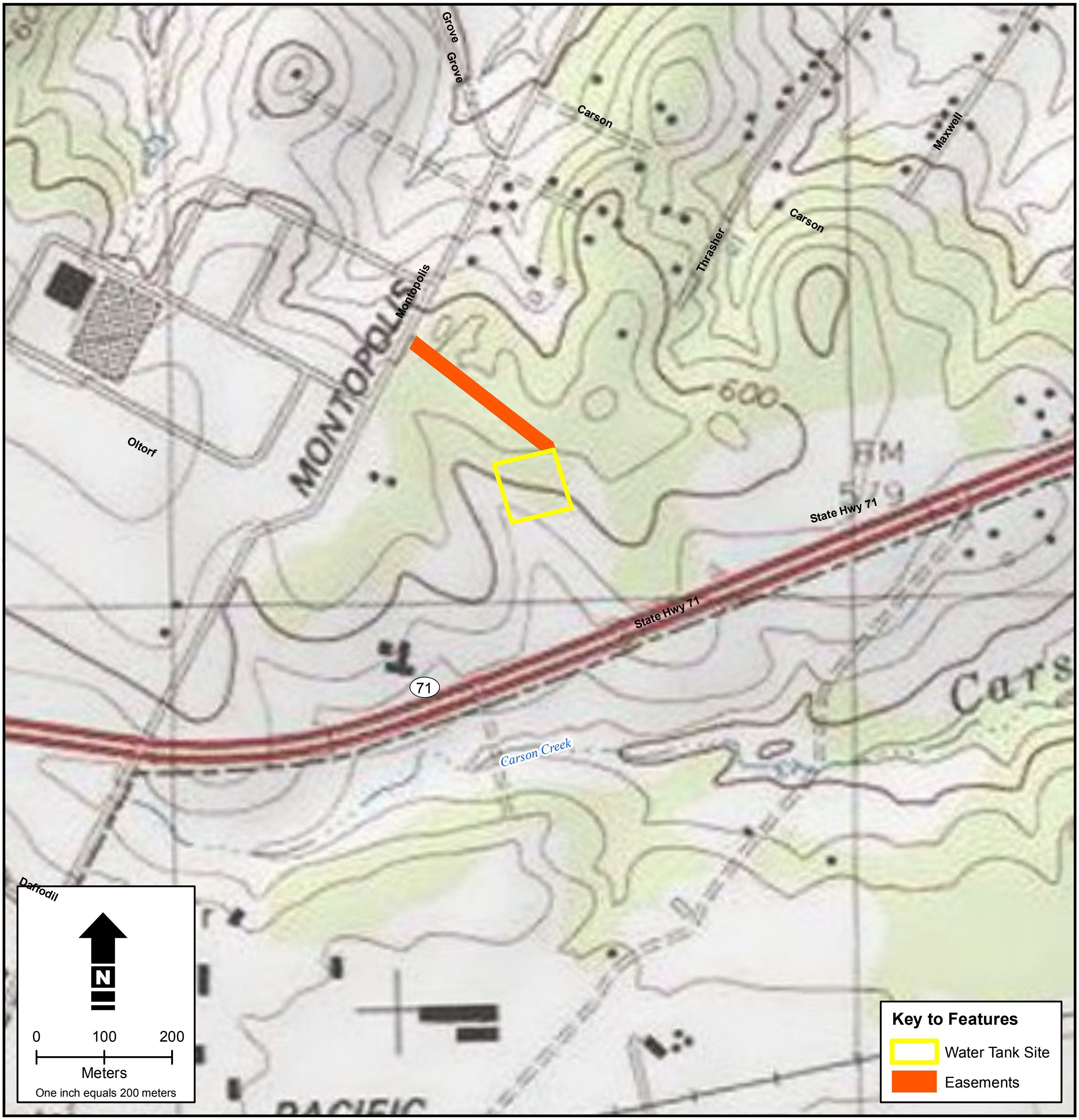
MANAGEMENT SUMMARY

Hicks & Company archaeologists, working on behalf of the City of Austin (the City) and CH2M Hill, the project's design engineer, conducted a 100-percent archaeology survey for the City's proposed Montopolis Watertank Reuse project located between Montopolis Drive and State Highway (SH) 71 (**Figure 1**). As planned, the proposed project will consist of the installation of a new waterline and an access road within a corridor approximately 260 meters in length by 20 meters in width. Additionally, the proposed project would include the installation of a new water tank and pump station facility to be located within a lot 2.01 acres in size for a total area of potential effects of 3.24 acres.

Investigations were conducted under Texas Antiquities Code (TAC) Permit #6565 in accordance with the Texas Historical Commission (THC) and the Council of Texas Archaeologists (CTA) guidelines for intensive areal surveys with archaeologists from Hicks & Company surveying 100 percent of the proposed project on foot. During survey, a total of 9 shovel tests were excavated and one prehistoric-age surficial lithic scatter was encountered and recorded as Site 41TV2438. The observed artifact assemblage of this upland site consisted of a bifacial core, 2-3 multidirectional cores, a few tested cobbles, and small amounts of lithic debitage. Shovel tests conducted at Site 41TV2438 were negative and no buried cultural deposits or features were noted. Due to a lack of chronological or cultural diagnostics, the lack of datable components that would add valuable data to the archaeological record, and a small assemblage size that is very typical of the area, Site 41TV2438 is recommended as ineligible for listing as a State Archaeological Landmark (SAL). Hicks & Company recommends that the proposed undertaking should be allowed to proceed to construction with no further archaeological investigations required.

Fieldwork for the archaeological survey was conducted on June 12, 2013, requiring approximately five hours to complete. Josh Haefner served as Principal Investigator for the project, and Gregg Cestaro served as Project Archaeologist. Gregg Cestaro and Josh Haefner conducted the survey and authored the report. Jerod McCleland, as GIS specialist, produced the maps and graphics for the report. Subsequent sections of this report include environmental and cultural backgrounds with a brief discussion of previous surveys and recorded sites, a description of field methodology, and a discussion of the results of the field investigation. This is followed by a conclusion section containing formal regulatory recommendations. Also included as are shovel tests results and isolated find information (**Appendix A**), and locations of shovel tests and Site 41TV2438 (**Appendix B**). All project-generated notes, forms, and photographs will be curated at the Texas Archaeological Research Laboratory (TARL) in Austin, Texas. This report is offered in partial fulfillment of TAC Permit #6565.



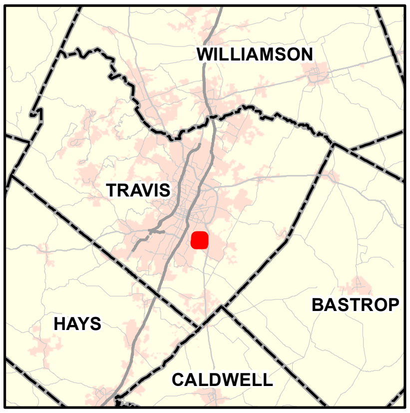


Figure 1

Project Location

Montopolis Water Reuse Site

USGS 7.5-minute Topographic Quadrangle:
Montopolis, TX

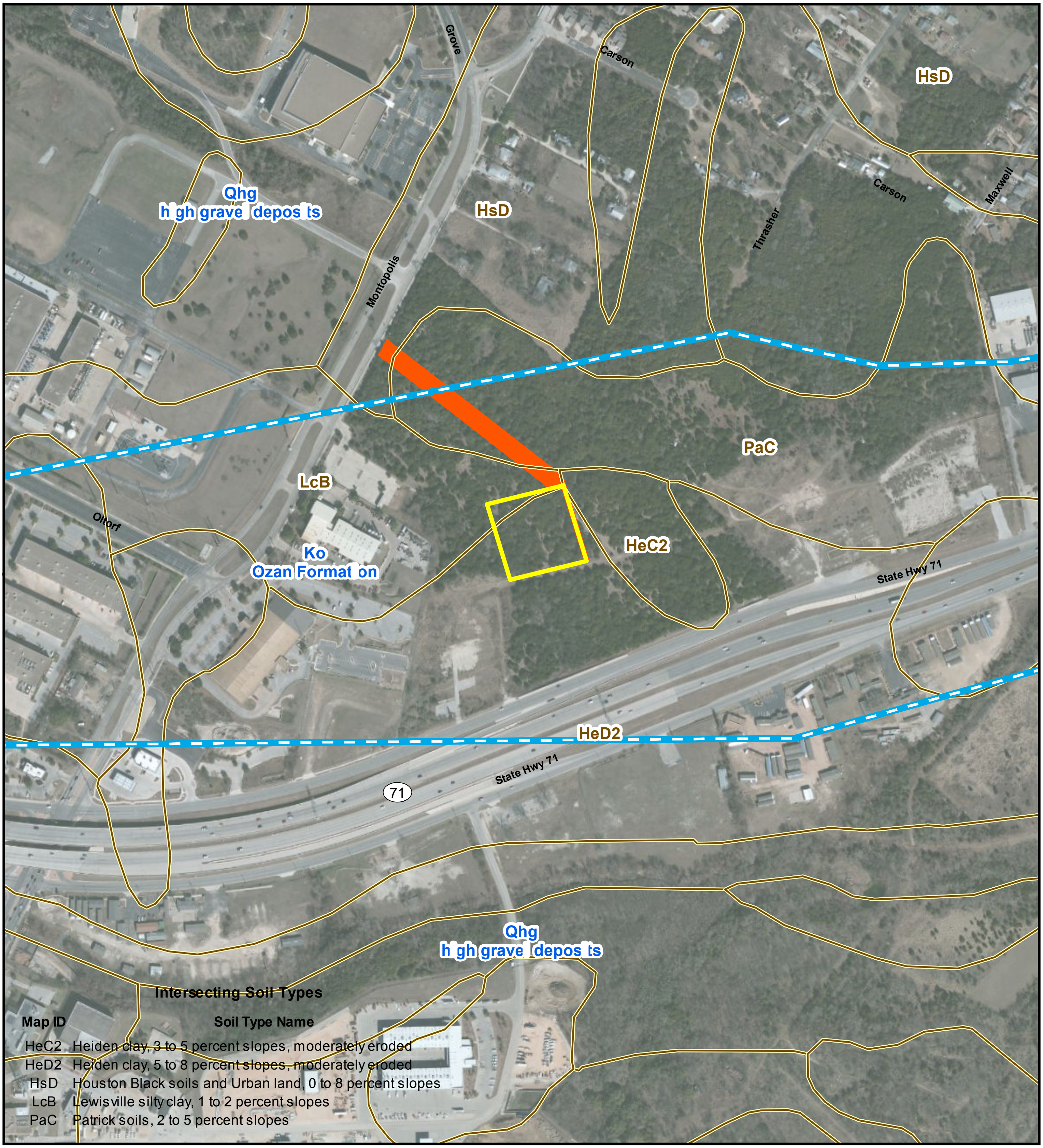
ENVIRONMENTAL SETTING

Geology and Topography

Geologically, the proposed project area is situated above the Ozan Formation (Oz) dating to the Cretaceous and, at its northern terminus, high gravel deposits (Qhg) dating to the beginning of the Early Pleistocene (**Figure 2**) (BEG 1972**)**. The Ozan Formation is comprised of clay, marly, calcareous content that decreases upward. Characteristic nodules of hematite and pyrite and silt-size quartz and calcite fragments abound and become more abundant upward where shape is blocky and fractures conchoidal. This geologic formation predates the arrival of humans in the Americas; as such, cultural deposits in these areas would likely be close to the surface in overlying sediment or on the surface itself. High gravel deposits in the Austin area are fluviatile terrace formations representing former levels of the Colorado River and its tributaries. Commonly, the matrix can be composed of gravel, silts, sands, and clays. This geologic formation coincides with the arrival of humans in the Americas; as such, cultural deposits in these areas could be buried below the surface. However, artifacts located within the gravel beds of the high terrace deposits would not likely be in- situ.

Soils

According to the United States Department of Agriculture's Web Soil Survey for Travis County, soils within the proposed project area consist of Heiden clay, 5 to 8 percent slopes, moderately eroded; Patrick soils, 2 to 5 percent slopes; Lewisville silty clay, 1 to 2 percent slops; and Houston Black soils and urban land, 0 to 8 percent slopes (**Figure 2**) (Werchan et al. 1974). Heiden clay is derived from clayey residuum weathered from Eagleford shale or Taylor marl. Both the Patrick and Lewisville series are parented from quaternary alluvium derived from mixed sources typically located on terrace landforms. As deposits potentially formed during the Prehistoric Period, these soils have the potential to contain intact archeological sites or features. Houston Black soils and urban land, 0 to 8 percent slopes, in approximation, consists of 56 percent Houston Black clay, 30 percent urban land, and about 14 percent other soils, including but not limited to Heiden and Burleson clay. This unit is located on ridges, foot slopes, and urban areas.



Intersecting Soil Types

Map ID	Soil Type Name
HeC2	Heiden clay, 3 to 5 percent slopes, moderately eroded
HeD2	Heiden clay, 5 to 8 percent slopes, moderately eroded
HsD	Houston Black soils and Urban land, 0 to 8 percent slopes
LcB	Lewisville silty clay, 1 to 2 percent slopes
PaC	Patrick soils, 2 to 5 percent slopes

N

0 75 150

Meters

One inch equals 150 meters

Figure 2

Geology and Soils

Montopolis Water Reuse Site

Key to Features

▭ Geology Boundaries

▭ Soil Type Boundaries

▭ Water Tank Site

🟧 Easements

CULTURAL BACKGROUND

Central Texas Archaeological Region

The project area is located within the Central Texas Archaeological Region (**Figure 3**). As defined by Prewitt (1981) and later modified by Collins (2004), the Central Texas Archaeological Region encompasses an area that is nearly 84,300 square kilometers in size. This region extends from the city of Uvalde northwestward to Sonora and, from here, northward to just beyond the city of Paint Rock onto the Grand and Rolling Plains. Moving northeast from Paint Rock, the city of Cleburne marks the northern most point of the Central Texas archaeological region. From here, the area extends southeast, beyond Waco into the Blackland Prairie and further south to just north of the city of Floresville. Like most other archaeological regions, the boundaries for the Central Texas region are ephemeral, subject to reinterpretation as more and more work is done. Ellis and Black (1997:25) discuss the ephemeral nature in defining exact boundaries for a Central Texas “archaeological region” citing inherent difficulties due to “considerable environmental diversity”. Implicit with these difficulties is the danger of assuming for the area a single ethnic or cultural identity. In all of its various iterations the core of the Central Texas Archaeological region has always been the Edwards Plateau (Hester 1989).

Most of the recent chronologies for Central Texas are based on six distinct time periods, roughly representing a 12000 year sequence of occupation. A synthesis of the culture-historical sequences provided by Collins (2004) and Johnson (1995) is as follows: Paleoindian (prior to 8800 before present [BP]), Early Archaic (8800–5800 BP), Middle Archaic (5800–4000 BP), Late Archaic (4000–1400 BP), Late Prehistoric (AD 600–1600), and Historic (AD 1600 to present). Although these divisions represent convenient temporal categories, they are also based in large part on perceived adaptations in subsistence and are reflected in changes in lithic and other technologies.

Paleoindian (prior to 8800 BP)

Scholars divide the Paleoindian period in North America by geological epochs. Pleistocene era peoples that inhabited North America from ca. 12,000–10,000 BP are referred to as Early Paleoindian with the advent of the Holocene as the arbitrary temporal demarcation between Early and Late Paleoindian periods (Collins 2004). The people of the Late Paleoindian period (10,000–8800 BP) utilized a similar lanceolate point technology and practiced lifestyles that were in many ways the same as the Early Paleoindian period. Diagnostic artifacts for the Early Paleoindian period include lanceolate-shaped, fluted projectile points such as Clovis, Folsom, and Plainview. Early projectile points were utilized as tips on atlatls and spears and were used in the hunting of big game such as mammoth, mastodon, bison, horse and camel (Black 1989). The shift from the Early to the Late Paleoindian subperiod is marked by the appearance of several unfluted projectile point styles such as the Dalton and San Patrice types and “Plainview like” points that are similar to Plainview points but differ in flaking technology and are noticeably thicker through the midsection (Collins 2004). The appearance of Golondrina-Barber and Saint Mary’s Hall point types postdate Dalton and San Patrice types (Collins 2004). Along with chipped stone artifact assemblages characterized by Clovis and Folsom points, artifact assemblages for Early Paleoindian peoples in Central Texas include engraved stones, exotic lithic materials such as obsidian, and ochre stained artifacts. During the Paleoindian period, a hunter-gatherer adaptation strategy was employed with an increase in the harvesting of flora and in the hunting of small game as big game died off towards the end of the Pleistocene.

The Early Paleoindian cultures in South and Central Texas are believed to be associated with the well-known big game hunting tradition of the Great Plains (Hester 1989). Most of the well-documented Early Paleoindian sites in Texas that are associated with extinct megafauna are located north and west of Central Texas on the Llano Estacado and adjacent areas of the Southern High Plains. In general, Early Paleoindian sites are scarce in Central Texas, or at least less visible than later sites. Conversely, Late Paleoindian sites are much more numerous in South and Central Texas, although both are usually identified from only surface-collected artifacts (Black and McGraw 1985). Subsistence data from several Late Paleoindian sites does suggest, however, that small game was exploited in addition to extinct megafauna. This data supports the idea that a hunting and gathering lifestyle may have already been adopted across much of Southwest and Central Texas prior to the Early Archaic period.

Paleoindian occupations in Central Texas have typically been associated with lanceolate projectile points such as Clovis, Folsom, Plainview, Golondrina, and Meserve and stemmed points such as Scottsbluff (Turner and Hester 1993). Recent investigations at the Wilson Leonard Site (41WM235) equate three styles of projectile points, Golondrina/Barber, St. Mary's Hall and Wilson, to the late Paleoindian period (Collins 2004). The Wilson component is dated at 10,000 to 9650 BP and is associated with features, artifacts, and a burial that are more Archaic-like in nature than Paleoindian (Collins 2004). The data from this site further suggests that the Archaic nature of the adaptation continues during the ensuing Golondrina/Barber and St. Mary's Hall components. These are dated between 9500 and 8800 BP and may represent a transitional period between the Paleoindian and the Archaic.

Early Archaic (ca. 8800–6000 BP)

Dating from approximately 8800 to 6000 BP, the Early Archaic period is subdivided into three projectile point style intervals: Angostura, Early Split Stem and Martindale/Uvalde, from 8800 to 6000 BP (Collins 2004). Generally, the shift from Paleoindian to Archaic subsistence strategies is measured by a change in technology focused on the use of burned rocks to process geophyte plant foods. This shift is traced back as early as 8800 BP at the Wilson-Leonard Site and at roughly comparable ages at several other Central Texas sites. At these locales, evidence for the use of earth ovens and burned rock technologies for processing plant foods is associated with lanceolate Angostura projectile points. Hence, the use of Angostura and late Paleoindian lithic technologies may have continued on into the Early Archaic period for a time but was gradually replaced by the bifurcate base split-stem and Martindale/Uvalde styles.

The Early Archaic period marks a shift to the use of burned limestone and other rocks in the form of scatters, hearths, middens and other features for the heated processing of plant foods. This represents the start of a long-lived Archaic cooking tradition, lasting from roughly 8800 to 1400 BP. This tradition was characterized by the repeated utilization of earth ovens and the resulting creation of burned rock middens at strategic places on the landscape. These new subsistence practices began with a distinctive cooking technology using layered arrangements of

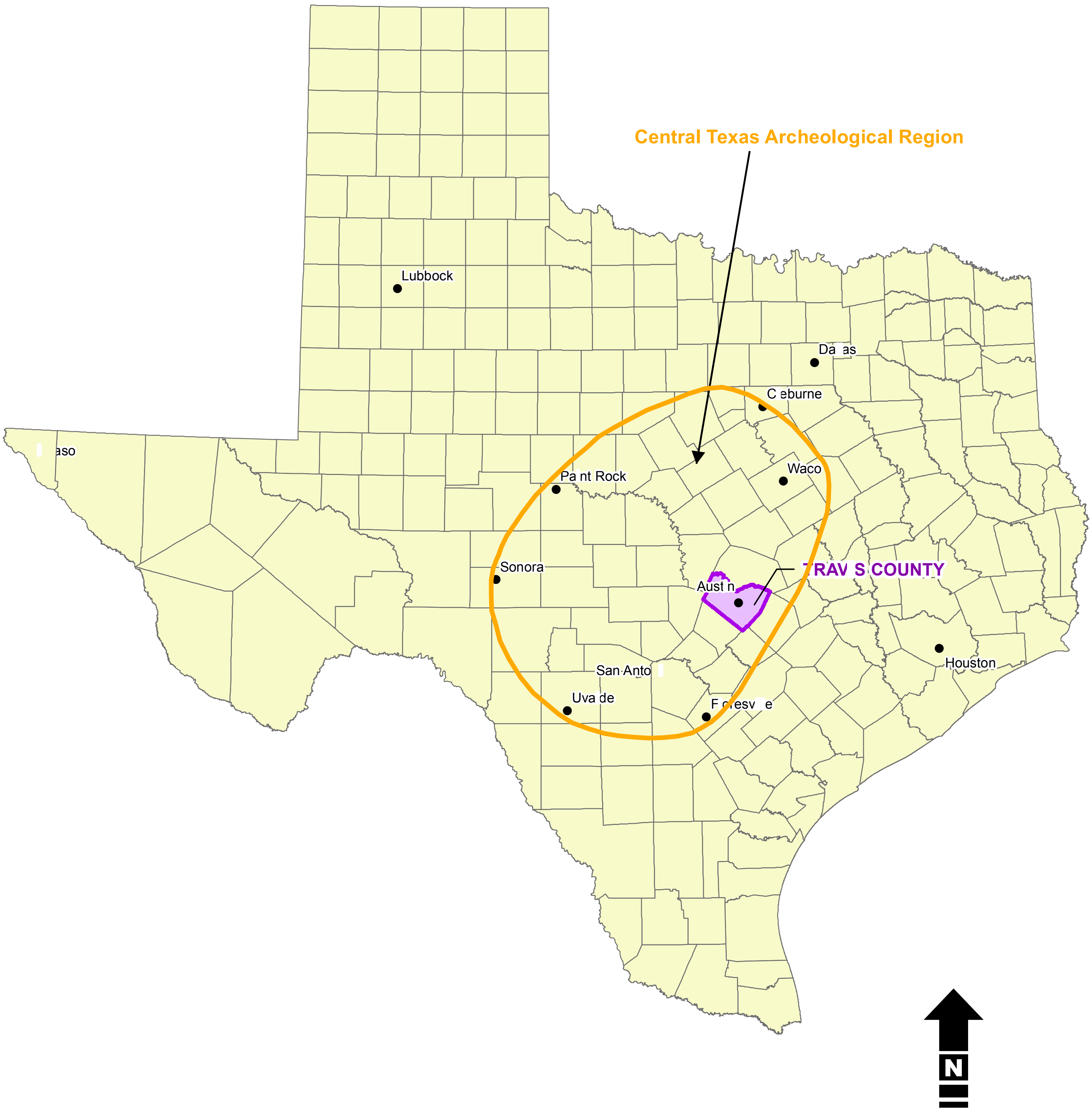


Figure 3

Central Texas Archeological Region

Montopolis Water Reuse Site

heated rocks in earth ovens, allowing for exploitation of a broad range of geophytes. These included upland xerophytic plants like sotol and other species such as Lily family onion bulbs, which grow in wetter environments.

Some of the most recent climatic reconstructions for the period note a moist and cool late Pleistocene environment with early to mid-Holocene shifts to drier conditions that became most pronounced during the mid-Holocene (ca. 5000–7000 BP, Ricklis and Collins 1994). In contrast, Johnson (1995) suggests that the relatively mesic conditions of the eastern Edwards Plateau during the Pleistocene and early Holocene/Paleoindian period underwent a brief dry interval during Late Paleoindian times, later returning to more mesic conditions during the ensuing Early Archaic period (roughly 8000–5800 BP). Whether the Early Archaic climate reflects a gradual drying period (Ricklis and Collins 1994) or a more mesic interval within an overall, long-lived trend toward aridity along the eastern Edwards Plateau, it appears that the use of burned rock midden technologies for plant food and other types of subsistence related processing began during this period and continued for many thousands of years.

Overall, the bulk of the Central Texas archaeological literature suggests that the Early Archaic occupations were generally small, widely distributed, and non-specialized (Black and McGraw 1985). Explanations for these characteristics support a generalized hunting-gathering strategy involving relatively high group mobility, poorly defined territories, and short-term occupations. Hence, broad spectrum, well-adapted, highly mobile subsistence strategies are theorized.

Middle Archaic (ca. 6000–4000 BP)

The Middle Archaic marks an intensification of the use of burned rock technologies to process plants and other types of foods within an increasingly arid environment. Ricklis and Collins (1994) recognize a pronounced mid-Holocene drying event from 7000 to 5000 BP, though it may have lasted longer. Johnson (1995) posits the occurrence of a dry Edwards Interval along the eastern Edwards Plateau from roughly 5500 to 1400 BP. Evidence for this is seen in the cessation of significant overbank sediment aggradation at a number of Central Texas sites. Instead of deposition, arid conditions catalyzed extensive downcutting and erosion along many Central Texas streams. Hypothetically, dry conditions would have promoted the spread of desert succulent xerophytic plants and fostered the increased use of burned rock middens. Drier conditions may also have engendered the return of bison in great numbers to the plateau during the Middle and Late Archaic periods. Furthermore, the proliferation of Bell/Andice/Calf Creek projectile point styles at the beginning of the Middle Archaic may have coincided with the return of bison to the Edwards Plateau and the adjacent Blackland Prairies; these broad bladed points have been associated with the exploitation of bison within archaeological literature. Additional Middle Archaic projectile point styles include Early Triangular, La Jita, Nolan, and Travis.

Late Archaic (ca. 4000–1400 BP)

Recent refinements in the Central Texas chronology divide the Late Archaic interval into two different subperiods (Johnson 1995). Subperiod I is marked by the appearance of Bulverde projectile points, which along with later forms (Pedernales, Castroville, Marshall and Montell) were used to hunt bison and other large game. Burned rock middens continued to proliferate during the Late Archaic I interval. The resources processed via burned rock technology may have included yucca, sotol, and perhaps agave lechuguilla. Other middens may simply be dumps for kitchen-type debris, which contain sizeable quantities of animal bones, broken stone tools, and flint-knapping detritus (Johnson 1995). Peoples associated with the Pedernales style interval, in particular, may have been adept at both hunting and the processing of large volumes of plant food materials.

The Late Archaic II interval (ca. 600 BC–AD 600) likely was a time of increasingly mesic conditions for all but the western and southwestern portions of the Edwards Plateau (Johnson 1995). The onset of more mesic conditions may have resulted in decreased numbers of upland xerophytic plants and perhaps bison (Johnson 1995), which may have forced adjustments in prehistoric subsistence strategies. There appears to be a decrease in the number of burned rock middens that can be directly attributable to the Late Archaic II interval. The projectile points used at this time are smaller and are characterized by such styles as Ensor, Fairland, Frio and Darl. Evidence suggests the large projectiles well-adapted to bison hunting may have been gradually replaced. In addition, it has been posited that the spread of Eastern Woodland belief systems may have had an influence on the Late Archaic II peoples of Central Texas (Johnson 1995).

Late Prehistoric (ca. AD 600–1600)

For Central Texas, the period of transition from the long Archaic period to what Collins (2004) labels the “Late Prehistoric” is one mired in ambiguity. Cultural traits that prevailed in other regions of Texas, such as the adoption of the bow and arrow, the use of pottery, and the practice of agriculture, were expected to reveal themselves, with time, in the Central Texas archaeological record (Suhm et al. 1954). In anticipation of these findings, early scholars had adopted the term “Neo-American” to describe post-Archaic life-ways. Others, recognizing the anomalous continuation of a basic hunting and gathering subsistence strategy, coined terms such as “Neo-Archaic” (Prewitt 1981) and “Post-Archaic’ (Johnson and Goode 1994). Bow and arrow technology appears to have indeed been adapted ca. 1200 BP (Collins 2004). Pottery is too utilized, but much later and is not as widespread as is seen in other regions of Texas. Evidence for agriculture for the area is minimal and, by all accounts, comes into use comparably late.

Johnson and Goode (1994) write that the Sabinal and Edwards arrowheads may have been the first arrowhead styles to appear on the eastern Edwards Plateau at about 1200 BP. This date is slightly more recent than the earliest accepted dates, ca. 1450 BP, for the advent of bow technology in eastern North America, although Odell (1988) argues that flakes and bifaces were utilized as arrow points during the Archaic period. It is widely believed that the bow and arrow entered into eastern North America from an arctic source (Shott 1997). Reasons for the adoption of this new technology are still being examined, with conventional assumptions that regarded the bow as being more efficient for hunting now being questioned (Larralde 1990). Within Central Texas, there appears to be a correlation of Edwards, and, later, Scallorn type arrowheads with conflict and warfare (Johnson and Goode 1994).

Austin Phase

While recognizing that a predominantly Archaic lifestyle persisted for Central Texas for far longer than neighboring regions, Collins (2004), like Jelks (1962) before him, organizes the Late Prehistoric into two subperiods. These subperiods correspond with the Austin and Toyah intervals that are distinguished by changes in projectile point styles. The Austin subperiod, or interval, is dated from ~1200 BP to 650 BP by Collins (2004). Associated with this subperiod are Scallorn and Edwards point types. Save for the adoption of bow technology, the material culture associated with the Austin subperiod is similar to that of the Late Archaic (Johnson and Goode 1994). As representative of such assemblages, Prewitt (1981:83) lists Clear Fork gouges, scrapers, small concave unifaces, grinding and hammer stones, bone awls, marine shell beads, and pendants. Johnson and Goode (1994) add that bifacial flint knives, although usually smaller than those with Archaic associations, are also commonly found.

Subsistence practices also seem to be very similar to those practiced during the Late Archaic. Regarding resource exploitation, Prewitt (1981:74) states that the “emphasis seems to be on gathering a balanced variety of plant foods rather than on hunting, although a slight increase occurs in the overall importance of hunting”. Burned rock middens have been dated to the Austin subperiod, though these seem to occur with a good deal less frequency than preceding periods (Goode 1991; Houk and Lohse 1993). During the Austin subperiod, there is marked widespread appearance of “true” cemeteries, a trend that carries over into the following Toyah subperiod (Prewitt 1981).

Toyah Interval

Both Collins (2004) and Johnson and Goode (1994) tentatively date the Toyah interval from ~ 650 BP to 200 BP. This time period is one of the better documented and understood of the prehistoric culture-historical time periods within and adjacent to Central Texas. This is because there are large numbers of well-documented Toyah sites, many of which are short lived, isolated occupations (Black 1986; Johnson 1994; Karbula 2003; Quigg and Peck 1995; Ricklis and Collins 1994). During the Toyah interval, the climate continued trending towards the mesic norms prevalent today and buffalo were returning to the area in numbers (Johnson and Goode 1994). In consort, Toyah subsistence aligns toward bison procurement and there is an increased emphasis on hunting compared to the Austin subperiod (Prewitt 1981).

Toyah has been variably described as an interval, a phase, and a horizon (University of Texas at Austin 2011). While the ascribed labels may vary, the intent seems to be the same: to identify a distinct cultural expression that abruptly appears across the Edwards Plateau, Rio Grande Plains, and the Lower Pecos. Largely this identification is based on two sets of unique material remains that appear in the Central Texas archaeological record during the 14th Century: a unique toolkit and earthenware pottery. It has been noted that technical and stylistic changes from the Austin phase to the Toyah phase was more pronounced than between the Late Archaic and Prehistoric periods.

Although not restricted to Toyah, perhaps the most recognized element of the Toyah stone toolkit is the Perdiz Point. In addition to the ubiquitous Perdiz point, the Toyah phase lithic assemblages include Clifton points and a variety of flaked tools oriented towards bison processing (Karbula 2003). Directly percussed flake blades are found in Toyah assemblages and represent a blade technology that was absent during the preceding Archaic (Johnson and Goode 1994). Other hallmarks of this time are sandstone abraders, beveled-edged Harahey and Covington knives, gravers, small drills often fashioned from small flakes, stone side scrapers, deer bone spatulates, grass basketry/mats, mussel shell pendants, bone awls and beads.

While there has been pottery found in association with sites that are pre-Toyah, it is during this period that ceramics first appear in the Central Texas archaeological record in numbers. Locally manufactured ceramic-types are known as Leon Plain, a bone tempered plainware and Doss Redware with slips that were decorated with red ochre. Occasionally, these vessels exhibit incised decorations, beveled rims, and an application of a fine wash to their interiors (Johnson 1994). In addition to these styles, ceramics were acquired from the Eastern Woodlands (Collins 2004). Occasionally, asphaltum-coated sherds are found and are likely intrusions from the Texas Gulf Coast tradition of the Karankawans. Within the archaeological record, most of the remnants of Toyah age pottery are fragmented potsherds, a consequence of weathering the low-firing technique of Toyah ceramic manufacture. When reconstruction of vessels has been possible, most appear to be utilitarian water jugs and simple bowls.

Johnson (1994) documents that most of the lithic tools found in Toyah assemblages were fabricated from either flakes or blades, although, bifacial reduction was, on occasion, also utilized. The fabrication of pointed-stem, barbed arrowheads from flint blades was new to Central Texas (Johnson 1994, Tunnell 1989). These points typically began as small blades, some as small as 7 centimeters in length extracted from block or rounded nodules. Sub-cubical shapes make ideal blade cores because they already have flat surfaces for striking platforms. After an initial flake detachment, a series of blades can be detached by rotating the core to access fresh platforms (Johnson 1994). Generally, the detached blades would be thicker along its longitudinal axis with extremely thin lateral edges. In order to prepare this preform for pressure flaking, the lateral edges were abruptly retouched. Johnson (1994) notes that previously identified Cliffton points were in actuality Perdiz preforms.

Studies suggest that bison presence in Central Texas reached its height during the Late Prehistoric (McDonald 1981). Across North America, this increase in bison numbers is often correlated with the “Little Ice Age” which brought in wetter conditions that brought about widespread vegetative growth (McDonald 1981). Within Texas, the Blackland Prairie with its high density of grasses such as little bluestem, Indian grass, buffalo grass and switch grass would have served the bison well, while the forested Post Oak may also have been a suitable habitat, particularly for *Bison athabascae*. Robust and wide-ranging, bison likely moved throughout the Central Texas region exploiting ecotones just as humans did.

The Late Prehistoric or Post-Archaic (ca. AD 600–1600) (Johnson 1995) in Central Texas is initially marked by the replacement of the dart and atlatl with the bow and arrow, as reflected in the shift from dart points to smaller, thinner and lighter arrow points (Ricklis and Collins 1994). Despite the shift to the bow and arrow, there is strong indication that the broad based hunting-gathering economy of the Late Archaic persisted into and throughout most of the Late Prehistoric period. The latter part of this period is marked by the appearance of pottery and a distinctive complex of tools composed of contracting-stem Perdiz arrow points, an abundance of unifacial end scrapers, thin, alternately beveled bifacial knives, and drills or perforators made of flakes and blades. Evidence suggests that after the Late Archaic, the climate again turned dry and somewhat arid toward the middle of the Late Prehistoric, during which a dramatic increase in bison exploitation suggests it became an increasingly important economic activity during the later part of this period.

Historic Period (AD 1528–Present)

The most radical changes in the Native American history of Central Texas came during the historic era (Black 1989). The horse was introduced into North America by Spanish settlers in the sixteenth century; nomadic groups, initially the Apaches and later the Comanches, adopted the horse and rapidly altered the aboriginal situation of Central Texas. These nomadic groups entered Central Texas from the plains and mountains to the north and west and within 150 years had forced most of the native peoples to flee. Most groups were destroyed by the combined effects of the nomadic raiders and the foreign diseases later introduced by Europeans. Others moved south, entering Spanish missions and settlements, or eastward to join various agricultural groups such as the Wichita (Black 1989).

The historic period in Texas begins with the arrival of Alvar Nunez Cabeza de Vaca and other survivors of the Navarez expedition on the Texas coast in 1528, although there may have been earlier landings. In any case, the influences of European colonization were not felt strongly in Texas until several centuries later. By the middle of the eighteenth century, though, the Spanish had established missions in East Texas and settlements in South Texas. This resulted in massive depopulation and cultural disintegration among Native American groups.

Anglo settlement in Central Texas began in the early 1820s when Stephen F. Austin received permission from the government of Mexico to settle 300 families in the coastal plain between the San Antonio and Brazos Rivers (Barker 2011). By the early 1830s a series of small forts had been established to defend against the Comanche Indians, on whose land these new settlers resided. The line of forts extended for almost 30 miles from northwest of Bastrop to just east of Austin and included Bastrop, Wilbarger’s Bend, Coleman’s Fort, Webber’s Fort, Gilleland Creek, Fort Colorado, and Fort Prairie, and passed through the general vicinity of the Onion Creek Greenway project area (Smyrl 2011). The Greenway project area is surrounded by several historic settlements: Del Valle (established in the 1870s) to the west, Garfield (established around 1880) to the east, and Hornsby Bend (settled in the 1830s and said to be the county’s earliest settlement) to the north, across the Colorado River. Most of these communities reached their peak population around the turn of the twentieth century; the construction of a rail line connecting Houston to Austin in the 1870s gradually led to a decline of the communities bypassed by the railroad.

Previous Investigations and Recorded Archeological Sites

According to the THC Online Sites Atlas (the Atlas) accessed on May 1, 2013, there have been no previous archeological surveys within the proposed project area (**Figure 4**). The nearest recorded survey, located adjacent to the proposed project’s western terminus, is an unnamed survey of the Montopolis Road alignment. Other surveys documented within one kilometer of the proposed project include a linear survey conducted on behalf of the State Department of Highways and Public Transportation in 1986 and an areal survey conducted by the Lower Colorado River Authority (LCRA) in 2001 under Texas Antiquities Permit #2537. During this survey, Site 41TV1951 was recorded. Located adjacent to a previously undocumented spring, this prehistoric site is described by Prikryl as one of "two of the most significant prehistoric cultural resource sites discovered in recent years during LCRA surveys" (THC 2013). Additionally, although no details of its components are available on the Atlas, archeological Site 41TV1697 is located approximately 720 meters southeast of the proposed project location.

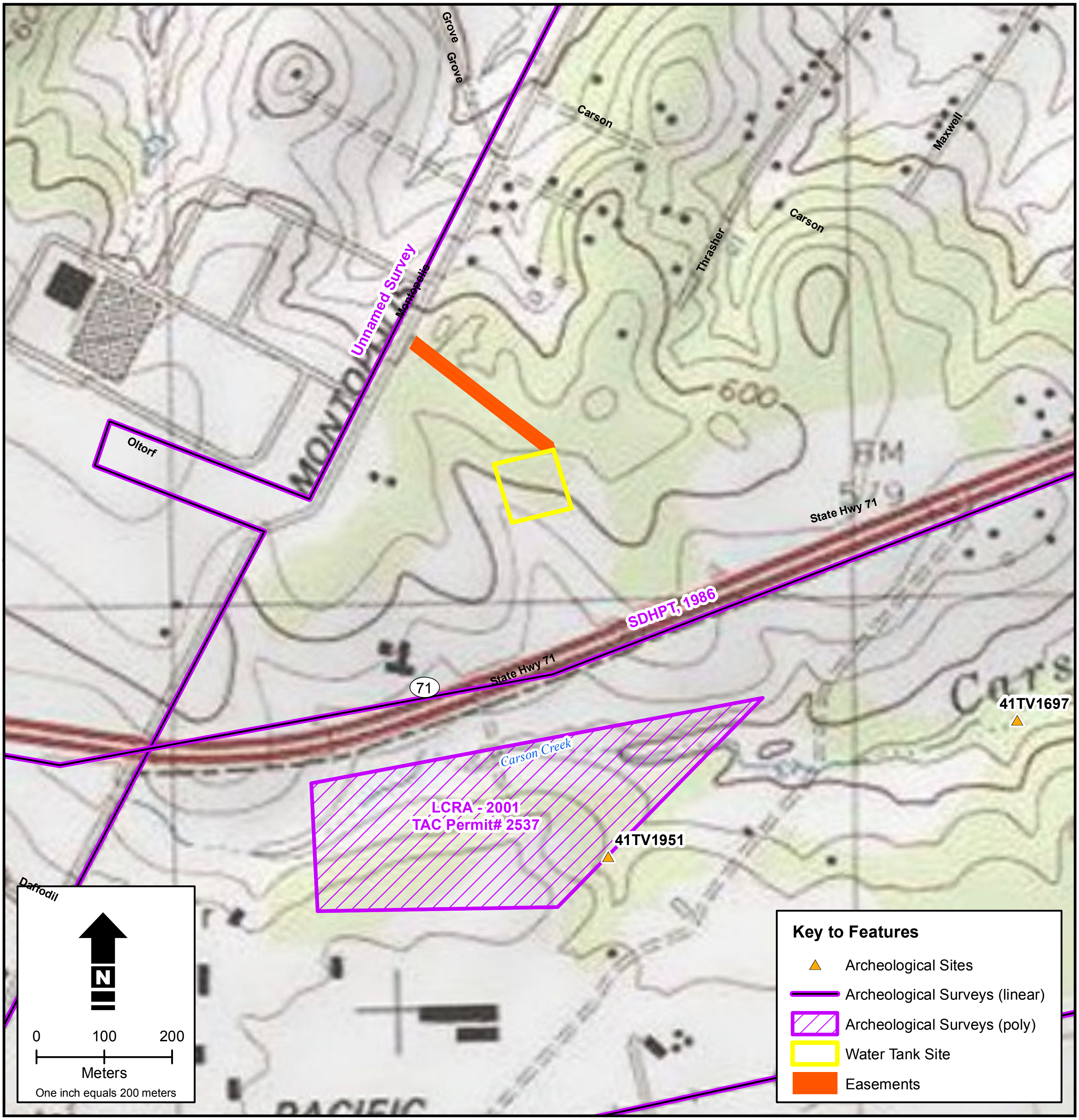
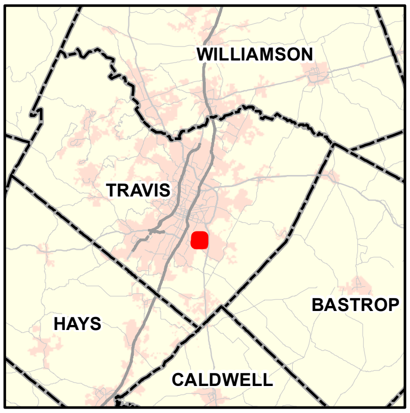


Figure 4

Previous Recorded Archeological
Sites and Surveys

Montopolis Water Reuse Site

USGS 7.5-minute Topographic Quadrangle:
Montopolis, TX



METHODOLOGY

Since the proposed project overlays geological formations that predate the arrival of humans in the Americas, it was determined that cultural deposits within the proposed project area would likely be close to the surface in overlying sediment or on the surface itself. Therefore, Hicks & Company proposed that pedestrian survey supplemented with shovel testing as an adequate methodology to assess the proposed project's potential to impact undocumented archeological resources and/or sites. The field methodology utilized in the course of the archaeological survey was tailored to provide the broadest possible evaluation of cultural resources within the project area.

Hicks & Company archaeologists conducted a 100-percent intensive survey of the project area following the THC/CTA's minimum survey standards for areal projects of less than 10 acres in size. All shovel tests were terminated at bedrock, dense clays or clay loams within a cobble matrix. All excavated soil from shovel tests was screened through quarter-inch wire mesh or hand-sorted when clays would not pass through screens. Each shovel test was recorded in ten-centimeter levels on standardized forms and their location plotted using a GPS. Once data were recorded, all shovel tests were backfilled.

With an absence of below-surface cultural deposits (two shovel tests placed within the site boundary were negative), newly recorded Site 41TV490 was delineated by the extent of the present surficial lithic scatter observed within and adjacent to the proposed project area.

Investigators used handheld GPS units and detailed maps to locate and record excavations within the proposed project area. GPS positions were recorded for all shovel tests. All GPS positions were downloaded and plotted on 7.5-minute USGS topographic and aerial maps by Hicks & Company GIS personnel.

RESULTS OF FIELD INVESTIGATIONS

Survey of the proposed project area initiated immediately east of Montopolis road, where the proposed water line/access road segment will tie into an existing water line. From this location, the proposed waterline/access road alignment runs southeast for 280 meters through densely wooded terrain, terminating at the northeast corner of the proposed water tank site location (**Figures 5 & Appendix B**). Three of the four shovel tests (JH1, GC1, and GC2) conducted along this segment noted sandy loams that ranged from brown (10YR 3/3) to dark yellowish brown (10YR 4/6) in color with high amounts of limestone gravel and calcium carbonate precipitate inclusions. These shovel tests terminated from 15-25 cmbs at hard clay or gravel bed matrices. Shovel test JH2 conducted at the water line/access road's termination at the northeast corner of the proposed water tank site location noted a black (10YR 2/1) humic loam with approximately 20 percent limestone cobble inclusions. This test terminated at 20 cmbs at bedrock.

The water tank site's proposed location is a square shaped area, 90 meters x 90 meters or approximately two acres in size, bounded on the south side by an existing gas pipeline right of way (**Appendix B**). Vegetation of the area is similar to that observed within and along the proposed waterline/access road corridor, with dense cedar and a low understory that gives way to patchy cedar and oak stands and intermittent exposures of chert and limestone cobbles (**Figures 6 and 7**). The proposed water tank location is home to a number of homeless encampments and is littered sporadically with debris and accumulated garbage (**Figures 8 and 9**). Five shovel tests (GC3, GC4, JH3-JH5) were excavated at the proposed water tank location. Shovel tests conducted at the center (GC4) and the northern extent (GC3 and JH5) of this tract noted silty clay loams and sandy loams that ranged from brown (10YR 4/3) to dark yellowish brown (10YR 4/6) in color. These tests terminated from 10-28 cmbs at thick dark brown (10YR 3/3) clays or at bedrock. Shovel tests (JH3 and JH4) excavated within the southern half of the proposed water tank area noted deeper clay loams that ranged from very dark gray (10YR 3/1) to black (10YR 2/1) in color terminating between 40-45 cmbs at thick impenetrable clays. None of the shovel tests excavated during the investigation were positive for cultural materials. A single site, Site 41TV2438, was recorded during the survey and is described in more detail below.

Figure 5: Overview of the proposed waterline/access road corridor facing southeast from Shovel Test JH1.

Figure 6: Overview of proposed water tank location facing southeast from Shovel Test JH2.

Figure 7: Limestone and chert cobble exposure, eroding from the thin soils.

Figure 8: Homeless encampment typical of the immediate area.

Figure 9: Modern trash scatter noted near southwest corner of proposed water tank location.

Site 41TV2438

During survey of the northeastern portion of the proposed water tank location, a small (40 meters x 20 meters) prehistoric surficial lithic scatter was encountered and recorded as Site 41TV2438 (**Appendix B**). This site is located on a slight, southeast trending, slope immediately west of an ephemeral drainage. The area is vegetated with cedars and, within the vicinity there are exposures of chert cobbles (**Figures 10 and 11**). Site 41TV2438 consists of a bifacial core, 2-3 multidirectional cores, 2-3 tested cobbles, and small amounts of debitage (**Figures 12 and 13**). Based on the artifact assemblage it is likely that this site represents short term use centered on the procurement of raw material. Shovel tests (GC3 and JH5) conducted at Site 41TV2438 were negative and no buried cultural deposits or features were noted. Due to a lack of chronological or cultural diagnostics, the lack of datable components that would add valuable data to the archaeological record, and a small assemblage size that is very typical of the area, Site 41TV2438 is recommended as ineligible for listing as a State Archaeological Landmark (SAL).

Figure 10: Overview of Site 41TV2438 facing west from eastern boundary.

Figure 11: Overview of Site 41TV2438 facing southeast from northern boundary.

Figure 12: Bifacial core or tool observed on surface of Site 41TV2438.

Figure 13: Multidirectional core observed on surface of Site 41TV2438.

CONCLUSIONS AND RECOMMENDATIONS

Pedestrian survey and shovel testing of the proposed Montopolis Water Reuse Site project in Travis County, Texas, revealed a single prehistoric archeological site of unknown temporal period with no features, and small amounts of observable materials. This site was recorded as 41TV2438. Due to a lack of chronological or cultural diagnostics, the lack of datable components that would add valuable data to the archaeological record, and a small assemblage size that is very typical of the area, Site 41TV2438 is recommended as ineligible for listing as a SAL according to criteria listed in 13 RAC 26.8 and 13 TAC 26.12. Based on the results of the current survey, it is recommended that no SALs will be affected by the proposed project and that the project can proceed to construction with no further archeological investigations. In the event that unanticipated archeological deposits are encountered during construction, work in the immediate area will cease and THC archeological staff will be contacted. Hicks & Company offers this draft report in partial fulfillment of TAC Permit #6565. No cultural materials were collected during the survey. All project-related notes will be permanently curated at the Texas Archeological Research Laboratory in Austin, Texas.

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APPENDIX A

SHOVEL TEST RESULTS

Table A-1 Shovel Tests Results					
Shovel Test	**Location**	**Surface Visibility**	**Depth (cmbs)**	**Description**	**Cultural Materials**
GC1	Southwest edge of easement 40 meters south of Montopolis	50%	25	**0-20 cmbs** Brown (10YR 4/3) silty sandy loam with large limestone inclusions. **20-25 cmbs** Dark brown (10YR 3/3) hard clay with calcium carbonate.	**None**
GC2	Southwestern edge midway of easement	20%	24	**0-21 cmbs** Brown (10YR 4/3) silty clay loam with large limestone inclusions. **21-24 cmbs** Dark brown 10YR 3/3 hard silty clay with calcium carbonate inclusions.	**None**
GC3	Northwest corner of Tank site north of surface finds	10%	28	**0-25 cmbs** Brown (10YR 4/3) silty clay loam with lesser amounts of limestone inclusions. **25-28 cmbs** Yellow (10YR 8/6) hard clay silts with no inclusions.	**None**
GC4	Western half central section of tank site near homeless dwelling, gently rising	10%	15	**0-10 cmbs** Hard brown (10YR 4/3) silty clays with many limestone inclusions **10-14 cmbs** Harder dark brown (10YR 3/3) clay with few inclusions.	**None**
JH1	Cedar thicket 35 meters southwest of Montopolis, uplands	15%	15	**0-15 cmbs** Dark yellowish brown (10YR 4/6) sandy loam within a limestone gravel matrix (70%). Terminated within gravel bed.	**None**
JH2	At northeast corner of tank location. Cedar thicket with heavy leaf litter	5%	20	**0-20 cmbs** Black (10YR 2/1) humic loam w approx. 20% limestone cobble inclusions. Terminated at bedrock.	**None**
JH3	Southeast corner of tank location, approx. 1 meter north of maintained underground pipeline corridor	5%	40	**0-40 cmbs** Black (10YR 2/1) clay loam with impenetrable clay at 40 cmbs.	**None**
JH4	Southwest corner of Tank site	80%	45	**0-35 cmbs** Very dark gray (10YR 3/1) clay loam w/ increasing mottles of light yellowish brown (10YR 6/4) clay.	**None**
JH5	Very west extent of Site 41TV2348	75%	10	**0-10 cmbs** Dark yellowish brown (10YR 4/6) sandy loam with chert and limestone gravels. Terminated at bedrock.	

APPENDIX B

LOCATIONS OF SHOVEL TESTS AND SITE 41TV2438

One inch equals 40 m

Appendix B

Shovel Tests and Site 41TV2438 Location
Montopolis Water Reuse Site

Key to Features

- ● Shovel Tests
- ● Surface Artifacts
- ▲ Isolated Finds
- 🟧 Site 41TV2438
- ☐ Water Tank Site
- 🟥 Easements

Appendix C
Communications Path Study

Montopolis Pump Station Radio Communication Links

PREPARED FOR: City of Austin
COPY TO: Yehuda Morag, Bill Phillips - CH2M HILL
PREPARED BY: CH2M HILL TBPE No. F-3699
DATE: September 25, 2013
PROJECT NUMBER: 472902.03.31.55

This document is released for the purpose of review by the City of Austin under the authority of Dhumal N. Aturaliye, P.E. 105693 on June 12, 2013. It is not to be used for construction, bidding or permitting purposes.

The purpose of this technical memorandum is to analyze and select radio communications methods and links for connecting the Montopolis Pump Station (MPS) to the City of Austin's Water Distribution Control System (WDCS) telecommunications network. The work completed to date is summarized in this Draft Technical Memorandum (TM) as are the steps recommended to complete this task.

Work Completed to Date

Initial desktop analysis of the following candidate communications methods and links has been completed:

- Three Broadband Communications Links using the unlicensed Industrial Scientific and Medical (ISM) 5725-5875 MHz (5.8 GHz) band.
- Four Narrowband Communications Links using the City's existing licensed Multiple Address System (MAS) 928-956 MHz band.

The initial desktop analysis work was completed using the following assumptions:

- Antennas at existing towers were placed at the top of these towers.
- The initial antennas at Harold Court and Montopolis are assumed to be mounted at 50' elevation, 10' above 40' towers. During the second round of analysis, it was assumed that a tower would be constructed at Montopolis to accommodate 5.8 GHz links between Montopolis and the following three stations: South Service Center, SAR WWTP and 51st Avenue Pump Station.
- The National Land Cover Database (NLCD) was used to estimate elevations above grade for structures and vegetation.

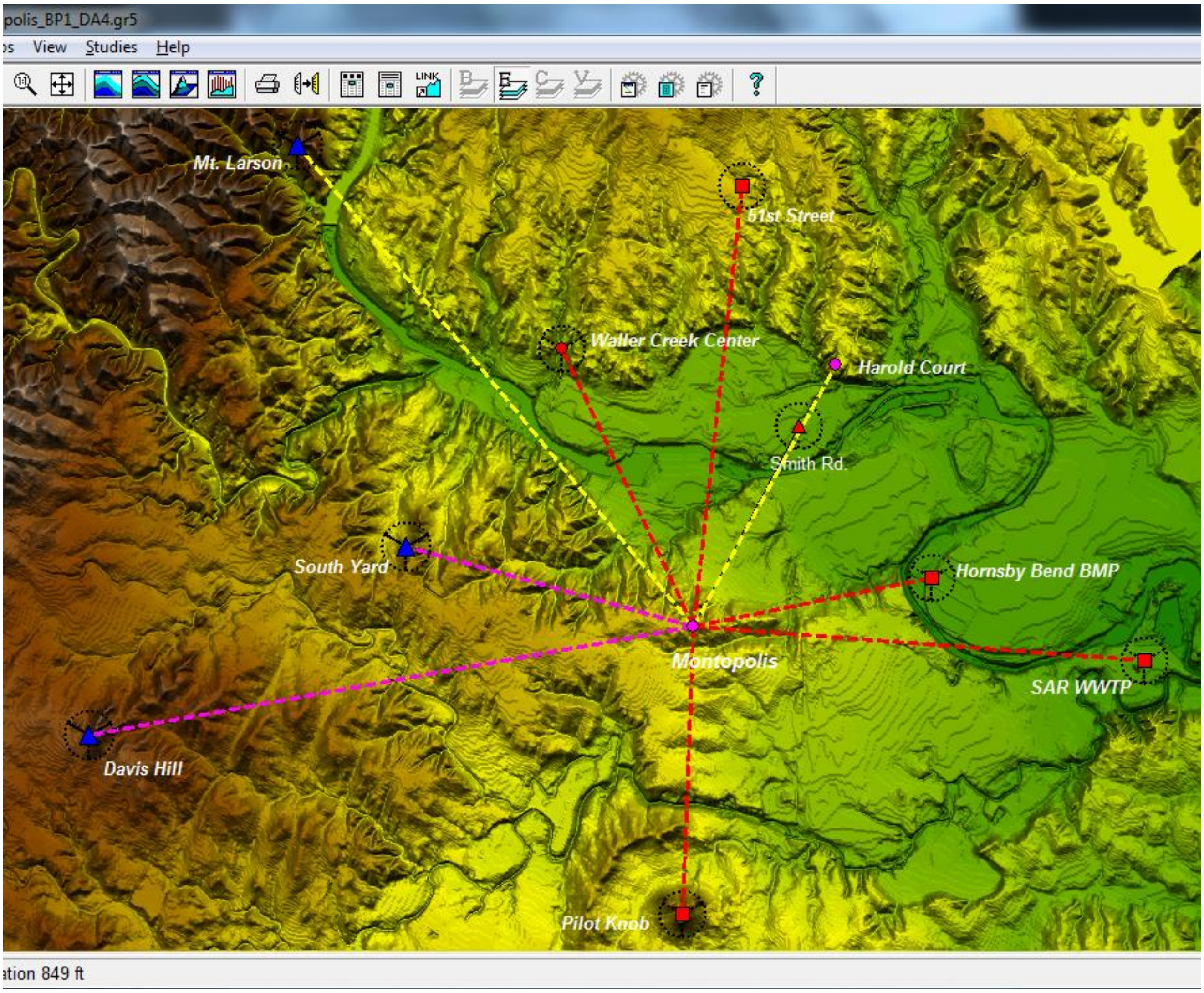
Figure 1 (Montopolis Communications Alternatives) below is a screenshot of the Pathloss 5.0C network display showing the seven links analyzed. The dashed red links are broadband links and the dashed yellow links are narrowband links. The dashed magenta link (between Montopolis Pump Station and the South Service Center) represents two links, one broadband and one narrowband.

Appendix A contains path analysis summary reports for each link. These reports are based on National Land Cover Database (NLCD) clutter elevations which are shown in color in these summary reports. Previous work for the City was based on the Shuttle Radar Topography (SRTM) dataset. Because radar topography was used to collect the SRTM data, the height of lower density structures such as trees are measured to be lower than their actual height. NLCD data was used for this task because the color coding is expected to be more useful to those conducting the field verification work and the NLCD terrain data is expected to be easier to edit based on the findings of the field verification work.

NLC Database

This database is based on land cover analysis with somewhat arbitrary above grade elevations assigned for each type of land cover. For the Montopolis links NLCD clutter is divided in shades of pink and red representing low and high, medium and high density development; and shades of green representing evergreen and deciduous forest.

Figure 1. Montopolis Communications Alternatives



Analysis

In general, summary reports based on NLCD clutter show higher tower heights than those based on SRTM clutter because of the differences in the methods use to produce the above grade elevation data. Having current Light Detection and Ranging (LiDAR) based clutter would significantly improve initial projections; but field verification and interference testing would still be required.

The Pathloss analysis showed that good communication can be achieved for all of the 900 MHz links at the assumed antenna heights. The initial analysis showed that the only viable link for the 5.8 GHz network would be between Montopolis and the South Service Center, with the antenna at Montopolis being installed on the top of the water tower. Subsequent analysis was performed with the assumption that a new communication tower would be constructed at the Montopolis Pump Station. The Pathloss analysis showed that with a tower of 120 feet, reliable communication over the 5.8 GHz network can be achieved from Montopolis to all four sites (Waller Creek, SAR, South Service Center and 51st Street). These model results need to be field verified.

The summary of the antenna heights required and the fade margins for each of the paths analyzed have been summarized in the tables shown below:

Table 1: Summary of 900 MHz Pathloss Link Analysis
(Assuming a 50’ antenna at Montopolis Pump Station)

Site Name	Fade Margin (dB)	Existing Tower Height (ft)	Proposed Antenna Height (ft)
Davis Hill	43.92	263.0	263
Harold Court	52.98	NA	50
Mount Larson	38.12	273.9	274
South Service Center	40.16	200.0	200

Table 2: Summary of 5.8GHz Pathloss Link Analysis
(Assuming a 50’ antenna at Montopolis Pump Station)

Site Name	Fade Margin (dB) 64 QAM 22. 5 / 16 QAM 15 / QPSK 7.5	Existing Tower Height (ft)	Proposed Antenna Height (ft)
Hornsby Bend	-34.10 / -26.10 / -15.10	100.0	100
South Austin Regional (SAR)	-21.32 / -13.32 / -2.32	200.0	200
South Service Center	-15.49 / -7.49 / 3.51	200.0	200

Table 3: Summary of 5.8GHz Pathloss Link Analysis
(Assuming a tower at Montopolis Pump Station)

Site Name	Fade Margin (dB) 64 QAM 22. 5 / 16 QAM 15 / QPSK 7.5	Proposed Antenna Height (ft)	Proposed Antenna Height at Montopolis (ft)
Waller Creek	5.83 / 13.83 / 24.83	100.0	113
South Austin Regional (SAR)	2.41 / 10.41 / 21.41	200.0	104
51st Street	2.62 / 10.62 / 21.62	70	114
South Service Center	3.11 / 11.41 / 22.11	118	124

Next Steps Recommendations

To finalize tower height recommendations and path reliability projections the following steps are recommended:

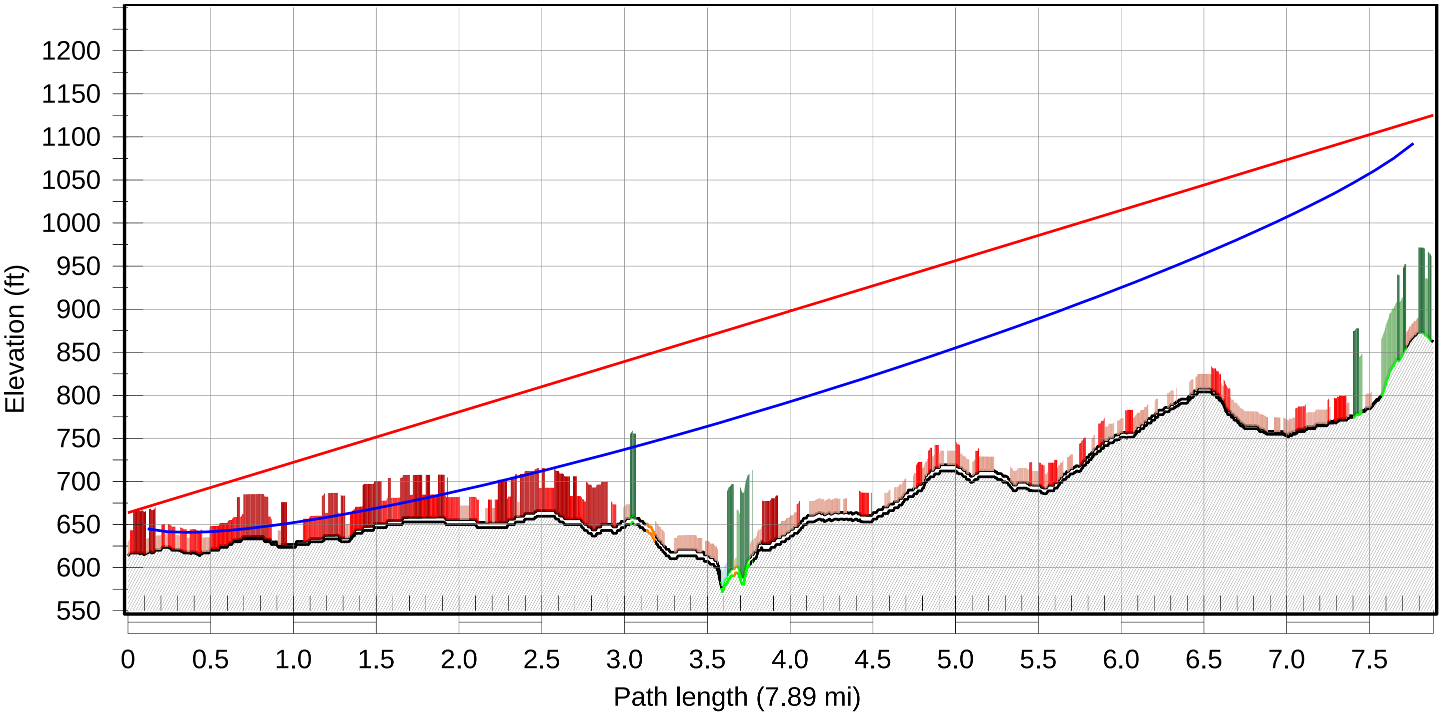
1. Conduct a field site surveys to complete the following activities:
    a. Verify existing MAS master antenna heights.
    b. Determine available space on existing towers for antennas.
    c. Measure for interference in the 5725-5875 MHz band at each potential broadband node location using a manageable directional antenna and at an elevation representative on the expected antenna locations to the degree practical.
    d. Determine the structural capacity of existing towers, if available from the tower owner, for supporting antennas and other equipment required for each link being considered.

   e. Determine locations and cable routes for equipment interfacing the antennas or radios for the links being considered to the local communications network interface.
   f. Travel each path using a GPS accurate to 5m horizontal and a range finder to estimate actual clutter types and elevations above grade.
2. Use field survey results to update radio path analysis including recommended tower heights and projected path reliability.
3. Conduct follow-up field work, if required, to resolve open items.
4. Update this Technical Memorandum (TM to an equipment list and implementation cost estimate.
5. Update and finalize this memorandum to incorporate updated and additional content.

Other Considerations

Interference in the unlicensed 5725-5875 MHz band is growing and projected to increase with this bands popularity. The 4G (WiMAX) technology which is also being considered by the City complies with the Institute of Electrical and Electronic Engineers (IEEE) 802.16e standard and is capable of avoiding interference which allow it to operate in a lower 5470-5725 MHz Unlicensed National Information Infrastructure (U-NII) band. The ability to avoid interference will allow radios to operate more reliably in the presence of interference and reduces competition.

Appendix A – Path Analysis Summary Reports



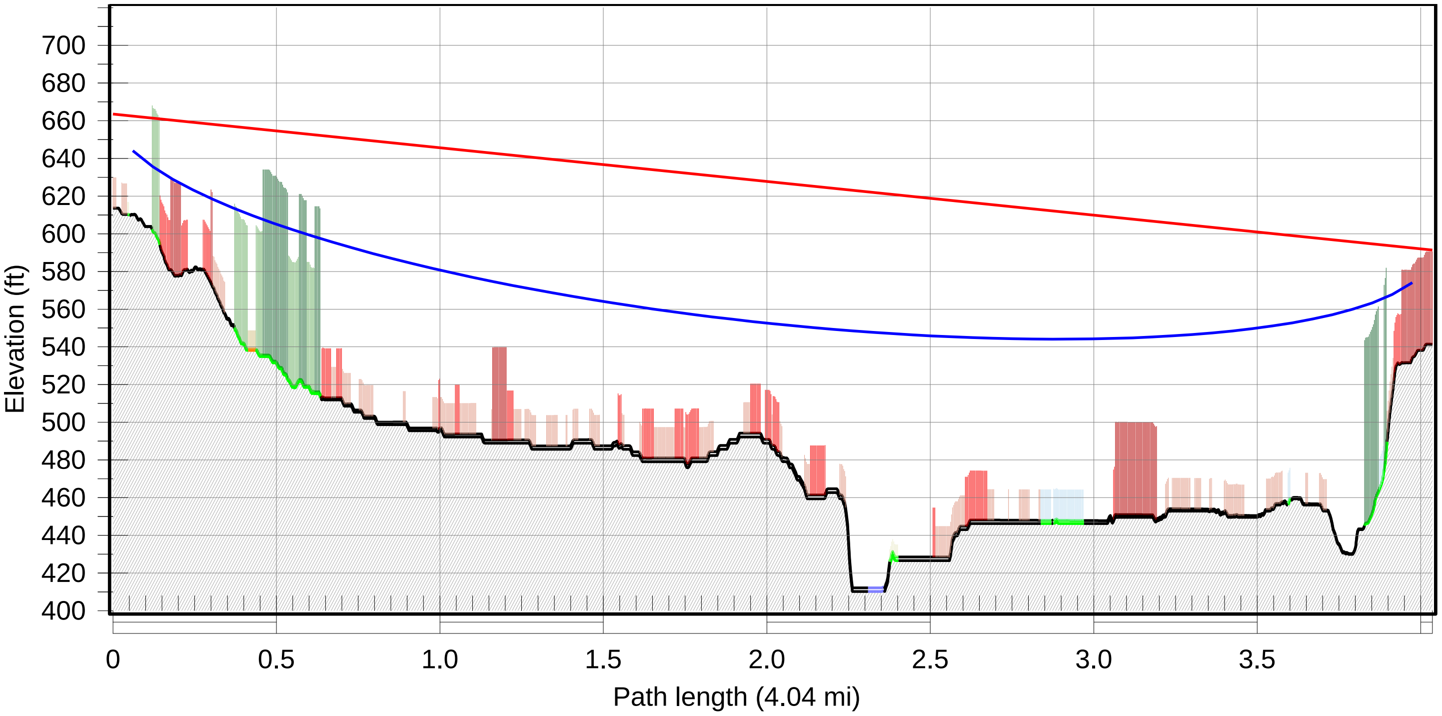
F = 928.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	Davis Hill
Latitude	30 13 03.39 N	30 11 41.00 N
Longitude	097 42 39.11 W	097 50 24.00 W
True azimuth (°)	258.50	78.44
Vertical angle (°)	0.59	-0.68
Elevation (ft)	613.52	862.04
Tower height (ft)	40.00	263.12
Antenna model	TY-900 (TR)	10017-7 (TR)
Antenna gain (dBi)	12.00	12.10
Antenna height (ft)	50.00	263.00
TX line model	LDF4.5-50 (5/8")	AVA5RK-50 (7/8")
TX line length (ft)	80.00	300.00
TX loss (dB)	3.26	5.30
RX loss (dB)	3.26	5.30
Diffraction loss (dB)	6.67	
Radio model	SD9	SD9
TX power (dBm)	37.00	37.00
EIRP (dBm)	45.74	43.80
Receive signal (dBm)	-68.08	-68.08

	Montopolis	Davis Hill
Thermal fade margin (dB)	43.92	43.92
Annual 2 way multipath availability (%)	99.99999	
Annual 2 way multipath unavailability (sec)	3.23	

Multipath fading method - Vigants - Barnett

Pathloss

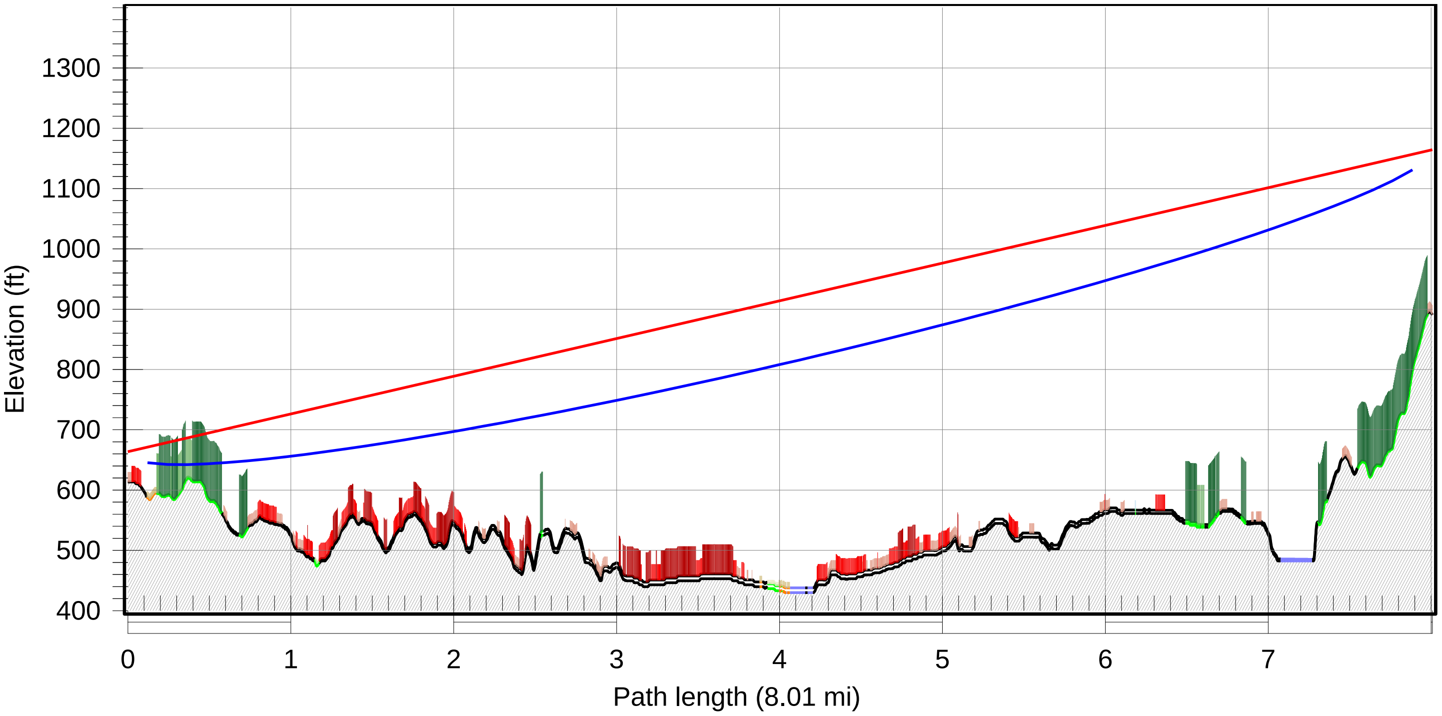


F = 928.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	Harold Court
Latitude	30 13 03.39 N	30 15 59.04 N
Longitude	097 42 39.11 W	097 40 24.67 W
True azimuth (°)	33.60	213.62
Vertical angle (°)	-0.22	0.17
Elevation (ft)	613.52	541.34
Tower height (ft)	40.00	
Antenna model	TY-900 (TR)	10017-7 (TR)
Antenna gain (dBi)	12.00	12.10
Antenna height (ft)	50.00	50.00
TX line model	LDF4.5-50 (5/8")	LDF4.5-50 (5/8")
TX line length (ft)	125.00	90.00
TX loss (dB)	3.97	3.42
RX loss (dB)	3.97	3.42
Diffraction loss (dB)	4.63	
Radio model	SD9	SD9
TX power (dBm)	37.00	37.00
EIRP (dBm)	45.03	45.68
Receive signal (dBm)	-59.02	-59.02

	Montopolis	Harold Court
Thermal fade margin (dB)	52.98	52.98
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.11	

Multipath fading method - Vigants - Barnett



F = 928.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	Mt. Larson
Latitude	30 13 03.39 N	30 18 32.50 N
Longitude	097 42 39.11 W	097 47 36.90 W
True azimuth (°)	321.87	141.83
Vertical angle (°)	0.64	-0.72
Elevation (ft)	613.52	890.42
Tower height (ft)	40.00	273.95
Antenna model	TY-900 (TR)	10017-7 (TR)
Antenna gain (dBi)	12.00	12.10
Antenna height (ft)	50.00	274.00
TX line model	LDF4.5-50 (5/8")	AVA5RK-50 (7/8")
TX line length (ft)	50.00	350.00
TX loss (dB)	2.79	5.85
RX loss (dB)	2.79	5.85
Diffraction loss (dB)	12.26	
Radio model	SD9	SD9
TX power (dBm)	37.00	37.00
EIRP (dBm)	46.21	43.25
Receive signal (dBm)	-73.88	-73.88

	Montopolis	Mt. Larson
Thermal fade margin (dB)	38.12	38.12
Annual 2 way multipath availability (%)	99.99998	
Annual 2 way multipath unavailability (sec)	7.28	

Multipath fading method - Vigants - Barnett

F = 928.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	South Yard
Latitude	30 13 03.39 N	30 13 53.00 N
Longitude	097 42 39.11 W	097 46 09.00 W
True azimuth (°)	285.24	105.21
Vertical angle (°)	0.58	-0.62
Elevation (ft)	613.52	662.73
Tower height (ft)	40.00	200.13
Antenna model	TY-900 (TR)	10017-7 (TR)
Antenna gain (dBi)	12.00	12.10
Antenna height (ft)	50.00	200.00
TX line model	LDF4-50A	AVA5RK-50 (7/8")
TX line length (ft)	100.00	250.00
TX loss (dB)	4.25	4.75
RX loss (dB)	4.25	4.75
Diffraction loss (dB)	16.81	
Radio model	SD9	SD9
TX power (dBm)	37.00	37.00
EIRP (dBm)	44.75	44.35
Receive signal (dBm)	-71.84	-71.84

	Montopolis	South Yard
Thermal fade margin (dB)	40.16	40.16
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	1.13	

Multipath fading method - Vigants - Barnett

F = 5800.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	Hornsby Bend BMP
Latitude	30 13 03.39 N	30 13 31.04 N
Longitude	097 42 39.11 W	097 39 07.34 W
True azimuth (°)	81.43	261.46
Vertical angle (°)	-0.42	0.38
Elevation (ft)	613.52	431.54
Tower height (ft)	40.00	99.74
Antenna model	58430 SM Integral Antenna w/ 15 dBi PR (TR)	58430 AP Integral Antenna (TR)
Antenna gain (dBi)	25.00	18.00
Antenna height (ft)	50.00	100.00
TX loss (dB)	0.00	0.00
RX loss (dB)	0.00	0.00
Diffraction loss (dB)	43.16	
Radio model	58430 PMP SM	58430 PMP AP

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin multipath (dB)	
64 QAM 22.5	19.00	16.00	-70.00	-70.00	44.00	34.00	-107.10	-104.10	-37.10	-34.10		
16 QAM 15	19.00	16.00	-78.00	-78.00	44.00	34.00	-107.10	-104.10	-29.10	-26.10		

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin multipath (dB)	
QPSK 7.5	19.00	16.00	-89.00	-89.00	44.00	34.00	-107.10	-104.10	-18.10	-15.10		

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5								
16 QAM 15								
QPSK 7.5								

Multipath fading method - Vigants - Barnett

F = 5800.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	SAR WWTP
Latitude	30 13 03.39 N	30 12 33.07 N
Longitude	097 42 39.11 W	097 36 16.03 W
True azimuth (°)	95.18	275.23
Vertical angle (°)	-0.27	0.20
Elevation (ft)	613.52	426.51
Tower height (ft)	40.00	99.74
Antenna model	58430 SM Integral Antenna w/ 15 dBi PR (TR)	58430 AP Integral Antenna (TR)
Antenna gain (dBi)	25.00	18.00
Antenna height (ft)	50.00	100.00
TX loss (dB)	0.00	0.00
RX loss (dB)	0.00	0.00
Diffraction loss (dB)	25.26	
Radio model	58430 PMP SM	58430 PMP AP

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 22.5	19.00	16.00	-70.00	-70.00	44.00	34.00	-94.32	-91.32	-24.32	-21.32		
16 QAM 15	19.00	16.00	-78.00	-78.00	44.00	34.00	-94.32	-91.32	-16.32	-13.32		

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
QPSK 7.5	19.00	16.00	-89.00	-89.00	44.00	34.00	-94.32	-91.32	-5.32	-2.32		

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5								
16 QAM 15								
QPSK 7.5								

Multipath fading method - Vigants - Barnett

F = 5800.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Montopolis	South Yard
Latitude	30 13 03.39 N	30 13 53.00 N
Longitude	097 42 39.11 W	097 46 09.00 W
True azimuth (°)	285.24	105.21
Vertical angle (°)	0.58	-0.62
Elevation (ft)	613.52	662.73
Tower height (ft)	40.00	200.13
Antenna model	58430 SM Integral Antenna w/ 15 dBi PR (TR)	58430 AP Integral Antenna (TR)
Antenna gain (dBi)	25.00	18.00
Antenna height (ft)	50.00	200.00
TX loss (dB)	0.00	0.00
RX loss (dB)	0.00	0.00
Diffraction loss (dB)	24.41	
Radio model	58430 PMP SM	58430 PMP AP

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 22.5	19.00	16.00	-70.00	-70.00	44.00	34.00	-88.49	-85.49	-18.49	-15.49		
16 QAM 15	19.00	16.00	-78.00	-78.00	44.00	34.00	-88.49	-85.49	-10.49	-7.49		

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
QPSK 7.5	19.00	16.00	-89.00	-89.00	44.00	34.00	-88.49	-85.49	0.51	3.51	0.51	3.51

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5								
16 QAM 15								
QPSK 7.5	99.6936	99.8464	99.8964	99.9481			99.8444	99.8444

Multipath fading method - Vigants - Barnett

	Montopolis	51st Street
Latitude	30 12 57.12 N	30 18 04.00 N
Longitude	097 42 19.06 W	097 41 39.00 W
True azimuth (°)	6.46	186.47
Vertical angle (°)	-0.11	0.05
Elevation (ft)	613.20	613.52
Tower height (ft)	40.00	167.32
Antenna model	58430 AP Integral Antenna (TR)	58430 SM Integral Antenna w/ 15 dBi PR (TR)
Antenna file name	motorola 58430 ap antenna	motorola 58430 sm ant with 15 dbi pr
Antenna gain (dBi)	18.00	25.00
Antenna height (ft)	114.27	69.72
Frequency (MHz)	5800.00	
Polarization	Vertical	
Path length (mi)	5.91	
Free space loss (dB)	127.30	
Atmospheric absorption loss (dB)	0.08	
Field margin (dB)	2.00	
Net path loss (dB)	86.38	86.38
Radio model	58430 PMP AP	58430 PMP SM
Radio file name	motorola 58430 ap 10 mhz bw	motorola 58430 sm 10 mhz bw
Climatic factor	2.00	
Terrain roughness (ft)	34.60	
C factor	3.23	
Average annual temperature (°F)	67.68	
Fade occurrence factor (Po)	9.659E-003	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 22.5	16.00	19.00	-70.00	-70.00	34.00	44.00	-67.38	-70.38	2.62	-0.38	2.62	
16 QAM 15	16.00	19.00	-78.00	-78.00	34.00	44.00	-67.38	-70.38	10.62	7.62	10.62	7.62
QPSK 7.5	16.00	19.00	-89.00	-89.00	34.00	44.00	-67.38	-70.38	21.62	18.62	21.62	18.62

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5	94.5392		98.1519				98.1519	98.1519
16 QAM 15	99.8973	99.6993	99.9652	99.8982			99.8635	1.7115
QPSK 7.5	99.9937	99.9876	99.9979	99.9958			99.9937	0.1302

Multipath fading method - Vigants - Barnett

	Montopolis	SAR WWTP
Latitude	30 12 57.12 N	30 12 33.07 N
Longitude	097 42 19.06 W	097 36 16.03 W
True azimuth (°)	94.34	274.39
Vertical angle (°)	-0.20	0.13
Elevation (ft)	613.20	426.51
Tower height (ft)	40.00	200.00
Antenna model	58430 AP Integral Antenna (TR)	58430 SM Integral Antenna w/ 15 dBi PR (TR)
Antenna file name	motorola 58430 ap antenna	motorola 58430 sm ant with 15 dbi pr
Antenna gain (dBi)	18.00	25.00
Antenna height (ft)	103.72	200.00
Frequency (MHz)	5800.00	
Polarization	Vertical	
Path length (mi)	6.05	
Free space loss (dB)	127.50	
Atmospheric absorption loss (dB)	0.08	
Field margin (dB)	2.00	
Net path loss (dB)	86.59	86.59
Radio model	58430 PMP AP	58430 PMP SM
Radio file name	motorola 58430 ap 10 mhz bw	motorola 58430 sm 10 mhz bw
Climatic factor	2.00	
Terrain roughness (ft)	23.36	
C factor	5.38	
Average annual temperature (°F)	67.78	
Fade occurrence factor (Po)	1.728E-002	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 22.5	16.00	19.00	-70.00	-70.00	34.00	44.00	-67.59	-70.59	2.41	-0.59	2.41	
16 QAM 15	16.00	19.00	-78.00	-78.00	34.00	44.00	-67.59	-70.59	10.41	7.41	10.41	7.41
QPSK 7.5	16.00	19.00	-89.00	-89.00	34.00	44.00	-67.59	-70.59	21.41	18.41	21.41	18.41

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5	92.4688		97.4476				97.4476	97.4476
16 QAM 15	99.8297	99.5298	99.9423	99.8407			99.7830	2.3353
QPSK 7.5	99.9883	99.9774	99.9961	99.9923			99.9884	0.2054

Multipath fading method - Vigants - Barnett

	Montopolis	South Yard
Latitude	30 12 57.12 N	30 13 53.00 N
Longitude	097 42 19.06 W	097 46 09.00 W
True azimuth (°)	285.65	105.62
Vertical angle (°)	0.16	-0.20
Elevation (ft)	590.00	662.73
Tower height (ft)	40.00	200.13
Antenna model	58430 AP Integral Antenna (TR)	58430 SM Integral Antenna w/ 15 dBi PR (TR)
Antenna file name	motorola 58430 ap antenna	motorola 58430 sm ant with 15 dbi pr
Antenna gain (dBi)	18.00	25.00
Antenna height (ft)	124.94	117.60
Frequency (MHz)	5800.00	
Polarization	Vertical	
Path length (mi)	3.97	
Free space loss (dB)	123.84	
Atmospheric absorption loss (dB)	0.05	
Field margin (dB)	2.00	
Net path loss (dB)	82.89	82.89
Radio model	58430 PMP SM	58430 PMP AP
Radio file name	motorola 58430 sm 10 mhz bw	motorola 58430 ap 10 mhz bw
Climatic factor	2.00	
Terrain roughness (ft)	25.19	
C factor	4.88	
Average annual temperature (°F)	67.66	
Fade occurrence factor (Po)	4.417E-003	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 22.5	19.00	16.00	-70.00	-70.00	37.00	41.00	-66.89	-63.89	3.11	6.11	3.11	6.11
16 QAM 15	19.00	16.00	-78.00	-78.00	37.00	41.00	-66.89	-63.89	11.11	14.11	11.11	14.11
QPSK 7.5	19.00	16.00	-89.00	-89.00	37.00	41.00	-66.89	-63.89	22.11	25.11	22.11	25.11

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5	97.1145	99.6136	99.0239	99.8693			98.8932	98.8932
16 QAM 15	99.9521	99.9809	99.9838	99.9935			99.9773	1.0842
QPSK 7.5	99.9974	99.9986	99.9991	99.9995			99.9986	0.0213

Multipath fading method - Vigants - Barnett

	Montopolis	Waller Creek Center
Latitude	30 12 57.12 N	30 16 10.42 N
Longitude	097 42 19.06 W	097 44 04.60 W
True azimuth (°)	334.64	154.63
Vertical angle (°)	-0.44	0.39
Elevation (ft)	613.20	467.39
Tower height (ft)	40.00	151.90
Antenna model	58430 AP Integral Antenna (TR)	58430 SM Integral Antenna w/ 15 dBi PR (TR)
Antenna file name	motorola 58430 ap antenna	motorola 58430 sm ant with 15 dbi pr
Antenna gain (dBi)	18.00	25.00
Antenna height (ft)	112.92	102.26
Frequency (MHz)	5800.00	
Polarization	Vertical	
Path length (mi)	4.09	
Free space loss (dB)	124.11	
Atmospheric absorption loss (dB)	0.05	
Field margin (dB)	2.00	
Net path loss (dB)	83.17	83.17
Radio model	58430 PMP AP	58430 PMP SM
Radio file name	motorola 58430 ap 10 mhz bw	motorola 58430 sm 10 mhz bw
Climatic factor	2.00	
Terrain roughness (ft)	20.00	
C factor	6.58	
Average annual temperature (°F)	67.67	
Fade occurrence factor (Po)	6.546E-003	

	TX power (dBm)		RX threshold level (dBm)		EIRP (dBm)		Receive signal (dBm)		Thermal fade margin (dB)		Flat fade margin - multipath (dB)	
64 QAM 22.5	16.00	19.00	-70.00	-70.00	34.00	44.00	-64.17	-67.17	5.83	2.83	5.83	2.83
16 QAM 15	16.00	19.00	-78.00	-78.00	34.00	44.00	-64.17	-67.17	13.83	10.83	13.83	10.83
QPSK 7.5	16.00	19.00	-89.00	-89.00	34.00	44.00	-64.17	-67.17	24.83	21.83	24.83	21.83

	Worst month multipath		Annual multipath		Annual rain		Total annual (2 way)	Time in mode (2 way)
64 QAM 22.5	99.4472	95.9094	99.8130	98.6160			98.4290	98.4290
16 QAM 15	99.9710	99.9289	99.9902	99.9759			99.9661	1.5372
QPSK 7.5	99.9978	99.9959	99.9993	99.9986			99.9979	0.0318

Multipath fading method - Vigants - Barnett

Appendix D
Geotechnical Report

Engineering Report

Geotechnical Investigation for the Proposed Montopolis Pump Station Facilities, Austin, Texas

Prepared for
City of Austin, Texas

September, 2013

CH2MHILL®

This document is released for the purpose of interim review under the authority of K.R. Chang, P.E. 94134 on September18, 2013. It is not to be used for construction, bidding, or permit purposes.

TBPE Firm Number 3699

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Acronyms and Abbreviations

asl	above sea level
ASTM	American Society for Testing and Standards
bgs	below ground surface
CBR	California Bearing Ratio
CMU	concrete masonry unit
ft	feet
H	horizontal
LF	Linear Feet
msl	Mean Sea Level
N	SPT Blow Count
OSHA	Occupational Safety and Health Administration
pcf	pounds per cubic foot
psf	pounds per square foot
psi	pounds per square inch
REC	recovery
RQD	rock quality designation
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
V	vertical

SECTION 1

Introduction

1.1 Purpose and Scope

CH2M HILL conducted a geotechnical investigation for the design and construction of the proposed Montopolis pump station facilities. This report details the field exploration, laboratory testing, engineering analyses and recommendations for the design and construction of the proposed facilities.

The geotechnical investigation included the following tasks:

- Conduct a total of seven standard penetration tests (SPT) soil borings with drilling depth ranging from 2 to 40 feet below the existing ground surface.
- Perform moisture contents, Atterberg Limits tests, and sieve analyses on representative soil samples.
- Perform engineering analyses and develop geotechnical design and construction recommendations.
- Prepare this report to provide recommendations for the earthwork and foundation design of the proposed facilities.

1.2 Project Description and Proposed Construction

The proposed pump station is located at the northeast corner of the intersection of Montopolis Drive and E. Ben White Blvd. Currently, the project site is heavily wooded. Topography of the site slopes from north to south, from elevations 604 feet to 587 feet. The project location map is presented in the geotechnical data report in Appendix A.

The proposed construction will consist of a 125-foot-in-diameter ground storage tank and a pump station. The detailed description of the proposed facilities, the plan dimension, approximate existing grade elevation, bottom elevation of base slab, estimated load, and type of construction are presented in Table 1-1. The detailed site plan is presented in Appendix B.

TABLE 1-1
General Structures Information

Structure Description	Plan Dimensions (ft)	Current Ground Elevation (ft, msl)	Top of Slab Elevation (ft, msl)	Estimated Unit Load	Type of Construction
4-M Ground Storage Tank	125’ dia x 40’ tall	594 to 603	598	2700/psf	Steel Tank
Pump Station	60’ X 65’	589 to 594	592	4000/ft of footing	1-story concrete masonry

SECTION 2

Geotechnical Exploration

2.1 Field Exploration

The field exploration was conducted by HVJ and Associates, Inc. of Austin, TX, and consisted of a total of seven Standard Penetration Test (SPT) borings. The SPT borings were advanced to depths ranging from 2 to 40 feet below ground surface.

The borings were located in the field using surveying equipment. The boring location plan and the boring logs are presented in Appendix B.

2.1.1 Standard Penetration Tests

The SPT borings were made in conformance with the American Society for Testing and Materials (ASTM) D1586 by driving a 2-inch outside diameter split-spoon sampler with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler the last 12 inches of an 18-inch drive, or the middle 12 inches of a 24-inch drive, were recorded as the standard penetration resistance (N) value. Split-spoon samples were taken at 2.5-foot spacing to 10 feet below ground surface and at 5-foot intervals thereafter. The bore holes were advanced with hollow-stem, continuous flight augers. Groundwater table was not encountered immediately after completion of the borings.

TABLE 2-1

Summary of Soil Borings

Boring ID	Estimated Ground Elevation (ft) [a]	Soil Boring Depth (ft, bgs)	GWT Depth (ft, bgs)
B-1	607	2	Not encountered
B-2	610	2	Not encountered
B-3	609	10	Not encountered
B-4	601	30	Not encountered
B-5	600	40	Not encountered
B-6	595	30	Not encountered
B-7	590	40	Not encountered

2.1.2 Laboratory Testing

All disturbed samples were visually classified in the field in accordance with the Unified Soil Classification System. To aid the soil classification and evaluation of engineering properties of the soils, seventeen moisture content and Atterberg limit tests (ASTM D4318) were conducted by HVJ and Associates. The laboratory results and test reports are presented in the soil boring logs in Appendix A.

SECTION 3

Subsurface Condition

The subsurface condition at the proposed facilities location generally consists of 1 to 2 feet of brown to dark brown highly plastic fat clay overlying 4 to 8 feet of very stiff sandy lean clay to lean clay, which overlies hard fat clay to the maximum depth of the borings of 40 feet. The groundwater table was not encountered in the borings immediately after the completion of the borings.

3.1 Shrink-Swell Soil

The tendency for a soil to shrink and swell with change in moisture content is a function of clay content and type, which are reflected in soil plasticity as defined by Atterberg Limits. A generalized relationship between shrink-swell (expansion) potential and the soil plasticity Index (P.I.) is shown in Table 3-1:

TABLE 3-1
General Relationship between P.I. and Shrink-Swell Potential

P. I. Range	Shrink-Swell Potential
0 - 15	Low
15 -25	Medium
25 - 35	High
Greater 35	Very High

The surficial stiff to hard clay at this site possess a high to very high shrink-swell potential. The amount of expansion that will actually occur with increase in moisture content is inversely related to the overburden pressure; that is, the larger the overburden pressure, the smaller the amount of expansion. Near surface soils are thus susceptible to shrink-swell behavior because the experience low amount of overburden.

SECTION 4

Geotechnical Analyses and Recommendations

The findings of the subsurface investigation and laboratory testing were used to develop the following design analyses and recommendations.

4.1 Overexcavation and Backfill

Because of the high to very high shrink-swell potential of the surficial fat clay, the fat clay should be over-excavated and replaced with compacted structural fill. The following over-excavation and backfill procedures are recommended:

- Over-excavate the fat clay to a depth to allow for 6 feet of compacted structural fill below the bottom of footings or base slab. The structural fill should be placed within 12 hours after the excavation. The bottom of the overexcavation should be extended to at least 5 feet from the edge of the perimeter footings
- The structural fill should meet the requirements as mentioned below in Subsection Fill and Backfill. The structural should be placed in 6-inch maximum loose lifts, with each lift compacted to at least 95 percent of the maximum dry density, as determined by ASTM D-698
- Around the perimeter footings, a 12-inch-thick and 10-foot-wide compacted fat clay should be placed to prevent surface water from entering the compacted structural fill
- All surface water should be diverted from the proposed facilities by sloping the grade from the facilities or by constructing a drainage swale

The overexcavation and backfill requirements are illustrated in the Figure 4.1.

4.2 Subgrade Preparation for Access Road

Overexcavation of fat clay under the access road is also recommended. The overexcavation should be extended to 5 feet beyond the perimeter of the pavement and to 12 inches below the base course of the pavement. The overexcavation should be replaced with structural fill placed in 6-inch maximum loose lifts, with each lift compacted to at least 95 percent of the maximum dry density, as determined by ASTM D-698.

4.3 General Excavation and Trench Excavation

The SPT borings indicate that the material at the site can be excavated with conventional earth moving equipment, such as backhoes and front-end loaders. An un-braced temporary excavation with the side slope inclined at 1.5 H to 1 V or flatter is expected to remain stable if it is not subjected to surcharge load or vibration. Excavations deeper than 5 feet should be sloped or shored in accordance with Occupational Safety and Health Administration (OSHA) Standard 29 CFP part 1926, 652 requirements. Surface water runoff should be prevented from entering the excavation by berms, swales, or other methods. All grass, topsoil, and organic material should be stripped before excavation begins. Excavation should be conducted in accordance with all federal, state, and local ordinances protecting workers.

In areas where un-braced excavations are not practical, an excavation support system shall be installed. Sheeting, soldier piles and lagging, and trench boxes can be used to provide support for excavation. Excavations within the influence zone of an existing structure, utility, or pavement must be shored. The influence zone is defined at a slope ratio of 1.5H:1V from the nearest edge of an existing structure, utility, or pavement.

FIGURE 4-1
Overexcavation and Backfill

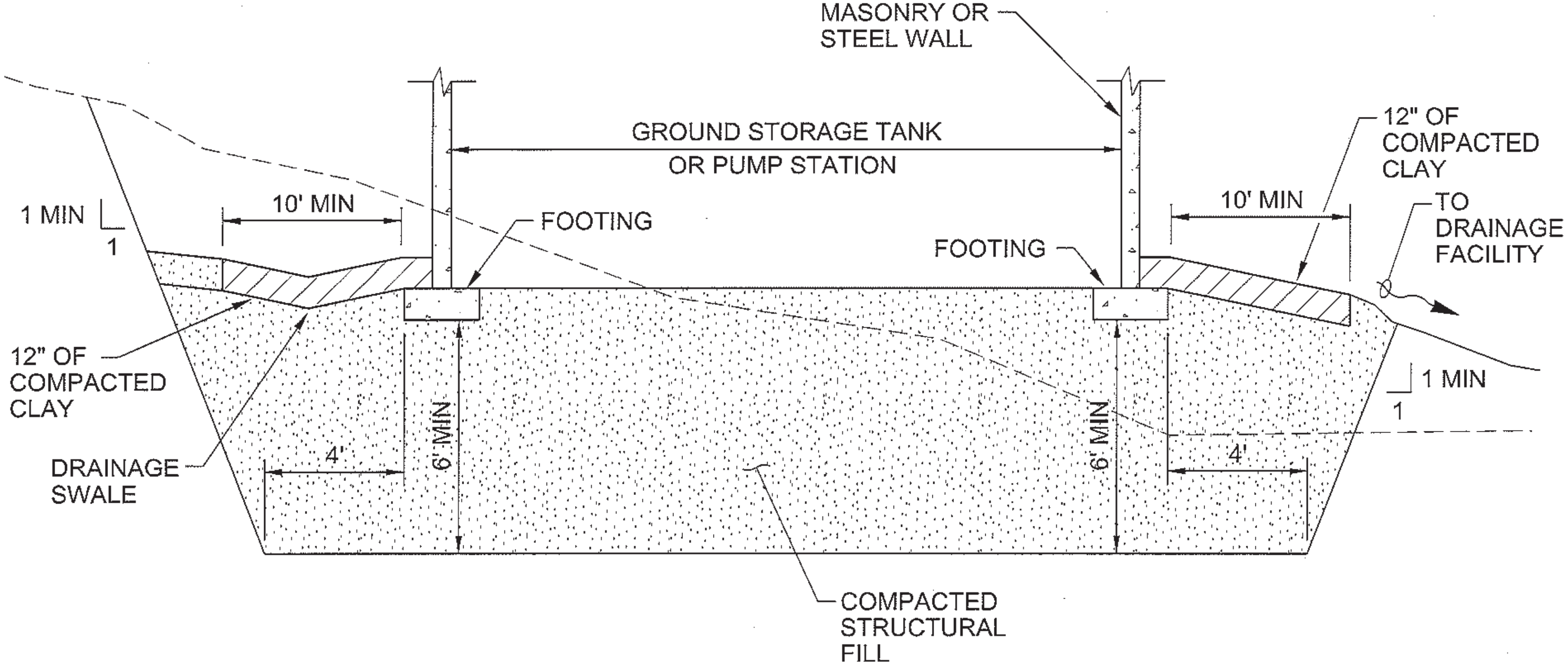

FIGURE 1
OVEREXCAVATION AND BACKFILL UNDER PROPOSED FACILITIES

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4.4 Fill and Backfill

4.4.1 Structural Fill

Structural fill is recommended for fill to be placed beneath slabs, footings, and pavements. Structural fill should consist of imported sand, silty sand, gravelly sand, clayey sand, and sandy clay classified as SP, SM, SW, SC, or CL in accordance with Unified Soil Classification system (ASTM D-2487). The sandy clay and clayey sand should have plasticity Index not less than 7 and not greater than 15 and the percent passing the No. 200 sieve should not exceed 55 percent. The fill material should be placed in 6-inch maximum loose lifts, with each lift compacted to at least 95 percent of the maximum dry density, as determined by ASTM D-698. At the time of compaction, the moisture content of the fill material should be at optimum moisture content, ±2 percent. Flexible Base material meets the requirements of TxDOT Standard Specifications, Item 247, Type A, Grade 1, material is also suitable for use as structural fill.

Structural fill should be used for fill adjacent to walls. The structural fill should be compacted with plate vibratory compactors or hand-operated power tampers. For backfill that will support adjacent structures, the backfill material should be placed in 6-inch maximum loose lifts with each lift compacted to 95 percent of the maximum dry density, as determined by ASTM D698. For backfill that will not support any structures, the backfill material should be placed in 8-inch maximum loose lifts with each lift compacted to 90 percent of the maximum dry density, as determined by ASTM D698. To prevent excessive lateral pressure on external walls, large compaction equipment should not be allowed within a zone formed by a 45-degree slope from the base of the wall footing.

4.4.2 Pipe Zone Backfill

Backfill material for the pipe zone should be placed from 6 inches below the invert of the pipe to 1 foot above the top of pipe. This pipe zone material should consist of imported sand, gravel, or crushed rock classified as SP,SW, GP or GW, in accordance with Unified Soil Classification system that is reasonably well graded from coarse to fine and free from clay ball, organic material, and other deleterious substances. The pipe zone backfill material should contain a maximum of 10 percent passing the No. 200 sieve, and a maximum particle size not exceeding 1- ½ inches.

Pipe zone backfill should be placed and spread in layers simultaneously on both sides of the pipe, not to exceed 6 inches loose thickness and compacted to at least 95 percent (± 2 percent) of the maximum dry density, as determined by ASTM D698. Compaction of the pipe zone backfill should be increased to 98 percent (± 2 percent) of the maximum dry density in areas beneath paved roadways, structures, and in areas that are sensitive to surface settlement. The Contractor should be made responsible for verifying that the pipe strength is adequate to withstand the weight and energy delivered by a roller or compactor during the pipe backfill operation.

If weak or soft soils are encountered during construction of the pipeline, such material should be over-excavated a minimum depth of 1 foot below the proposed pipe invert and replaced with 1-½ inch-minus crushed limestone. In lieu of using crushed limestone, controlled, low strength material may be used with the approval of the Engineer. Controlled, low strength material is a fluid mixture of Portland cement, water, and fine aggregates or fly ash. The consistency of the material is that of a slurry grout, and the material is placed like concrete. For use as a pipe zone backfill material, the mixture should be designed for a 28-day compressive strength of 100 to 150 psi.

4.4.3 Trench Backfill above Pipe Zone

In grassy areas, backfill material above the pipe zone backfill may consist of excavated soil. Such excavated soil shall be free of roots, debris, clay, organic material, rock larger than 3 inches, or other deleterious objects to be suitable for use as trench backfill above the pipe zone. Trench backfill should be placed and spread in layers with 6-inch maximum loose lifts and should be compacted to 90 percent (± 2 percent) of the maximum dry density, as determined by ASTM D698.

In areas beneath paved roadways, structures, and in areas that are sensitive to surficial settlement the trench should be backfill with pipe zone backfill material placed in 6-inch lifts and compacted to 95 percent (± 2 percent) of the maximum dry density as determined by ASTM D698. Moisture conditions of the soil shall be within 2 percent of the optimum moisture content.

4.4.4 Steel Tank Sand Cushion

Sand cushion shall consist of clean washed natural or manufactured sand conforming to the requirements of ASTM C144 with the additional requirement that the percent passing the No. 200 sieve not exceed 5 percent. Sand shall be free of chlorides or other corrosive and deleterious substances. Resistivity of saturated sand shall be not less than 10,000 OHM-CM.

4.5 Groundwater Control

Groundwater table was not encountered in the borings. However, control of stormwater may be necessary for trench excavation. Stormwater that accumulates in the bottom of the excavation should be diverted by trenching to a low sump, and then pumped out by sump pump. Attempts should be made to divert stormwater runoff away from open excavations by building temporary diversion berms or ditches.

4.6 Lateral Earth Pressures

Structural fill, as recommended above, should be used for backfill behind walls. For walls backfilled with structural fill, the equivalent earth pressures, in terms of equivalent fluid pressure, presented in Table 4-2 are recommended for calculating at-rest, active and passive earth pressures.

TABLE 4-2

Recommended Design Equivalent Fluid Pressure

Condition	Equivalent Fluid Pressure, Above Groundwater Table, psf/ft	Equivalent Fluid Pressure, Below Groundwater Table, psf/ft
At-Rest	60	94
Active	40	83
Passive	360	250

4.7 Thrust Restraints

Pressurized pipes and fittings are commonly joined with push-on or mechanical joints. These joints do not provide significant restraint against separation caused by thrust forces as a result of a change in direction or a change in pipe cross-section. To resist the thrust force it is recommended the use of restrained joints.

The design of thrust restraint system is primarily to estimate the length of pipe that must be restrained on each side of the thrust force location. Several parameters must be considered in the design of length of the thrust restraints. These parameters are; pipe size, internal pressure, depth of cover, and characteristics of the soil surrounding the pipe, such as, unit weight, friction angle, cohesion etcetera.

Assuming the backfill soil to be used is prepared in accordance with the recommendations of this report; it is recommended to use the following soil engineering properties for the restrained joint design:

- Friction angle (phi) = 32°
- Cohesion (c) = 0 pounds per square foot (psf)
- Unit weight of soil (gamma) =120 pounds per cubic foot (pcf)
- Allowable bearing capacity = 2,000 psf
- Soil/ductile iron pipe contact friction angle (δ) = 21°
- Modulus of Soil reaction = (E') = 1,500 psi

- Friction reduction factors:
  - Ductile Iron Pipe (wrapped) = 0.56
  - Ductile Iron Pipe (unwrapped) = 0.80

A geotechnical engineer should design thrust restraints using actual pipe testing pressures and the indices presented above.

4.8 Foundation Design Recommendations

4.8.1 Spread Footings and Slabs-on-Grade

Based on the soil profile encountered in the borings, and assuming the tank and buildings' foundations will be prepared as recommended above, it is recommended that the proposed facilities be supported with shallow spread footings and slab-on-grade or mat foundation provided that the foundation soil is prepared as recommended above. For foundation supporting steel tank, it is recommended using a reinforced concrete ring foundation. The spread footings and ring footings should be designed using a maximum allowable net bearing pressure of 5,000 psf. This allowable bearing pressure can be increased 30% for short-term loads such wind loading. The spread footings should be at least 18 inches wide and embedded at least 1 foot below the finished grade.

The slabs-on-grade or mat foundation should be designed using a modulus of subgrade reaction for a 1-foot square plate of 150 tons per cubic foot (tcf) for the proposed facilities. This modulus of subgrade reaction should be adjusted to account for the difference in size between the plate and the actual foundation. The following equation provides the necessary adjustments:

$$K_s = K_1\left(\frac{B+1}{2B}\right)^2$$

where:

K_s = Adjusted modulus of subgrade reaction for square mat or raft foundation, (tcf)

K_1 = Modulus of subgrade reaction for a 1-foot square plate, (tcf)

B = Width of square mat or raft foundation, (feet)

The equation above applies to square mat or raft foundations. The following equation should be used to adjust Ks for rectangular mat of raft foundation:

$$K_r = \frac{K_s\left(1+\frac{B/L}{2}\right)}{1.5}$$

where:

K_r = Adjusted modulus of subgrade reaction for a rectangular mat or raft foundation, (tcf)

K_s and B = as defined above

L = Length of mat or foundation, (feet)

The total and differential settlements of the proposed facilities supported by the foundation recommended above and assuming the underlying fat clay will be over-excavated and replaced as recommended above, are estimated to be about ½ inch and ¼inch, respectively. CH2M HILL believes that the estimated settlements are within tolerable limits for the proposed facilities.

Without removing the recommended 6 feet of fat clay, the estimated potential vertical rise (PVR) from existing dry condition to wet condition would be about 1 to 2 inches. With the removal of fat clay, the estimated PVR would be ½ to ¼ inch.

4.8.2 Concrete Seal Slabs

After overexcavation and backfill and before placement of concrete slab, pump station, and tank ring wall foundations, a seal concrete slab should be placed over the backfill surface to preserve the moisture content of the soil and prevent rain from turning the soil into mud. The seal concrete slab should be at least 4 inches thick and have an unconfined compressive strength of 2000 psi. Seal slab shall also be placed over the backfill surface within the tank ring wall foundation allowing for a sand cushion directly below the steel tank floor plate of 4” minimum thickness.

4.8.3 Seismicity

The project site is located in an area of low seismic activity. Based on the results of the soil borings conducted at the project site and additional subsurface information within the project region, the site is classified as D using the 2009 edition of the International Building Code (IBC2009).

4.9 Pavement Design Recommendations

New access roads and parking areas will be constructed for access to the facilities. The subgrade soil at the site mainly consists of highly plastic clay. The subgrade soil should be over-excavated as recommended or stabilized with lime to a depth of 12 inches and compacted to a minimum of 95% of the maximum dry density as determined by ASTM D-698. The moisture content of the stabilized material should be at optimum moisture content, ±2 percent. The lime stabilization should be performed in accordance with TxDOT Item 260. For the pavement design, a California Bearing Ratio (CBR) of 2 for the stabilized subgrade is recommended.

4.10 Summary

The findings and recommendations of this investigation are summarized below:

- Foundation soil under the proposed facilities should be over-excavated to 6 feet below the bottom of the footings or base slab and replaced with structural fill placed in 6-inch lifts and compacted to at least 95 percent of the maximum dry density as determined by ASTM D698.
- The subgrade soil under pavement should be over-excavated to 12 inches below the bottom of base course and replaced with compacted structural fill or stabilized with lime to a depth of 12 inches.
- Side slopes for excavations shallower than 5 feet should be no steeper than 1.5 H to 1 V. Excavations deeper than 5 feet should be sloped in accordance with OSHA requirements.
- Structural fill should be placed beneath structures, piping, and roads in maximum 6-inch lifts and compacted to at least 95 percent of the maximum dry density, as determined by ASTM D698.
- Concrete seal slabs (Mud Mats) should be placed on top of the structural fill, below the structure foundations, to preserve the moisture content and protect the working surface during construction activities.
- To support the proposed facilities, spread footings designed with a maximum allowable bearing net pressure of 5,000 psf is recommended. The footings should be at least 18 inches wide. A modulus of subgrade reaction of 150 tons per cubic foot (tcf) is recommended for the design of the slab-on-grade and mat foundation.

SECTION 5

Limitations

This report has been prepared for the exclusive use of City of Austin, for specific application to the proposed pump station Facilities. This report is in accordance with generally accepted geotechnical engineering practices. No other warranty, express or implied, is made.

The analyses and recommendations in this report are based on the data obtained from the soil borings. The borings indicate soil conditions only at specific locations, times, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between the boring locations. If variations in subsurface conditions from those described are noted during construction, recommendations in this report may need to be re-evaluated.

Information on actual subsurface conditions exists only at specific locations and dates indicated. Soil conditions and ground water levels at other locations may differ from conditions occurring at the boring locations. If any changes in the nature, design, or location of the pipelines are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing. CH2M HILL is not responsible for any claims, damages, or liability associated with interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of CH2M HILL.

SECTION 6

References

ASTM. *Test Method D422 Standard Test Method for Particle-Size Analysis of Soils.*

ASTM. *Test Method D1586 Method for Penetration Test and Split-Barrel Sampling of Soils.*

ASTM. *Test Method D2487 Standard Test Method for Classification of Soils for Engineering Purposes.*

ASTM. *Test Method D698 Test for Moisture-Density Relations of Soils. Using 10-lb Rammer and 18-inch Drop.*

ASTM. *Test Method D4318 Standard Test Method for Atterberg Limit Tests of Soil*.

Appendix A
Geotechnical Data Report Prepared by HVJ

HVJ
ASSOCIATES

Houston
Austin
Dallas
San Antonio

10100 Reunion Place, Ste. 850
San Antonio, TX 78216
866.447.9081 Ph
512.443.3442 Fax
www.hvj.com

August 27, 2013
Robert K. Cullwell, PE
CH2M Hill
12301 Research Blvd, Bldg. 4, Suite 250
Austin, Texas 78759

Re: Geotechnical Investigation Data Report
Montopolis Pump Station Facilities
COA Facilities Rotation List (2010-2012)
Austin, Texas
Owner: City of Austin
HVJ Project No. AG 10 11441

Dear Mr. Cullwell:

Submitted herein is the draft of geotechnical investigation report of our geotechnical investigation for the above referenced project. The study was performed in accordance with HVJ proposal number AG 10 11441.1 dated November 2, 2012.

It has been a pleasure to work for you on this project and we appreciate the opportunity to be of service. Please notify us if there are questions or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.
Texas Firm Registration No. F-000646

DRAFT **DRAFT**

Jason Schwarz, P.E.
Project Manager

Zach Lootens, EIT
Staff Engineer

This document has been released for purpose of interim review on August 27, 2013. This document is not to be used for construction or bidding purposes.

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APPENDIX

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1 INTRODUCTION

1.1 General

HVJ Associates, Inc. (HVJ) was retained by CH2M Hill to perform a geotechnical investigation for the Montopolis Pump Station Facility. The proposed project is located approximately 0.3-0.5 miles northeast of Montopolis and SH71 intersection. The purpose of this project is to construct a new pump station/water tank.

1.2 Scope of Work

HVJ's scope of work is to provide information on subsurface conditions at the proposed location for the new pump station facility. The primary objective of this study was accomplished by:

- Task 1: Exploratory Borings
    - Drilled a total of 7 borings at depths of 2, 10, 30, and 40 feet below existing grade for a total drilling depth of 154 linear feet.
- Task 2: Laboratory Testing
    - Performed laboratory tests on select soil samples to determine the physical and engineering properties of the subsurface materials.
- Task 3: Data Report
    - This Data Report includes the following
        - Site vicinity map
        - Geology map
        - Plan of borings
        - Boring logs
        - Laboratory test results summary
        - Site Characterization

Subsequent sections of this report contain descriptions of the field exploration, laboratory testing program, the general site and subsurface conditions, construction recommendations and limitations.

2 FIELD EXPLORATION

2.1 General

The field exploration program undertaken for the project was conducted between July 16th, 2013 and July 26th, 2013. Seven (7) borings were completed to investigate subsurface conditions. The 7 borings were drilled to termination depths as follows: 2 (2 foot); 1 (10 foot); 2 (30 foot); 2 (40 foot). Borings were advanced using a B-53 Mobile truck mounted drill rig equipped with continuous flight augers as well as standard sampling equipment. Approximate boring locations are provided in the Plan of Borings, Plate 3. The final boring logs are presented in Plates 4 through 10 with a key to terms and symbols used provided on Plate 11.

2.2 Sampling Methods and Field Testing

Fine grained, cohesive soils encountered were sampled using a 3-inch outer diameter thin-walled tube, which was pushed into the soil in general accordance with ASTM standard D 1587- *Thin Walled Tube Sampling of Soils.* The samples were extruded in the field and a calibrated pocket penetrometer was used to obtain an estimate of the unconfined compressive strength of the sample.

Standard Penetration Tests (SPTs) were conducted in non-cohesive soils within the soil strata. The requirement that TCP be conducted every five feet caused the SPTs to be performed with a slight deviation from ASTM D 1586 – *Penetration Test and Split-Barrel Sampling of Soils.* The procedure performed in the field consisted of driving a standardized 1.50 ± 0.005 inch inner diameter split-spoon sampler into undisturbed soil with a 140-pound hammer falling 30 inches. The split-spoon sampler was first seated 6 inches to penetrate any loose cuttings and was then driven an additional 12 inches with blows from the hammer. The number of hammer blows required to drive the sampler each 6-inch increment was recorded. The penetration resistance, or "N-value", is defined as the number of hammer blows required to drive the sampler the final 12 inches and was used in the field to estimate the density of granular soils or the consistency of cohesive soils. In very dense material the SPT test was typically stopped after 50 blows from the hammer and the measurement was recorded as 50 blows per distance penetrated (e.g. 50 over 3 inches).

Classification and field test results for both the thin-walled tube and split-spoon samples were recorded onto field logs, which included a visual description in accordance with ASTM D 2488 – *Visual Description and Identification of Soils.* After field documentation and logging was complete, the individual soil samples were either wrapped in plastic or placed in sealed containers to prevent loss of moisture and were transported to our laboratory for further examination and testing.

2.3 Groundwater Conditions

No groundwater was encountered during the investigation. However, groundwater observations made during drilling operations typically do not accurately reflect the true groundwater conditions. Therefore, the lack of free flowing groundwater into the boreholes should not be taken as confirmation the groundwater table is at a depth below the boring(s) termination depth. Additionally, it should be noted that groundwater levels may fluctuate seasonally in response to rainfall/climatic conditions and the boring were drilled during a period of extreme drought (potential drought of record).

2.4 Borehole Completion

All project borings were backfilled with soil cuttings, bentonite chips as required to meet existing surface conditions.

3 LABORATORY TESTING

3.1 General

Soil samples transported to our laboratory were further examined and described and a preliminary soil classification was assigned to each soil sample based on ASTM D 2487 – *Classification of Soil for Engineering Purposes.*

Classification testing, which included moisture contents, Atterberg limits, and percent passing the No. 200 sieve, was subsequently conducted on select samples. The results of these tests were used to confirm or modify the preliminary soil classifications.

The sampling information obtained in the field was used in conjunction with the laboratory examination and testing to generate final boring logs, provided in Plates 4 through 10. A Key of Terms and Symbols for the boring logs is provided on Plates 11A-B. The laboratory test results are provided on the final borings logs, as well as tabulated in Appendix A.

3.2 Atterberg Limits

Select samples were tested to determine the Atterberg Limits in accordance with ASTM D4318-10 (Tex 104E, and 105E). The Atterberg Limit test is used to classify the soil using the Unified Soil Classification System (USCS). The Atterberg Limit test consists of two parts: a liquid limit test and a plastic limit test. The liquid limit equipment setup consists of a brass cup partially filled with soil which is grooved with a specialized grooving tool, and then dropped freely from a specified height to the rubber base below at a constant rate of 2 drops per second. The liquid limit test is performed on soil that has been sieved through the No. 40 sieve and brought to a moisture content that would close the ½-inch groove within 20 to 30 blows for two consecutive tests. The moisture content of the soil is then measured and recorded as the liquid limit. The second part of the tests consists of a rolling a remolded sample between the tips of the fingers and a glass plate until transverse cracks appear at a rolled diameter of 1/8-inch. The moisture content of the rolled sample is taken and recorded as the plastic limit.

3.3 Percent Passing the No. 200 Sieve

Select soil samples were tested in accordance with ASTM D1140-00 (Tex 111E) to determine the amount of material finer than the No. 200 sieve for use in classification. An oven dried sample of material is weighed then washed over a 75-μm (No. 200) sieve, allowing clay and other particles to be dispersed and removed from the soil. The retained material is oven dried then reweighed. The loss in mass resulting from the washing is calculated as mass percent of the original sample and is reported as the percentage of material finer than a No. 200 sieve.

3.4 Moisture Content

Moisture content testing was performed on select soil samples to determine the in situ state of moisture of the soil. A fresh sample was weighed before being placed in an oven with a controlled temperature of 230°F and dried back to a constant mass. Upon the drying and reweighing of the sample, the total mass of water lost was recorded. The ratio of the water loss to the dried mass is recorded as the moisture content. This test was performed in accordance with ASTM D2216-10 (Tex 103E).

4 SITE CHARACTERIZATION

4.1 General Geology

According to the Geologic Atlas of Texas, Seguin Sheet (University of Texas Bureau of Economic Geology, 1974), the proposed project is located within an area characterized by High Terrace Deposits (Qht) and Taylor Group (Kta).

The High Terrace Deposits generally consist of gray to tan gravel, sand, silt, and clay. Gravel is commonly exposed to the surface in southeastern parts, and silty clay is in an upper part underlain by coarse soils in northwestern parts.

The Taylor Group has been divided into three formations, based on Keith Young (1965), from bottom to top: Sprinkle, Pecan Gap, and Bergstrom. The formations consist of calcareous, montmorillonitic, highly over-consolidated clay, marly clay, and clay shale varying in color and calcium carbonate content. It is highly plastic, with high swelling potential, and very unstable. When left exposed to the air, it will slake. Thickness of the Taylor Group ranges from approximately 50 feet thick in the area of southeast Austin to approximately 300 feet thick in the area of Walnut Creek.

According to available geologic data, there are no mapped faults within the local vicinity of the project.

4.2 Subsurface Stratigraphy

Soil and groundwater conditions along the project alignment described herein are based on information obtained at the boring locations only. Significant variations at areas not explored by the project borings may require reevaluation of our findings and conclusions. Subsurface soils as encountered at the project location are discussed below.

In general, the subsurface encountered at the site can be characterized using three layers. The uppermost layer at the site ranges from 0-2 feet thick and consists of dark brown Fat Clay (CH) with varying amounts of sand and gravel. The middle layer was made up of a tan colored clayey soil that seemed to have increasing sand content in the north end of the project area. In this layer Clayey Sand (SC) and Lean Clay (CL) was encountered with depths ranging from 4-7.5 feet. The lowest layer, containing tan and light gray Fat Clay (CH), extended past the termination depths of all borings. Table 2, below, shows the laboratory testing statistics for each layer described above.

Table 2: Soil Laboratory Summary

Laboratory Test	Average	Maximum	Minimum	Standard Deviation
Upper				
Moisture Content (%)	21	23	19	2.4
Liquid Limit (%)	66	72	60	8.5
Plasticity Index (%)	38	47	29	12.7
% Passing No. 200 Sieve	74	80	68	8.3
Middle				
Moisture Content (%)	10	11	9	0.9
Liquid Limit (%)	44	48	40	3.4
Plasticity Index (%)	22	28	18	3.4
% Passing No. 200 Sieve	85	96	70	11.3
Lower				
Moisture Content (%)	14	17	11	2.2
Liquid Limit (%)	55	63	49	5.1
Plasticity Index (%)	32	41	23	6.6
% Passing No. 200 Sieve	93	97	90	2.8

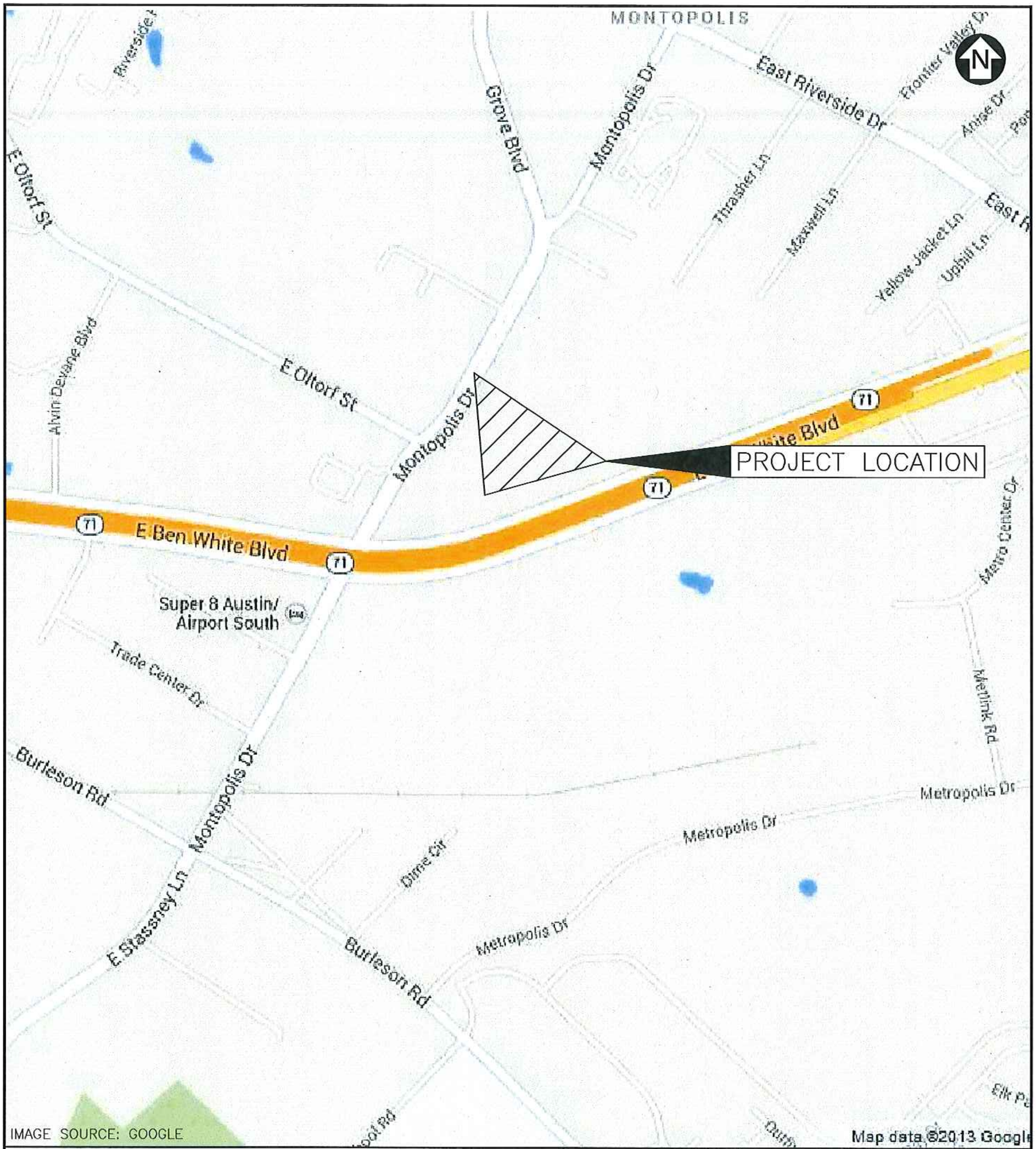
5 LIMITATIONS

This geotechnical data report has been issued for the exclusive use of CH2M Hill and the City of Austin for the Montopolis Water Pump Station Project.

In performing our geotechnical investigation, HVJ Associates, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ Associates, Inc. makes no warranty, express or implied. The information contained in this report is based on data obtained from subsurface exploration and laboratory testing, as well as preliminary project design information that has been provided to us.

The exploration methods used indicate subsurface conditions only at the specific location where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations or areas where borings were not performed. Should any subsurface conditions other than those described in our test boring be encountered, HVJ Associates should be immediately notified so that further investigation and supplemental recommendations can be provided.

ILLUSTRATIONS



MAP LOCATION

HVJ ASSOCIATES

SCALE: N.T.S

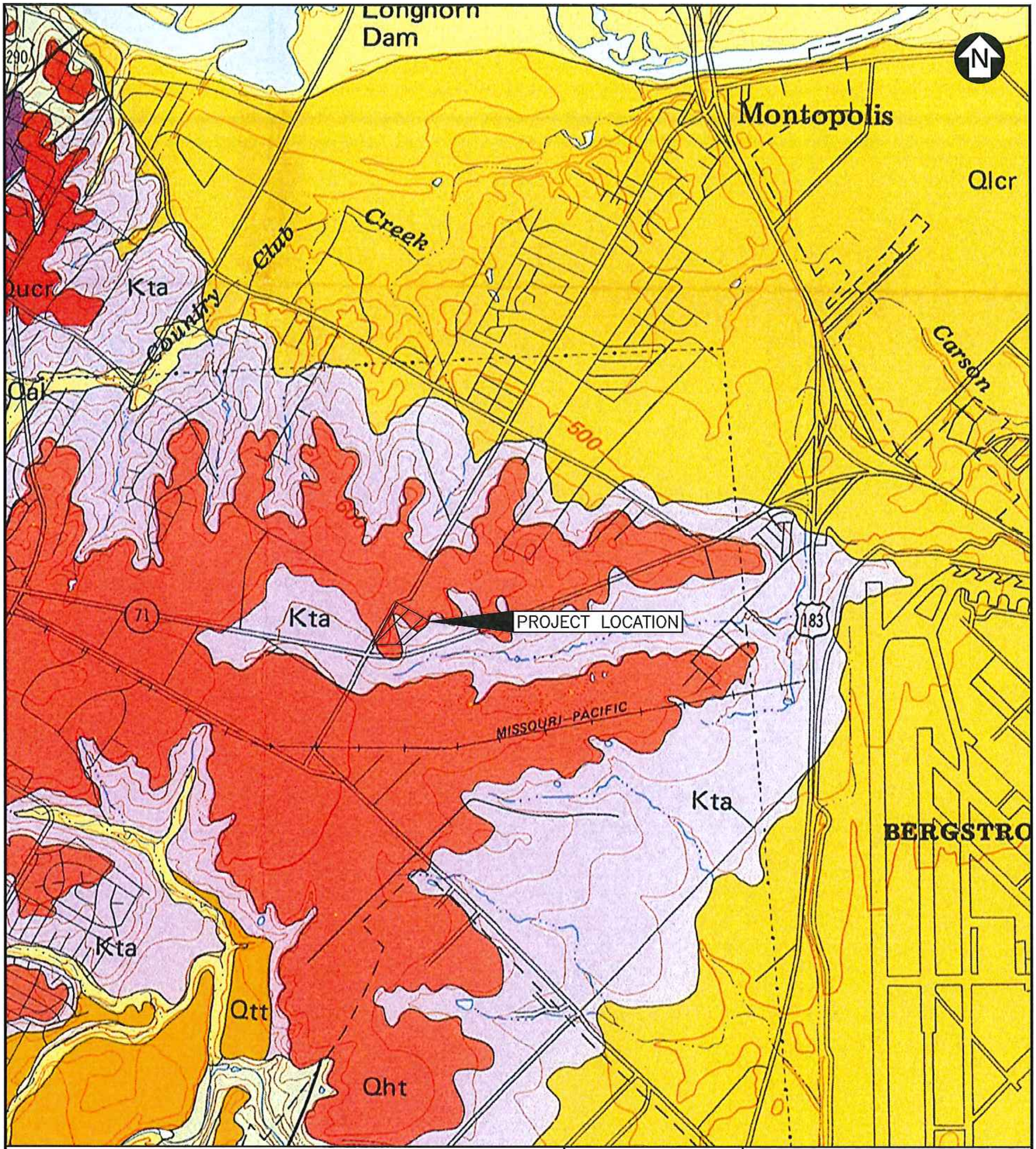
DATE: 8/15/2013

DRAWN BY:	PROJ. CHK:	APPRV. BY:
ZL	JS	JS

SITE VICINITY MAP
MONTOPOLIS WATER PUMP STATION PROJECT
TRAVIS COUNTY
AUSTIN, TX

PROJECT NO.:	FILENAME:	
AG 10 11441	VIC	PLATE 1

DATE:
FILE:



LEGEND

Qal	Alluvium
Qtt	Tributary Terrace Deposits
Qht	High Terrace Deposits
Qucr	Upper Colorado River Terrace Deposits
Qlcr	Lower Colorado River Terrace Deposits
Kta	Taylor Group

MAP LOCATION

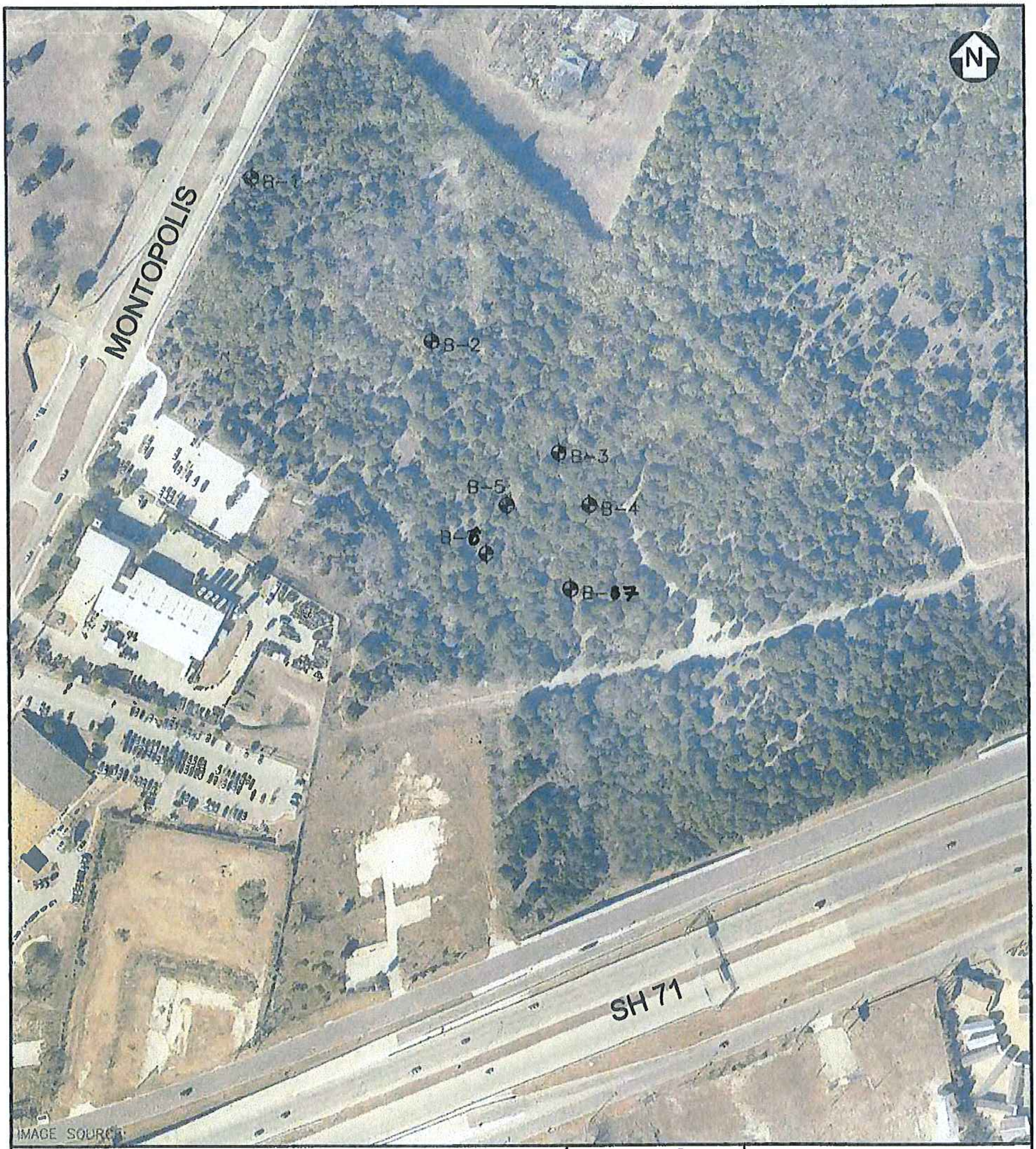
HVJ ASSOCIATES

SCALE: N.T.S		
DATE: 8/15/13		
DRAWN BY: ZL	PROJ. CHK: JS	APPRV. BY: JS

GEOLOGY MAP
MONTOPOLIS WATER PUMP STATION
TRAVIS COUNTY
AUSTIN, TX

PROJECT NO.: AG 10 11441	FILENAME: GEO	PLATE 2

DATE:
FILE:



Base Map Source: Google Maps

⌖ Bore Location

MAP LOCATION

HVJ ASSOCIATES

SCALE: N.T.S		
DATE: 8/19/2013		
DRAWN BY: ZL	PROJ. CHK: JS	APPRV. BY: JS

PLAN OF BORINGS
MONTOPOLIS PUMP STATION FACILITIES
AUSTIN, TEXAS

PROJECT NO.:	FILENAME:	
AG 10 11441	POB	PLATE 3

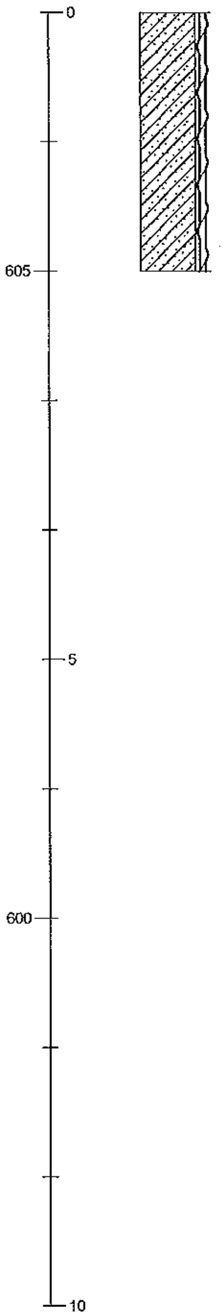
DATE:
FILE:

LOG OF BORING

Project: Montopolis
Boring No.: B-1
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/26/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 607 feet
Station: --
Offset: --



ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF ● ■ ▲ ✳ 0.5 1.0 1.5 2.0 MOISTURE ○ CONTENT, % PLASTIC LIMIT ├──┤ LIQUID LIMIT 10 20 30 40 50 60 70 80 90
		Ligh brown, medium dense, **CLAYEY SAND WITH GRAVEL (SC)**. (High Terrace Deposits) NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.			

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 4

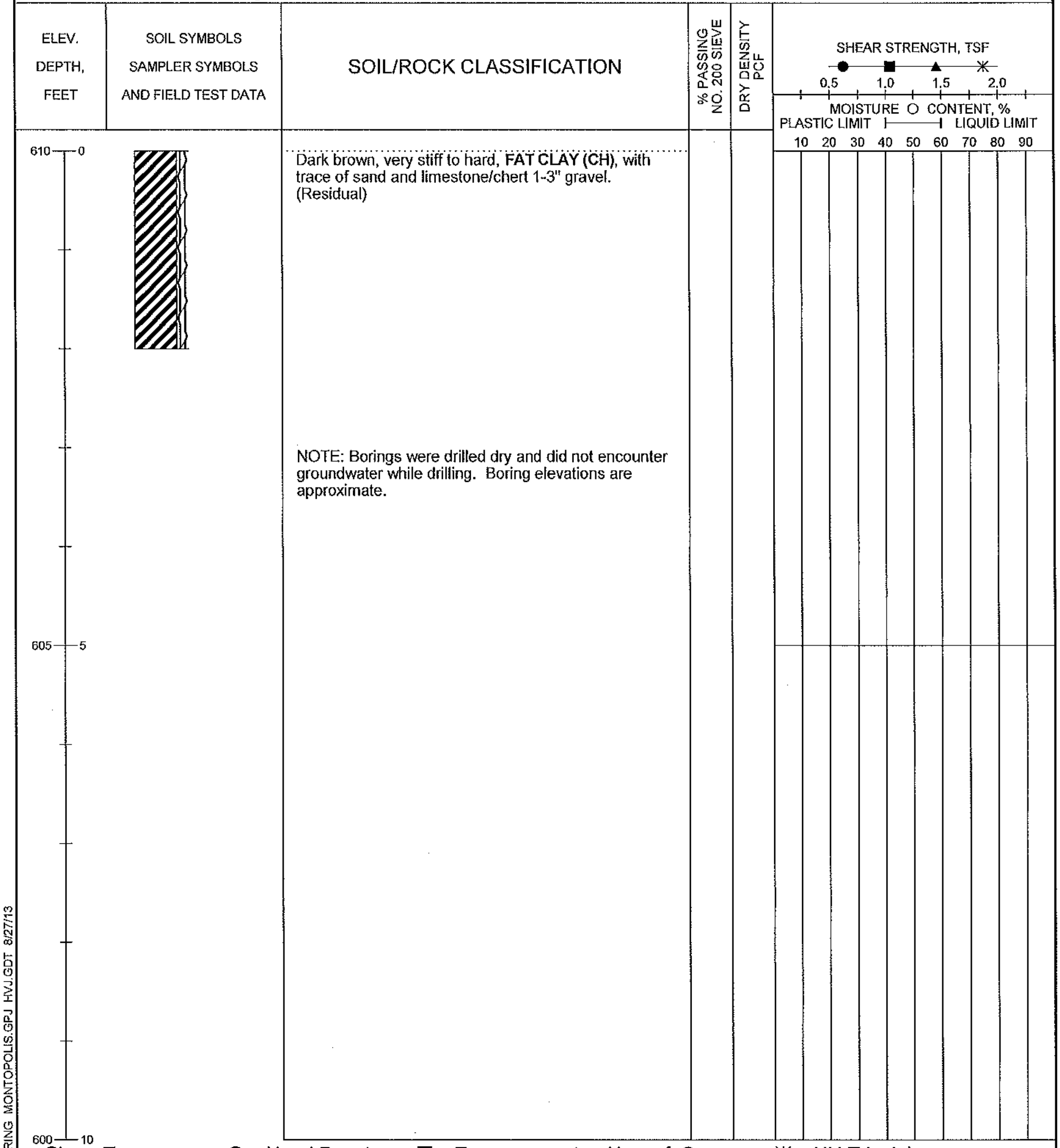
HVJ ASSOCIATES

LOG OF BORING

Project: Montopolis
Boring No.: B-2
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/26/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 610 feet
Station: --
Offset: --



Dark brown, very stiff to hard, **FAT CLAY (CH)**, with trace of sand and limestone/chert 1-3" gravel. (Residual)

NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 5

LOG OF SOIL BORING MONTOPOLIS.GPJ HVJ.GDT 8/27/13

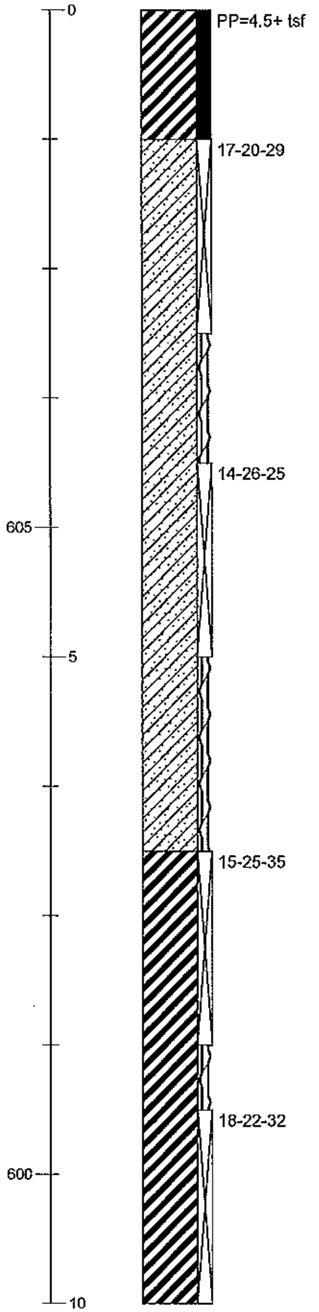
LOG OF BORING

Project: Montopolis
Boring No.: B-3
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/16/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 609 feet
Station: --
Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF ● ■ ▲ ✳ 0.5 1.0 1.5 2.0 MOISTURE ○ CONTENT, % PLASTIC LIMIT ├──┤ LIQUID LIMIT 10 20 30 40 50 60 70 80 90



Dark brown, hard, **SANDY FAT CLAY (CH)**, with organics. (Residual)

Tan, dense, **CLAYEY SAND WITH GRAVEL (SC)**. (High Terrace Deposits)

Tan, hard, **FAT CLAY (CH)**, marly. (Taylor Group)

NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

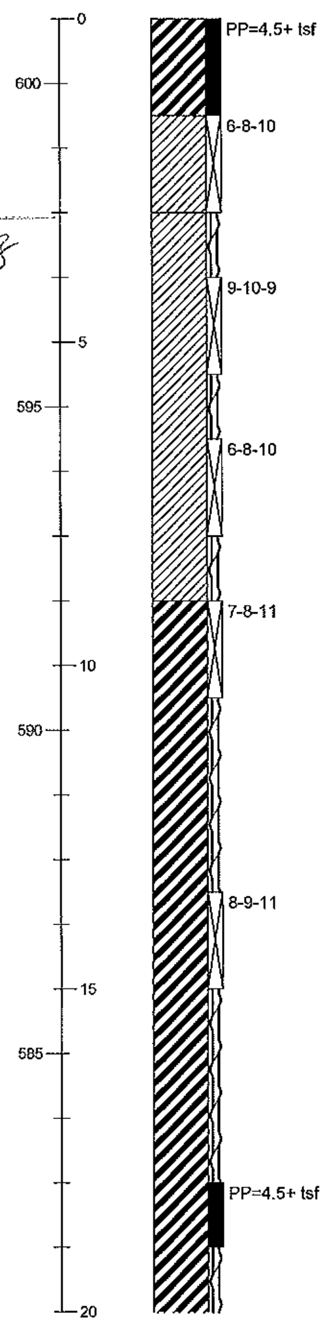
See Plate 3 for boring location.

PLATE 6

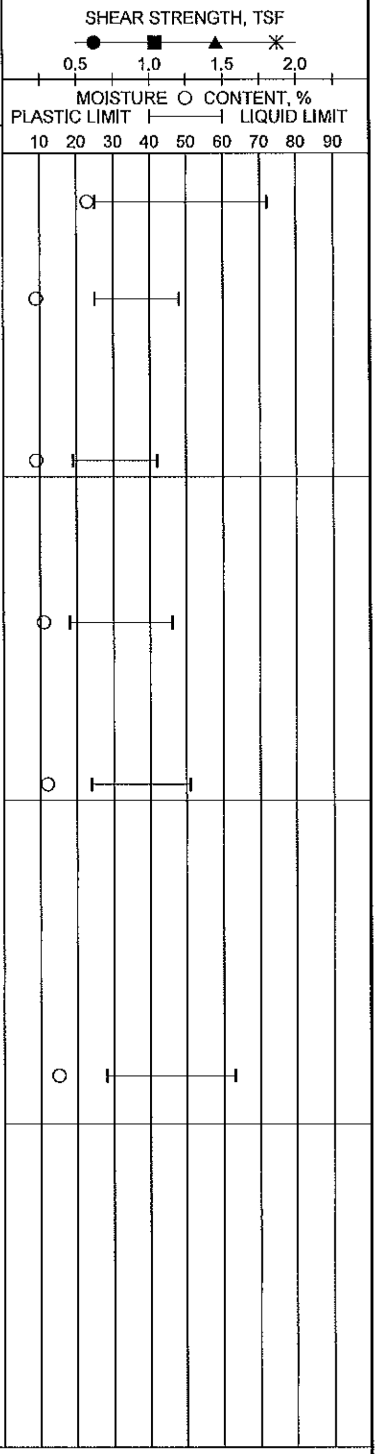
HVJ ASSOCIATES

LOG OF BORING

Project: Montopolis		Project No.: AG 1011441
Boring No.: B-4	Date: 7/16/2013	Elevation: 601 feet
Groundwater during drilling: ---	Northing: --	Station: --
Groundwater after drilling: ---	Easting: --	Offset: --



SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
Dark brown, hard, **FAT CLAY (CH)**, with organics. (Residual)	80	
Tan, very stiff to hard, **SANDY LEAN CLAY (CL)**, marly. (Taylor Group)	70	
Tan, very stiff, **LEAN CLAY (CL)**, marly. (Taylor Group)	91 96	
Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group)	94 97	



Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 7a

HVJ ASSOCIATES

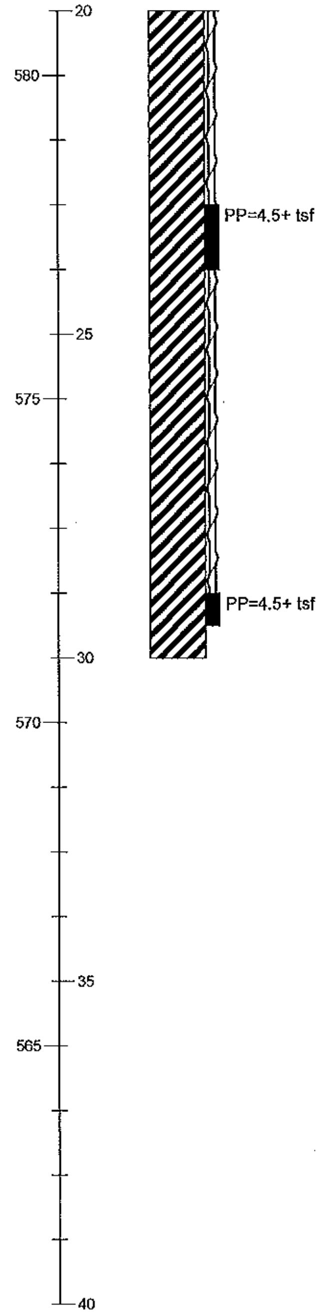
LOG OF BORING

Project: Montopolis
Boring No.: B-4
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/16/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 601 feet
Station: --
Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF (0.5, 1.0, 1.5, 2.0) MOISTURE ○ CONTENT, % PLASTIC LIMIT ⊢—⊣ LIQUID LIMIT (10 20 30 40 50 60 70 80 90)
20–30	PP=4.5+ tsf PP=4.5+ tsf	Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group) [Cont...]			



Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group) [Cont...]

NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 7b

HVJ ASSOCIATES

LOG OF BORING

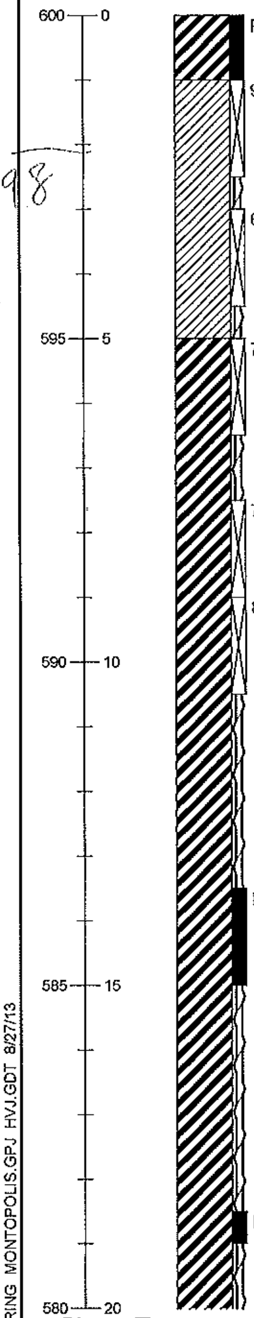
Project: Montopolis
Boring No.: B-5
Groundwater during drilling: ---
Groundwater after drilling: ---

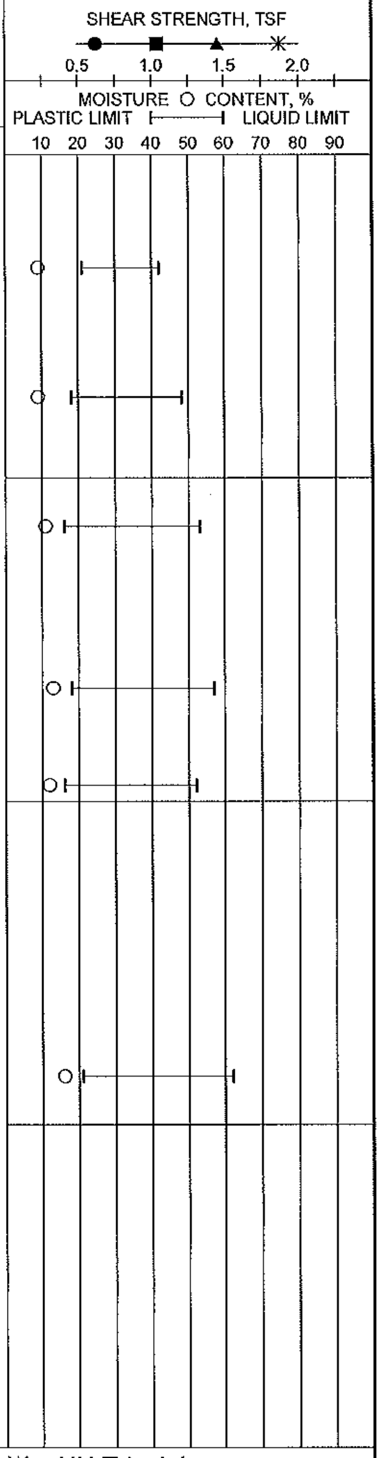
Date: 7/17/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 600 feet
Station: --
Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF
600 — 0	PP=4.5+ tsf	Brown, hard, **SANDY FAT CLAY (CH)**. (Residual)		
	9-10-12	Tan, hard, **SANDY LEAN CLAY (CL)**, with calcareous deposits, marly. (Taylor Group)		
	6-7-10			
595 — 5	7-8-10	Tan and light gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group)		
	7-8-11			
	8-17-12			
590 — 10				
	PP=4.5+ tsf			
585 — 15				
	PP=4.5+ tsf			
580 — 20				

598





Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 8a

HVJ ASSOCIATES

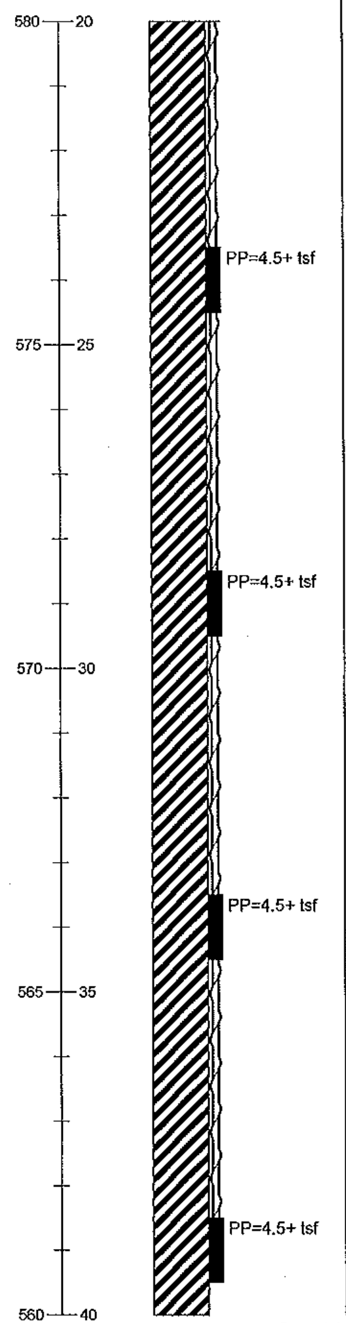
LOG OF BORING

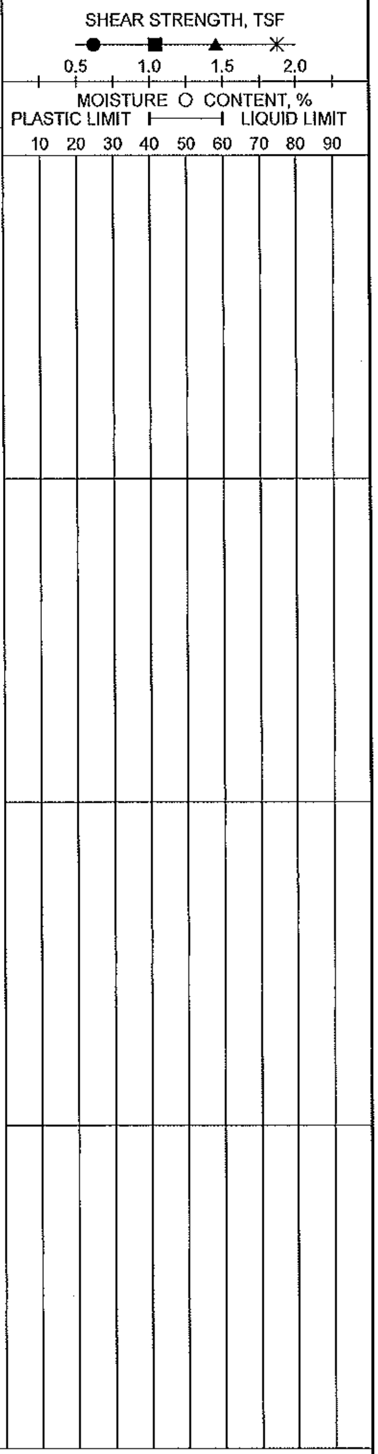
Project: Montopolis
Boring No.: B-5
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/17/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 600 feet
Station: --
Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF / MOISTURE CONTENT, %
580–20 to 560–40	PP=4.5+ tsf PP=4.5+ tsf PP=4.5+ tsf PP=4.5+ tsf	Tan and light gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group) [Cont...]			





NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

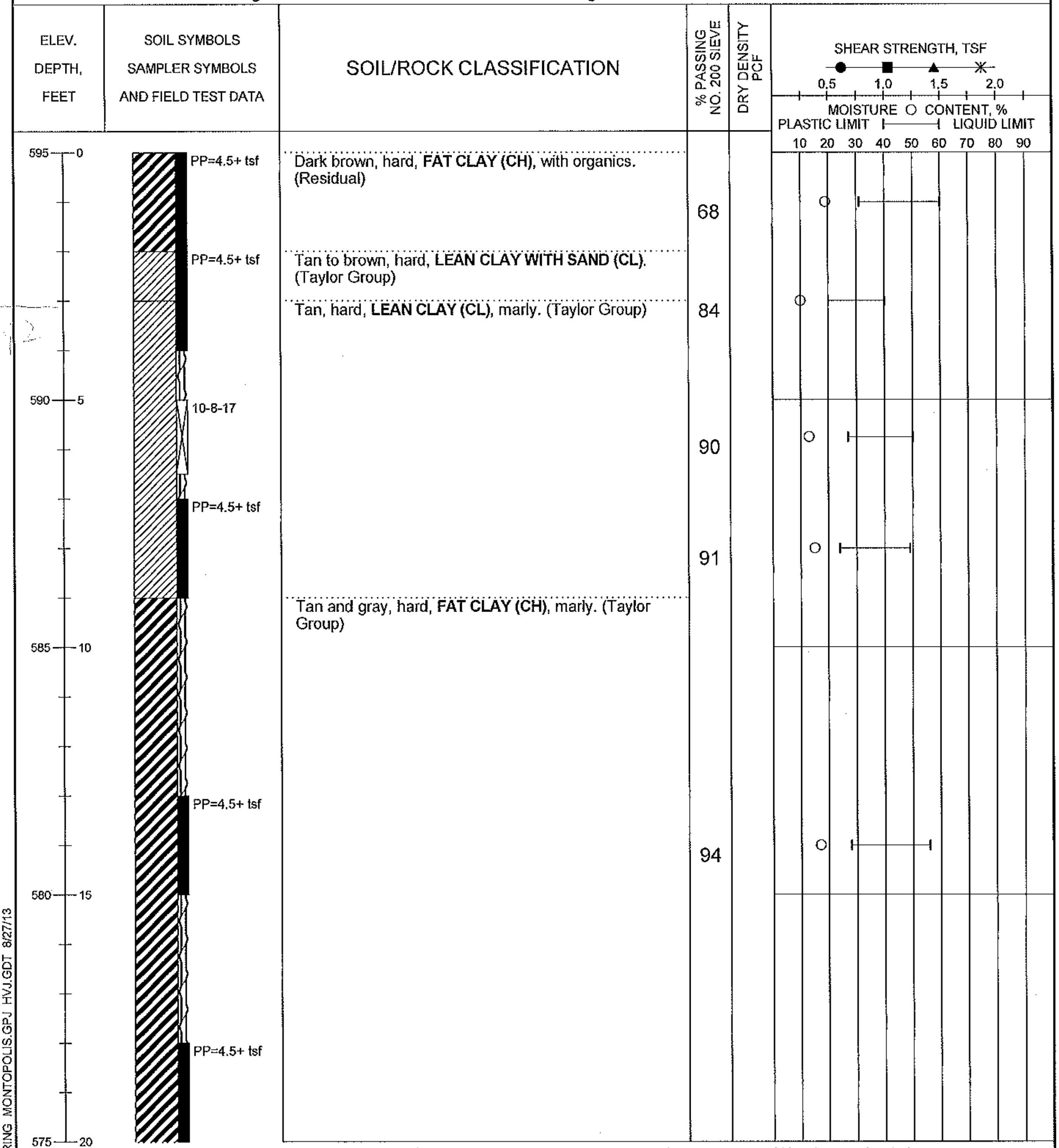
PLATE 8b

LOG OF BORING

Project: Montopolis
Boring No.: B-6
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/16/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 595 feet
Station: --
Offset: --



Dark brown, hard, **FAT CLAY (CH)**, with organics. (Residual)

Tan to brown, hard, **LEAN CLAY WITH SAND (CL)**. (Taylor Group)

Tan, hard, **LEAN CLAY (CL)**, marly. (Taylor Group)

Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group)

592

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 9a

HVJ ASSOCIATES

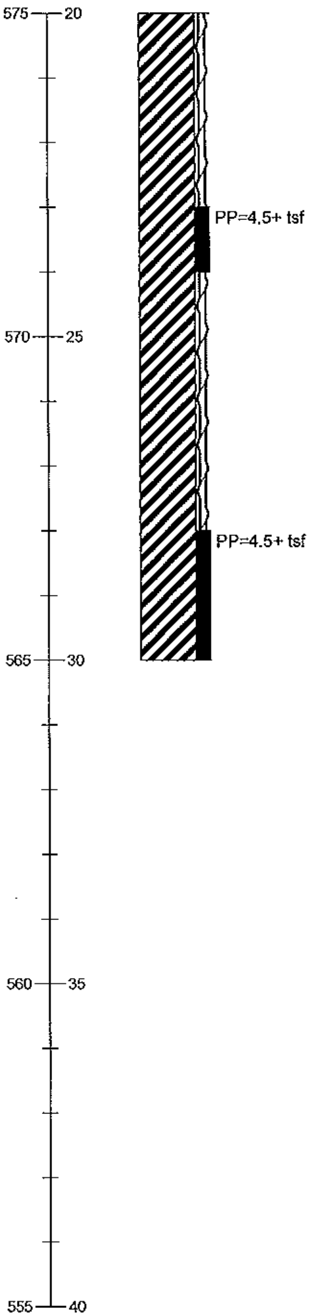
LOG OF BORING

Project: Montopolis
Boring No.: B-6
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/16/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 595 feet
Station: --
Offset: --

ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF ● ■ ▲ ✳ 0.5 1.0 1.5 2.0 MOISTURE ○ CONTENT, % PLASTIC LIMIT ├──┤ LIQUID LIMIT 10 20 30 40 50 60 70 80 90



Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group) [Cont...]

NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 9b

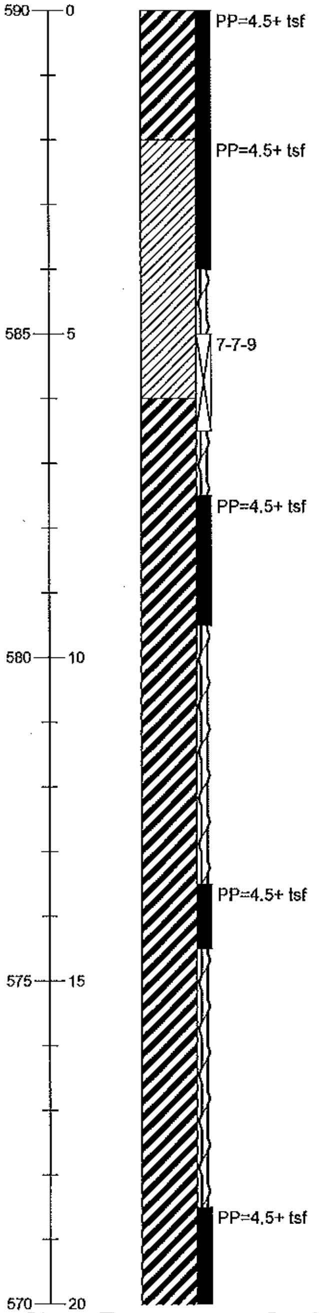
LOG OF BORING

Project: Montopolis
Boring No.: B-7
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/17/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 590 feet
Station: --
Offset: --

592



ELEV. DEPTH, FEET	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	SOIL/ROCK CLASSIFICATION	% PASSING NO. 200 SIEVE	DRY DENSITY PCF	SHEAR STRENGTH, TSF 0.5 1.0 1.5 2.0 / MOISTURE ○ CONTENT, % PLASTIC LIMIT ⊢⊣ LIQUID LIMIT 10 20 30 40 50 60 70 80 90
590 — 0	PP=4.5+ tsf	Dark brown, hard, **SANDY FAT CLAY (CH)**, with organics. (Residual)			
	PP=4.5+ tsf	Tan, hard, **SANDY LEAN CLAY (CL)**, with calcareous deposits, marly. (Taylor Group)			
585 — 5	7-7-9				
		Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group)			
	PP=4.5+ tsf				
580 — 10					
	PP=4.5+ tsf				
575 — 15					
	PP=4.5+ tsf				
570 — 20					

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

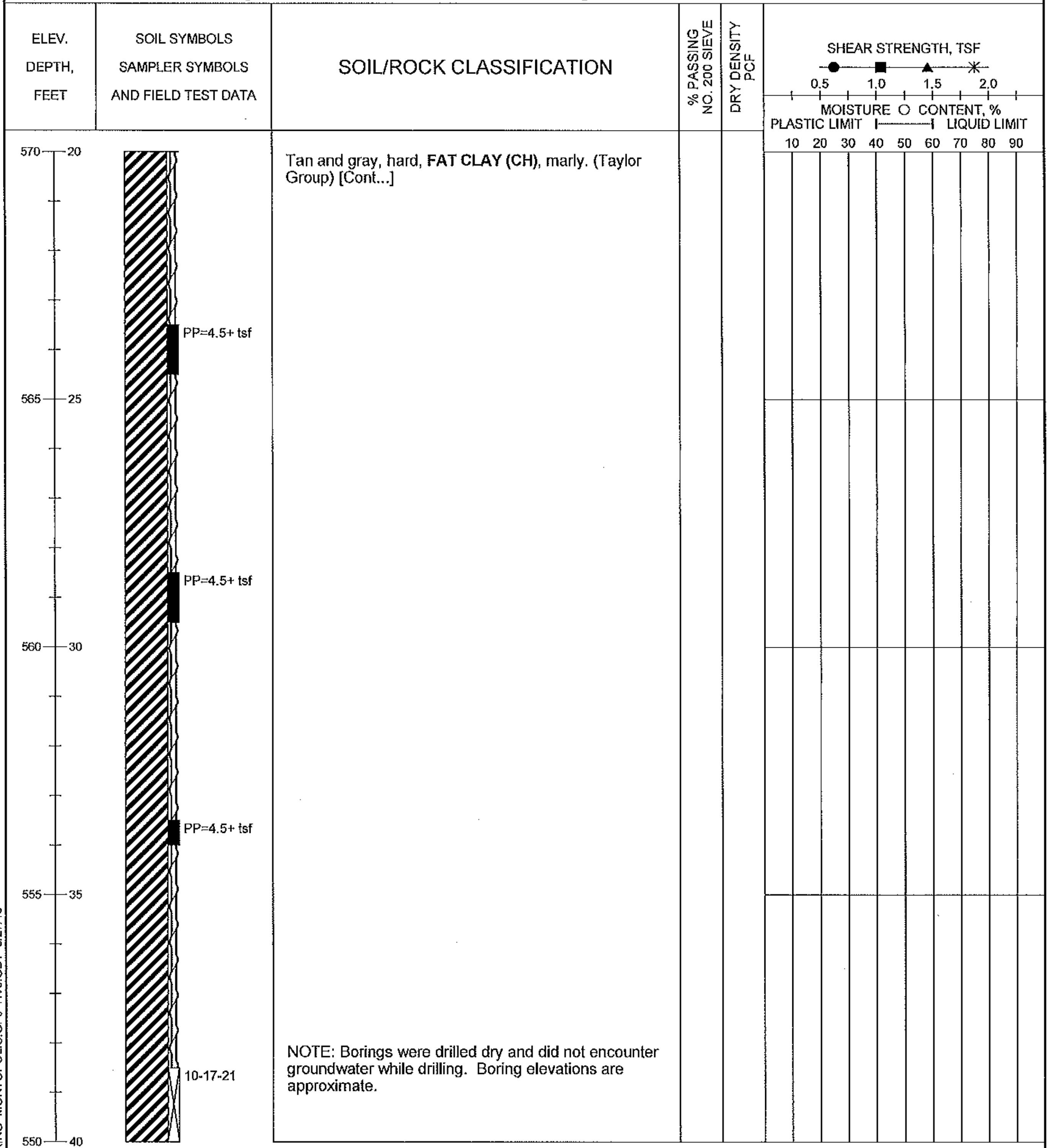
See Plate 3 for boring location.

LOG OF BORING

Project: Montopolis
Boring No.: B-7
Groundwater during drilling: ---
Groundwater after drilling: ---

Date: 7/17/2013
Northing: --
Easting: --

Project No.: AG 1011441
Elevation: 590 feet
Station: --
Offset: --



Tan and gray, hard, **FAT CLAY (CH)**, marly. (Taylor Group) [Cont...]

NOTE: Borings were drilled dry and did not encounter groundwater while drilling. Boring elevations are approximate.

Shear Types: ● = Hand Penet. ■ = Torvane ▲ = Unconf. Comp. ✳ = UU Triaxial

See Plate 3 for boring location.

PLATE 10b

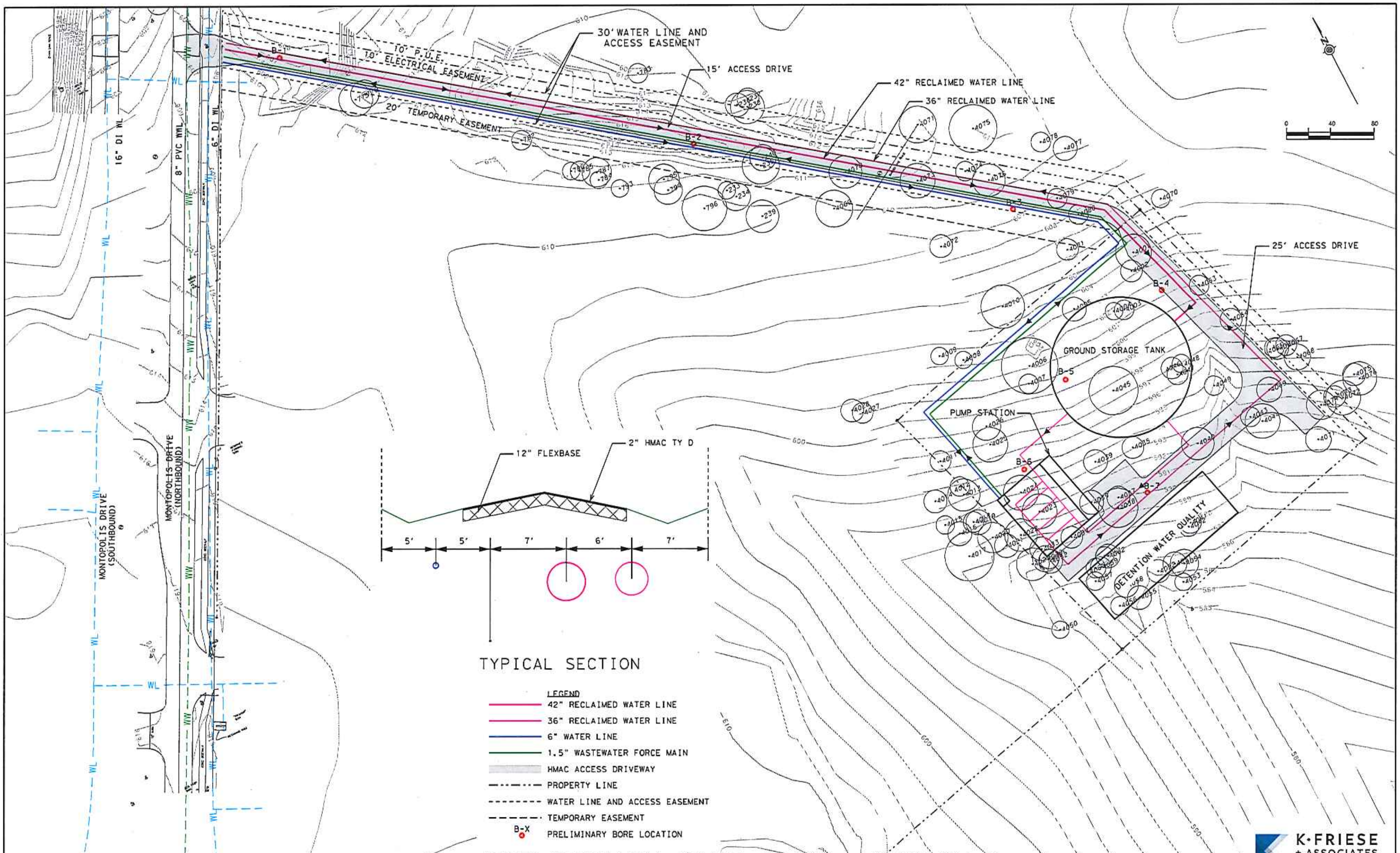
APPENDIX A

LABORATORY TEST SUMMARY

LABORATORY TEST RESULTS SUMMARY
Project Name: Montopolis Pump Station
Project Number: AG 10 11441

Boring Number	Depth (ft)	% Passing No. 200 Sieve	Liquid Limit (%)	Plasticity Index (%)	Moisture Content (%)	Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (tsf)
B-4	0-1.5	80	72	47	22.6			
	1.5-3	70	48	23	9.4			
	4-5.5	91	42	23	8.7			
	6.5-8	96	46	28	11.1			
	9-10.5	94	51	27	11.6			
	13.5-15	97	63	35	14.9			
B-5	1-2.5		42	21	8.7			
	3-4.5		48	18	9.4			
	5-6.5		53	37	11.1			
	7.5-9		57	39	12.7			
	9-10.5		52	36	11.7			
	13.5-15		62	41	15.8			
B-6	0-2	68	60	29	19.2			
	2-4	84	40	20	10.3			
	5-6.5	90	50	23	13.3			
	7-9	91	49	25	15.3			
	13-15	94	56	28	17.4			

Appendix B
Site Plan and Soil Boring Locations



PRELIMINARY SITE PLAN - OPTION B

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Appendix E
Chapter 210 Rules For Use of Reclaimed Water

SUBCHAPTER B : GENERAL REQUIREMENTS FOR THE PRODUCTION, CONVEYANCE, AND USE OF RECLAIMED WATER

§§210.21 - 210.25

§210.21. Applicability.

This subchapter establishes general requirements applicable to producers, providers, and users of reclaimed water. This subchapter also establishes requirements and specifications for transfer, storage, and irrigation using reclaimed water and design criteria of reclaimed water systems. Additionally, this subchapter establishes requirements and specifications necessary to minimize discharges of waste into or adjacent to waters in the state.

Adopted January 8, 1997 Effective February 12, 1997

§210.22. General Requirements.

(a) Reuse of untreated wastewater is prohibited.

(b) Food crops that may be consumed raw by humans shall not be spray irrigated. Food crops including orchard crops that will be substantially processed prior to human consumption may be spray irrigated. Other types of irrigation that avoid contact of reclaimed water with edible portions of food crops are acceptable.

(c) There shall be no nuisance conditions resulting from the distribution, the use, and/or storage of reclaimed water.

(d) Reclaimed water shall not be utilized in a way that degrades ground water quality to a degree adversely affecting its actual or potential uses.

(e) Reclaimed water managed in ponds for storage must be prevented from discharge into waters in the state, except for discharges directly resulting from rainfall events or in accordance with a permit issued by the commission. All other discharges are unauthorized. If any unauthorized overflow of a holding pond occurs causing discharge into or adjacent to waters in the state, the user or provider, as appropriate, shall report the noncompliance. A written submission of such information shall also be provided to the TNRCC regional office and to the Austin Office, Water Enforcement Section (MC-149), within five (5) working days of becoming aware of the overflow. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the anticipated time it is expected to continue; and, steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

Adopted January 8, 1997 Effective February 12, 1997

§210.23. Storage Requirements for Reclaimed Water.

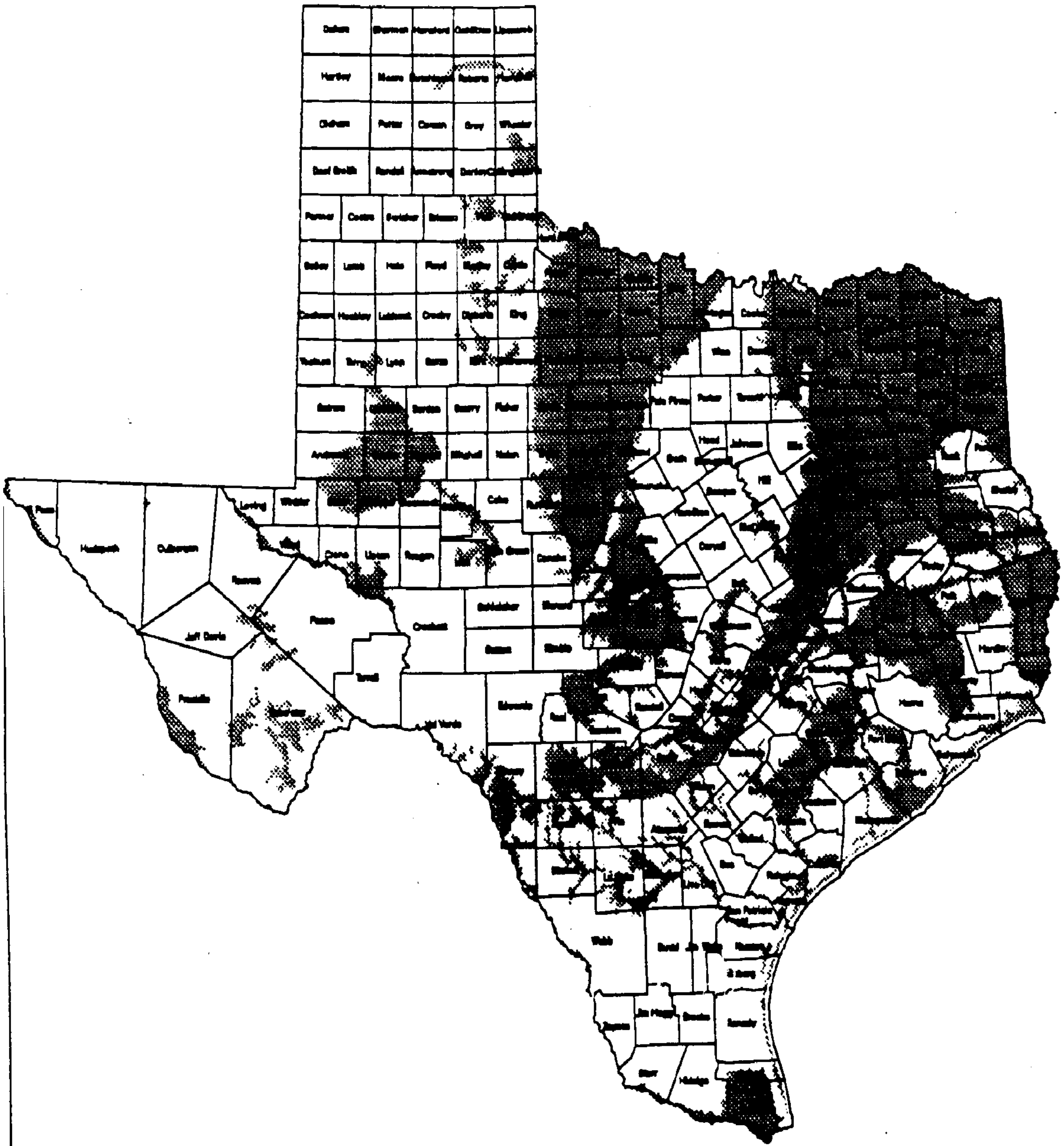
(a) Except for authorized on-channel ponds, storage facilities for retaining reclaimed water prior to use shall not be located within the floodway.

(b) Except as provided by subsection (e) of this section, all initial holding ponds must be lined in accordance with either subsection (c) or (d) of this section, as appropriate.

(c) All initial and subsequent holding ponds containing Type I and Type II effluent, located within the recharge zone of the Edwards Aquifer, as defined in Chapter 213 of this title (relating to Edwards Aquifer), and all initial holding ponds containing Type II effluent, located in a vulnerable area as defined by a rating of 110 or greater on the statewide "*Ground-Water Pollution Potential - General, Municipal, and Industrial Sources*" (DRASTIC) map (as shown in Figure 1 of this chapter), shall conform to the following requirements: (Figure 1: 30 TAC §210.23(c)).

FIGURE 1: 30 TAC §210.23(c)

DRASTIC Pollution Potential Index of 110 or Greater



(1) The ponds, whether constructed of earthen or other impervious material, shall be designed and constructed so as to prevent groundwater contamination;

(2) Soils used for pond lining shall be free from foreign material such as paper, brush, trees, and large rocks;

(3) All soil liners must be of compacted material, at least 24 inches thick, compacted in lifts no greater than 6 inches thick and compacted to 95% of Standard Proctor Density. In-situ clay soils meeting the soils liner requirements shall be excavated and re-compacted a minimum of 6 inches below planned grade to assure a uniformly compacted finished surface.

(4) Soil liners must meet the following particle size gradation and Atterberg limits:

(A) 30% or more passing a number 200 mesh sieve; and

(B) a liquid limit of 30% or greater; and a plasticity index of 15 or greater and have a permeability less than or equal to 1 X 10^{-7} cm/sec;

(5) Synthetic membrane linings shall have a minimum thickness of 40 mils with a leak detection system. In situ liners at least 24 inches thick meeting a permeability less than or equal to 1 X 10^{-7} cm/sec are acceptable alternatives;

(6) Certification shall be furnished by a Texas Registered Professional Engineer that the pond lining meets the appropriate criteria prior to utilization of the facilities; and

(7) Soil embankment walls shall have a top width of at least five feet. The interior and exterior slopes of soil embankment walls shall be no steeper than one foot vertical to three feet horizontal unless alternate methods of slope stabilization are utilized. All soil embankment walls shall be protected by a vegetative cover or other stabilizing material to prevent erosion. Erosion stops and water seals shall be installed on all piping penetrating the embankments.

(d) All initial holding ponds designed to contain Type I effluent, located outside of the recharge zone of the Edwards Aquifer, and Type II effluent, located in areas in the state not identified in subsection (c) of this section shall conform to the following requirements:

(1) The ponds, whether constructed of earthen or other impervious materials, shall be designed and constructed so as to prevent groundwater contamination;

(2) Soils used for pond lining shall be free from foreign material such as paper, brush, trees, and large rocks;

(3) All soil liners must be of compacted material having a permeability less than or equal to 1 x 10^{-4} cm/sec, at least 24 inches thick, compacted in lifts no greater than 6 inches each;

(4) Synthetic membrane linings shall have a minimum thickness of 40 mils. In situ liners at least 24 inches thick meeting a permeability less than or equal to 1×10^{-4} cm/sec are acceptable alternatives;

(5) Certification shall be furnished by a Texas Registered Professional Engineer that the pond lining meets the appropriate criteria prior to utilization of the facilities; and

(6) Soil embankment walls shall have a top width of at least five feet. The interior and exterior slopes of soil embankment walls shall be no steeper than one foot vertical to three feet horizontal unless alternate methods of slope stabilization are utilized. All soil embankment walls shall be protected by a vegetative cover or other stabilizing material to prevent erosion. Erosion stops and water seals shall be installed on all piping penetrating the embankments.

(7) An alternative method of pond lining which provides equivalent or better water quality protection than provided under this section may be utilized with the prior approval of the executive director.

(8) A specific exemption may be obtained from the executive director if, after the review of data submitted by the reclaimed water provider or user, as appropriate, the executive director determines containment of the reclaimed water is not necessary, considering:

(A) soil and geologic data, and ground water data, including its quality, uses, quantity and yield; and

(B) adequate demonstration that impairment of ground water for its actual or potential use will be prevented.

(e) Reclaimed water may be stored in leak-proof, fabricated tanks.

(f) Subsequent holding ponds utilized for the receipt and storage of reclaimed water of a quality that could cause or causes a violation of a surface water quality standard or impairment of ground water for its actual or intended use will also be subject to the storage requirements of this section.

Adopted January 8, 1997 Effective February 12, 1997

§210.24. Irrigation Using Reclaimed Water.

(a) The reclaimed water user shall provide reasonable control of the application rates for reclaimed water applied to irrigation areas. These controls shall encourage the efficient use of reclaimed water and avoid excessive application of reclaimed water that results in surface runoff or excessive percolation below the root zone.

(b) The reclaimed water provider or user, as applicable shall determine and document typical irrigation demands for the proposed use based on type of vegetation and land area to be irrigated. As one alternative, a typical method for determining irrigation needs is shown in Table 1 of this section. However, other alternative methods may be used. (Figure 1: 30 TAC §210.24(b))

FIGURE 1: 30 TAC §210.24(b)

TABLE 1
WATER BALANCE EXAMPLE
(All Units are Inches of Water per Acre of Irrigated Area)

	a	b	Ri	c	d			e	f	g
Month (1)	Average Precipitation (2)	Average Runoff (3)	Average Infiltrated Rainfall (4)	Evapotranspiration (5)	Required Leaching (6)	Total Water Needs (5)+(6) (7)	Effluent Needed in Root Zone (7)-(4) (8)	Evaporation from Reservoir Surface (9)	Effluent to be Applied to Land (8)/K (10)	Consumption from Reservoir (9)+(10) (11)
Jan.	2.11	0.40	1.71	0.80	0.00	0.80	0.00	0.02	0.00	0.02
Feb.	2.43	0.57	1.86	1.20	0.00	1.20	0.00	0.01	0.00	0.01
Mar.	2.02	0.36	1.66	2.80	0.20	3.00	1.34	0.09	1.58	1.67
Apr.	3.19	1.03	2.16	3.40	0.22	3.62	1.46	0.05	1.72	1.77
May	4.19	1.74	2.45	6.10	0.64	6.74	4.29	0.10	5.05	5.15
June	3.30	1.10	2.20	6.50	0.76	7.26	5.06	0.20	5.95	6.15
July	2.20	0.45	1.75	6.70	0.87	7.57	5.82	0.34	6.85	7.19
Aug.	2.12	0.41	1.71	4.60	0.51	5.11	3.40	0.34	4.00	4.34
Sept.	3.58	1.30	2.28	5.10	0.50	5.60	3.32	0.19	3.91	4.10
Oct.	3.09	0.96	2.13	4.10	0.35	4.45	2.32	0.14	2.73	2.87
Nov.	2.23	0.46	1.77	2.10	0.06	2.16	0.39	0.07	0.46	0.53
Dec.	2.34	0.52	1.82	1.00	0.00	1.00	0.00	0.03	0.00	0.03
	32.80	9.30	23.50	44.40	4.11	48.51	27.40	1.58	32.25	33.83

Table 1 Footnotes

a. Up-to date rainfall and evaporation data sets are available from the Texas Natural Resources Information System.

b. Runoff should be determined by an acceptable method such as the Soil Conservation Service method found in SCS Technical Releases No. 55. For calculation purposes only, a CN value of 74 was assumed for good pasture with Class "C" soils.

c. Suggested source of values is the "Bulletin 6019, Consumptive Use of Water by Major Crops in Texas", Texas Board of Water Engineers.

d. In low rainfall areas, this is the required leaching to avoid salinity build-up in the soil where:

$$L = \frac{Ce}{C1-Ce}(E - Ri)$$

Ri = Infiltrated rainfall

Ce = Electrical conductivity of effluent

C1 = Maximum Allowable Conductivity of Soil Solution (Table 3)

E = Evapotranspiration

For calculation purposes only, Ce is measured to be 1.5 millimhos/cm @ 25 ° and C1 is 10.0 (Bermuda Grass)

e. Net evaporation from reservoir surface. For the purpose of calculation, an assumption must be made as to the ratio of irrigated land area to reservoir surface area. For this example problem, the necessary reservoir area was assumed to be 17% of the irrigated area. If, after all calculations are made, the reservoir dimensions do not seem reasonable, then a new assumption must be made and the calculations repeated. Values in column (9) are adjusted to be inches per irrigated acre.

f. K is the irrigation efficiency which for this example is taken to be 0.85.

g. The total of this column together with the expected annual volume of effluent will determine the acreage of irrigated land required.

(c) The reclaimed water provider shall be responsible for conducting periodic audits of appropriate controls implemented by reclaimed water users. Other typical irrigation operational considerations that must be addressed include the following:

(1) Irrigation of Food Crops.

(A) Irrigation of edible crops that will be peeled, skinned, cooked, or thermally processed before consumption is allowed. Direct contact of the reclaimed water with such crops is allowed.

(B) Irrigation of citrus fruit is allowed. Direct contact of the reclaimed water with citrus is allowed.

(C) Irrigation of edible crops that will not be peeled, skinned, cooked, or thermally processed before consumption is allowed if an indirect application method is used which will preclude the direct contact with the reclaimed water. For instance, a ridge and furrow, drip irrigation, or a subsurface distribution system may be used to irrigate such above ground crops. However, these methods would not be suitable for crops such as carrots or radishes.

(D) Irrigation of edible crops that will not be peeled, skinned, cooked, or thermally processed before consumption that allows for direct contact of the reclaimed water on the crop is prohibited.

(2) Irrigation of pastures used by animals milked for human consumption shall be conducted in a manner to avoid contact of reclaimed water with such animals.

(3) Irrigation of landscaped areas:

(A) Application of reclaimed water on public access facilities shall be controlled by agreement with the reclaimed water provider or by local ordinance.

(B) Reclaimed water may not be used to fill swimming pools, hot tubs, wading pools, or other structures designed for contact recreation.

(d) General irrigation requirements.

(1) A provider or user designing or operating an irrigation system using reclaimed water is responsible for ensuring that reclaimed water overflow, crop stress, and undesirable soil contamination by a salt does not occur. To prevent such occurrences, the provider or user is required to consider, evaluate, and respond appropriately to the following factors as the need arises:

(A) Precipitation inputs to the water balance should utilize the average monthly precipitation based on past rainfall records.

(B) The consumptive use requirements (evapotranspiration losses) of the crop system should be developed on a monthly basis. The method of determining the consumptive use requirement shall be documented by the provider or user as a part of the water balance study and the records of the study maintained for possible commission review.

(C) A leaching requirement, calculated as shown in Table 1 of this section, shall be included in the water balance study when the total dissolved solids concentration of the reclaimed water presents the potential for developing excessive soil salinity buildup due to the long term operation of the irrigation system.

(2) The irrigation site must be maintained with a vegetative cover or be under cultivation during times when reclaimed water is being applied.

(3) The irrigation practices shall be designed so as to prevent incidental ponding or standing water except where local farming conditions and the accepted irrigation delivery systems and cropping patterns are such that, as an unavoidable consequence of such conditions, systems, and patterns, there will be standing water.

(4) Irrigation application rates and application times shall be developed so as to minimize "wet grass" conditions in unrestricted landscaped areas during the periods the area could be in use.

(5) Irrigation systems shall be designed so that the irrigation spray does not reach any privately-owned premises outside the designated irrigation area or reach public drinking fountains.

(6) There shall be no application of effluent when the ground is water saturated or frozen.

(7) Distribution systems must be designed to prevent operation by unauthorized personnel.

(8) Irrigation operations shall be managed in a manner to minimize the inadvertent contact of reclaimed water with humans.

(9) Operational or tailwater controls shall be provided to preclude discharge of reclaimed water from irrigation sites.

Adopted January 8, 1997 Effective February 12, 1997

§210.25. Special Design Criteria for Reclaimed Water Systems.

(a) All hose bibs and faucets shall be painted purple and designed to prevent connection to a standard water hose. Hose bibs shall be located in locked, below grade vaults which shall be clearly labeled as being of non-potable quality. As an alternative to the use of locked, below grade vaults with standard hose bibs services, hose bibs may be placed in a non-lockable service box which can only be operated by a special tool so long as the hose bib is clearly labeled as non-potable water, in accordance with subsection (b) of this section.

(b) One of the following requirements must be met by the user or provider, for any area where reclaimed water is stored or where there exist hose bibs or faucets:

(1) Signs having a minimum size of eight inches by eight inches, as shown in Figure 1, shall be posted at all storage areas and on all hose bibs and faucets reading, in both English and Spanish, "Reclaimed Water, Do Not Drink" or similar warning. (Figure 1: 30 TAC §210.25(b)(1));

FIGURE 1: 30 TAC §210.25(b)(1)

DO NOT DRINK THE WATER

NO TOMAR EL AGUA

(2) The area shall be secured to prevent access by the public.

(c) Reclaimed water piping shall be separated from potable water piping by a horizontal distance of at least nine feet. Where the nine foot separation distance cannot be achieved, the reclaimed water piping must meet the line separation requirements of Chapter 290 of this title (relating to Water Hygiene).

(d) Where a reclaimed water line parallels a sewer line, the reclaimed water line shall be constructed in accordance with subsection (e) or (f) of this section. The horizontal separation distance shall be three feet (outside to outside) with the reclaimed water line at the level of or above the sewer line. Reclaimed water lines which parallel sewer lines may be placed in the same benched trench. Where a reclaimed water line crosses a sewer line, the requirements of §290.44(e)(5)(B) of this title (relating to Location of Water Lines) shall be followed, with “reclaimed water line” substituted in §290.44(e) of this title (relating to Location of Water Lines) for “water line.”

(e) Reclaimed water lines which transport reclaimed water under pressure shall be sized according to acceptable engineering practices for the needs of the reclaimed water users. The designer shall consider methods to prevent or maintain lines to mitigate the effect of the deposition of solids in such lines. Pipe specified for reclaimed water force mains shall be of a type having an expected life at least as long as that of the lift station and shall be suitable for the reclaimed water being pumped and operating pressure to which it will be subjected. All pipe shall be identified in the technical specifications with appropriate American Society for Testing and Materials, American National Standard Institute, or American Water Works Association (AWWA) standard numbers for both quality control (dimensions, tolerance, and installation such as bedding or backfill). All pipes and fittings shall have a minimum working pressure rating of 150 pounds per square inch. Final plans and specifications shall describe required pressure testing for all installed reclaimed water force mains. Minimum test pressure shall be 1.5 times the maximum design pressure. Allowable leakage rates shall be determined as described in §317.2(d)(4) of this title (relating to Pressure Sewer Systems).

(f) Gravity flow reclaimed water lines shall meet the requirements of §317.2 (a) of this title (relating to General Requirements) and §317.2(c) of this title (relating to High Velocity Protection). The designer shall consider methods to prevent high velocity scour or maintain line fluid velocity to mitigate the effects of the deposition of solids in the gravity conveyance.

(g) All exposed piping and piping within a building shall be either purple pipe or painted purple. All buried piping installed after the effective date of these rules shall be one of the following: manufactured in purple, painted purple, taped with purple metallic tape, or bagged in purple. All exposed piping should be stenciled in white with a warning reading "NON-POTABLE WATER." All exposed or buried reclaimed water piping constructed at a wastewater treatment facility is exempt from the color coding requirements of this section.

(h) When applicable, in accordance with §317.1(a)(3) - (4) of this title, (relating to General Provisions), the design of distribution systems which will convey reclaimed water to a user shall be submitted to the executive director and must receive an approval. The design of the distribution systems must meet the requirements of Chapter 317 of this title (relating to Design Criteria for Sewerage Systems). Where a municipality is the plan review authority for certain sewer systems which transport primarily domestic waste, in accordance with §317.1(a)(5) of this title, in lieu of the commission, design submittal will not be subject to submittal to the commission and instead must be approved by the municipality. Materials shall be submitted for approval by the executive director in accordance with the Texas Engineering Practice Act (Article 3271a, Vernon's Annotated Texas Statutes).

(i) All ground level and elevated storage tanks shall be designed, installed, and constructed in accordance with current AWWA standards with reference to materials to be used and construction practices to be followed, except for health-based standards strictly related to potable water storage and contact practices, where appropriately less restrictive standards may be applied.

Adopted January 22, 1997 Effective February 12, 1997

Appendix F
Cost Estimate Details

Montopolis Reuse Pump Station
Preliminary Design - Class 4 Estimate
472902 / Rev. 0

Project name	Montopolis WST & PS Austin TX 78704 USA
Client	City of Austin
Architect	CH2M Hill
Engineer	CH2M Hill
Estimator	Robert Lawson
Labor rate table	2_Labor Union (2013)
Equipment rate table	1_EqRates_2013a_75%
Job size	1 LS
Duration	18 MO
Bid date	2:00 PM
Project	Montopolis WST & PS
Project Number	472902
Market Segment	WBG
Business Group	WBG
Estimate Class 1-5	Class 4
Design Stage	Preliminary
Project Manager	Joe Jenkins/AUS
Rev No. / Date	0 / Aug 19, 2013
Cost Index	Aug 2013
Est. No.	2013.814839
Report format	Sorted by 'Facility/Work Pkg/Trade Pkg/WorkActiv/Unit Price' 'Detail' summary
Cost index	Texas-Austin

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
01								**Pump Station**										
		03.0						**Concrete Work**										
			03-10					**Cast-In-Place Concrete Work**										
				RW				**RECYCLED WATER**										
					03-10-02-12			**Cast-In-Place Concrete, Continuous Footings, 12" thick**										
	03					r03111.365	1000	C.I.P. concrete forms, slab on grade, bulkhead with keyway, wood, 6" high, 1 use, includes erecting, bracing, stripping and cleaning	12.00 lf	C1	0.89	3.29	-	-	-	4.18	50	100
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.64 ton	RODM4	1,000.00	853.41	-	-	-	1,853.41	1,190	2,380
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	0.64 ton	C5	-	33.69	7.35	-	-	41.04	26	53
	03					r03211.060	2215	Reinforcing in place, crane cost for handling, add to above, slabs	0.64 ton	C5	-	36.62	7.99	-	-	44.61	29	57
	03					r03211.060	2410	Reinforcing steel, in place, dowels, deformed, 2' long, #4, A615, grade 60	24.00 ea	RODM2	0.73	2.05	-	-	-	2.78	67	133
	03					r03211.060	2700	Dowel cap, visual warning only, plastic, #3 to #8	24.00 ea	RODM2	0.27	1.23	-	-	-	1.50	36	72
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	7.48 cy		90.00	-	-	-	-	90.00	673	1,347
	03					r03310.570	4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	7.48 cy	C20	-	16.27	3.17	-	-	19.43	145	291
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	198.00 sf	C10	-	0.95	-	-	-	0.95	187	375
	03					r03391.350	0300	Curing, sprayed membrane curing compound	1.98 csf	CLAB2	8.05	7.36	-	-	-	15.41	31	61
	03					r31221.610	1100	Fine grading, fine grade for slab on grade, machine	22.00 sy	B11L	-	0.79	0.51	-	-	1.30	29	57
								03-10-02-12 Cast-In-Place Concrete, Continuous Footings, 12" thick	**7.48 CY**		**182.60**	**140.63**	**6.00**			**329.23**	**2,463**	**4,926**
					03-10-02-18			**Cast-In-Place Concrete, Continuous Footings, 18" thick**										
	03					r03111.365	1000	C.I.P. concrete forms, slab on grade, bulkhead with keyway, wood, 6" high, 1 use, includes erecting, bracing, stripping and cleaning	48.00 lf	C1	0.89	3.29	-	-	-	4.18	200	401
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	5.13 ton	RODM4	1,000.00	853.41	-	-	-	1,853.41	9,514	19,031
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	5.13 ton	C5	-	33.69	7.35	-	-	41.04	211	421
	03					r03211.060	2215	Reinforcing in place, crane cost for handling, add to above, slabs	5.13 ton	C5	-	36.62	7.99	-	-	44.61	229	458
	03					r03211.060	2410	Reinforcing steel, in place, dowels, deformed, 2' long, #4, A615, grade 60	96.00 ea	RODM2	0.73	2.04	-	-	-	2.77	266	533
	03					r03211.060	2700	Dowel cap, visual warning only, plastic, #3 to #8	96.00 ea	RODM2	0.27	1.23	-	-	-	1.50	144	287
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	59.84 cy		90.00	-	-	-	-	90.00	5,386	10,774
	03					r03310.570	4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	59.84 cy	C20	-	16.26	3.17	-	-	19.43	1,163	2,326
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	1,056.00 sf	C10	-	0.95	-	-	-	0.95	1,000	2,000
	03					r03391.350	0300	Curing, sprayed membrane curing compound	10.56 csf	CLAB2	8.05	7.36	-	-	-	15.41	163	326
	03					r31221.610	1100	Fine grading, fine grade for slab on grade, machine	117.33 sy	B11L	-	0.79	0.51	-	-	1.30	152	305
								03-10-02-18 Cast-In-Place Concrete, Continuous Footings, 18" thick	**59.84 CY**		**179.52**	**122.93**	**5.49**			**307.94**	**18,427**	**36,862**
					03-10-05-08			**Cast-In-Place Concrete, Slabs on Grade, 8" thick**										
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	7.50 ton	RODM4	1,000.00	853.41	-	-	-	1,853.41	13,895	27,796
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	7.50 ton	C5	-	33.69	7.35	-	-	41.04	308	615
	03					r03211.060	2215	Reinforcing in place, crane cost for handling, add to above, slabs	7.50 ton	C5	-	36.62	7.99	-	-	44.61	334	669
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	87.39 cy		90.00	-	-	-	-	90.00	7,865	15,734
	03					r03310.570	4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	87.39 cy	C20	-	16.26	3.17	-	-	19.43	1,698	3,398

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					03-10-05-08			**Cast-In-Place Concrete, Slabs on Grade, 8" thick**										
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	3,470.00 sf	C10	-	0.95	-	-	-	0.95	3,285	6,571
	03					r03391.350	0300	Curing, sprayed membrane curing compound	34.70 csf	CLAB2	8.05	7.36	-	-	-	15.41	535	1,070
	03					r31221.610	1100	Fine grading, fine grade for slab on grade, machine	385.56 sy	B11L	-	0.79	0.51	-	-	1.30	501	1,002
								03-10-05-08 Cast-In-Place Concrete, Slabs on Grade, 8" thick	**87.39 CY**		**178.99**	**139.49**	**6.75**			**325.22**	**28,421**	**56,855**
					03-10-05-12			**Cast-In-Place Concrete, Slabs on Grade, 12" thick**										
	03					r03111.365	1000	C.I.P. concrete forms, slab on grade, bulkhead with keyway, wood, 6" high, 1 use, includes erecting, bracing, stripping and cleaning	9.33 lf	C1	0.89	3.29	-	-	-	4.18	39	78
	03					r03111.365	1000	C.I.P. concrete forms, slab on grade, bulkhead with keyway, wood, 6" high, 1 use, includes erecting, bracing, stripping and cleaning	9.33 lf	C1	0.89	3.29	-	-	-	4.18	39	78
	03					r03151.350	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	145.00 lf	CARP1	3.79	3.40	-	-	-	7.19	1,043	2,086
	03					r03151.350	1300	Waterstop, PVC, ribbed type, split, 3/8" thick x 6" wide	163.00 lf	CARP1	3.79	3.40	-	-	-	7.19	1,172	2,345
	03					r03151.350	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	12.00 ea	CARP1	44.00	8.84	-	-	-	52.84	634	1,269
	03					r03151.350	5250	Waterstop, fittings, rubber, flat, dumbbell or center bulb, field union, 3/8" thick x 9" wide	14.00 ea	CARP1	44.00	8.84	-	-	-	52.84	740	1,480
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.84 ton	RODM4	1,000.00	853.41	-	-	-	1,853.41	3,401	6,804
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	2.10 ton	RODM4	1,000.00	853.41	-	-	-	1,853.41	3,887	7,775
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	1.84 ton	C5	-	33.69	7.35	-	-	41.04	75	151
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	2.10 ton	C5	-	33.69	7.35	-	-	41.04	86	172
	03					r03211.060	2215	Reinforcing in place, crane cost for handling, add to above, slabs	1.84 ton	C5	-	36.62	7.98	-	-	44.61	82	164
	03					r03211.060	2215	Reinforcing in place, crane cost for handling, add to above, slabs	2.10 ton	C5	-	36.62	7.99	-	-	44.61	94	187
	03					r03211.060	2410	Reinforcing steel, in place, dowels, deformed, 2' long, #4, A615, grade 60	19.00 ea	RODM2	0.73	2.04	-	-	-	2.77	53	105
	03					r03211.060	2410	Reinforcing steel, in place, dowels, deformed, 2' long, #4, A615, grade 60	19.00 ea	RODM2	0.73	2.04	-	-	-	2.77	53	105
	03					r03211.060	2700	Dowel cap, visual warning only, plastic, #3 to #8	19.00 ea	RODM2	0.27	1.23	-	-	-	1.50	28	57
	03					r03211.060	2700	Dowel cap, visual warning only, plastic, #3 to #8	19.00 ea	RODM2	0.27	1.23	-	-	-	1.50	28	57
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	21.39 cy		90.00	-	-	-	-	90.00	1,925	3,851
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	24.45 cy		90.00	-	-	-	-	90.00	2,200	4,401
	03					r03310.570	4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	21.39 cy	C20	-	16.26	3.17	-	-	19.43	416	832
	03					r03310.570	4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	24.45 cy	C20	-	16.26	3.17	-	-	19.43	475	950
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	566.22 sf	C10	-	0.95	-	-	-	0.95	536	1,072
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	647.11 sf	C10	-	0.95	-	-	-	0.95	613	1,225
	03					r03391.350	0300	Curing, sprayed membrane curing compound	5.66 csf	CLAB2	8.05	7.36	-	-	-	15.41	87	175
	03					r03391.350	0300	Curing, sprayed membrane curing compound	6.47 csf	CLAB2	8.05	7.36	-	-	-	15.41	100	199
	03					r31221.610	1100	Fine grading, fine grade for slab on grade, machine	62.91 sy	B11L	-	0.79	0.51	-	-	1.30	82	163
	03					r31221.610	1100	Fine grading, fine grade for slab on grade, machine	71.90 sy	B11L	-	0.79	0.51	-	-	1.30	93	187
								03-10-05-12 Cast-In-Place Concrete, Slabs on Grade, 12" thick	**45.84 CY**		**229.51**	**156.73**	**6.00**			**392.24**	**17,980**	**35,968**
					03-10-06-08			**Cast-In-Place Concrete, Straight Walls, 8" thick**										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					03-10-06-08			**Cast-In-Place Concrete, Straight Walls, 8" thick**										
	03					r03111.385	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	48.00 lf	C2	1.69	9.74	-	-	-	11.43	548	1,097
	03					r03111.385	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	48.00 lf	C2	1.69	9.74	-	-	-	11.43	548	1,097
	03					r03111.385	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	1,808.00 sfca	C2	0.60	5.73	-	-	-	6.33	11,451	22,906
	03					r03111.385	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	1,600.00 sfca	C2	0.60	5.73	-	-	-	6.33	10,133	20,271
	03					r03150.595	3050	Form oil, coverage varies greatly, maximum, includes material only	4.82 gal		19.85	-	-	-	-	19.85	96	191
	03					r03150.595	3050	Form oil, coverage varies greatly, maximum, includes material only	4.27 gal		19.85	-	-	-	-	19.85	85	169
	03					r03151.350	3500	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	48.00 lf	CARP1	13.40	3.05	-	-	-	16.45	790	1,579
	03					r03151.350	3500	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	48.00 lf	CARP1	13.40	3.05	-	-	-	16.45	790	1,579
	03					r03151.350	5205	Waterstop, rubber, field union, 3/8" x 6" wide, walls	4.00 ea	CARP1	33.00	8.84	-	-	-	41.84	167	335
	03					r03151.350	5205	Waterstop, rubber, field union, 3/8" x 6" wide, walls	4.00 ea	CARP1	33.00	8.84	-	-	-	41.84	167	335
	03					r03211.060	0700	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.95 ton	RODM4	1,000.00	654.28	-	-	-	1,654.28	3,231	6,463
	03					r03211.060	0700	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	1.73 ton	RODM4	1,000.00	654.28	-	-	-	1,654.28	2,859	5,718
	03					r03211.060	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	1.95 ton	C5	-	33.69	7.35	-	-	41.04	80	160
	03					r03211.060	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	1.73 ton	C5	-	33.69	7.35	-	-	41.04	71	142
	03					r03211.060	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	1.95 ton	C5	-	36.62	7.99	-	-	44.61	87	174
	03					r03211.060	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	1.73 ton	C5	-	36.62	7.99	-	-	44.61	77	154
	03					r03310.535	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	22.77 cy		90.00	-	-	-	-	90.00	2,049	4,099
	03					r03310.535	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	20.15 cy		90.00	-	-	-	-	90.00	1,813	3,627
	03					r03310.570	5350	Structural concrete, placing, walls, pumped, 15" thick, includes strike off & consolidation, excludes material	22.77 cy	C20	-	25.07	4.89	-	-	29.96	682	1,365
	03					r03310.570	5350	Structural concrete, placing, walls, pumped, 15" thick, includes strike off & consolidation, excludes material	20.15 cy	C20	-	25.07	4.89	-	-	29.96	604	1,208
	03					r03352.960	0050	Concrete finishing, walls, burlap rub with grout, includes breaking ties and patching voids	904.00 sf	CEFI1	0.04	0.94	-	-	-	0.98	888	1,777
	03					r03352.960	0050	Concrete finishing, walls, burlap rub with grout, includes breaking ties and patching voids	800.00 sf	CEFI1	0.04	0.94	-	-	-	0.98	786	1,572
								03-10-06-08 Cast-In-Place Concrete, Straight Walls, 8" thick	**42.92 CY**		**269.09**	**610.12**	**6.20**			**885.41**	**38,002**	**76,021**
					03-10-06-10			**Cast-In-Place Concrete, Straight Walls, 10" thick**										
	03					r03111.385	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	8.00 lf	C2	1.69	9.74	-	-	-	11.43	91	183
	03					r03111.385	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	264.00 sfca	C2	0.60	5.73	-	-	-	6.33	1,672	3,345
	03					r03150.595	3050	Form oil, coverage varies greatly, maximum, includes material only	0.70 gal		19.84	-	-	-	-	19.84	14	28
	03					r03211.060	0700	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.36 ton	RODM4	1,000.00	654.27	-	-	-	1,654.27	589	1,178
	03					r03211.060	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	0.36 ton	C5	-	33.68	7.36	-	-	41.04	15	29
	03					r03211.060	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	0.36 ton	C5	-	36.63	7.98	-	-	44.61	16	32
	03					r03310.535	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	4.16 cy		90.00	-	-	-	-	90.00	374	748

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					03-10-06-10			Cast-In-Place Concrete, Straight Walls, 10" thick										
	03					r03310.570	5350	Structural concrete, placing, walls, pumped, 15" thick, includes strike off & consolidation, excludes material	4.16 cy	C20	-	25.08	4.89	-	-	29.96	125	249
	03					r03352.960	0010	Finishing: break ties & patch voids (walls, cols or beams)	264.00 sf	CEFI1	0.03	0.79	-	-	-	0.82	215	430
								03-10-06-10 Cast-In-Place Concrete, Straight Walls, 10" thick	**4.16 CY**		**222.08**	**519.44**	**6.20**			**747.71**	**3,110**	**6,222**
					03-10-06-12			Cast-In-Place Concrete, Straight Walls, 12" thick										
	03					r03111.385	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	60.00 lf	C2	1.69	9.74	-	-	-	11.43	686	1,371
	03					r03111.385	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	2,640.00 sfca	C2	0.60	5.73	-	-	-	6.33	16,720	33,447
	03					r03150.595	3050	Form oil, coverage varies greatly, maximum, includes material only	7.04 gal		19.85	-	-	-	-	19.85	140	280
	03					r03211.060	0700	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	4.28 ton	RODM4	1,000.00	654.28	-	-	-	1,654.28	7,077	14,157
	03					r03211.060	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	4.28 ton	C5	-	33.69	7.35	-	-	41.04	176	351
	03					r03211.060	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	4.28 ton	C5	-	36.62	7.99	-	-	44.61	191	382
	03					r03310.535	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	49.87 cy		90.00	-	-	-	-	90.00	4,488	8,978
	03					r03310.570	5350	Structural concrete, placing, walls, pumped, 15" thick, includes strike off & consolidation, excludes material	49.87 cy	C20	-	25.07	4.89	-	-	29.96	1,494	2,989
	03					r03352.960	0010	Finishing: break ties & patch voids (walls, cols or beams)	2,640.00 sf	CEFI1	0.03	0.79	-	-	-	0.82	2,152	4,304
								03-10-06-12 Cast-In-Place Concrete, Straight Walls, 12" thick	**49.87 CY**		**213.96**	**444.01**	**6.20**			**664.17**	**33,122**	**66,259**
					03-10-13-12			Cast-In-Place Concrete, Equipment Pads, 12" thick										
	03					r03111.365	2050	C.I.P. concrete forms, slab on grade, curb, wood, 6" to 12" high, 2 use, includes erecting, bracing, stripping and cleaning	92.00 sfca	C1	1.40	6.70	-	-	-	8.10	746	1,491
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	0.16 ton	RODM4	1,000.00	853.40	-	-	-	1,853.40	289	578
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	0.24 ton	C5	-	33.70	7.36	-	-	41.05	10	20
	03					r03211.060	2400	Reinforcing steel, in place, dowels, deformed, 2' long, #3, A615, grade 60	48.00 ea	RODM2	2.09	1.89	-	-	-	3.97	191	382
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	4.23 cy		90.00	-	-	-	-	90.00	381	762
	03					r03310.570	4600	Structural concrete, placing, slab on grade, direct chute, over 6" thick, includes strike off & consolidation, excludes material	4.23 cy	C6	-	13.28	0.30	-	-	13.58	57	115
	03					r03310.570	5610	Structural concrete, placing, by walking cart, 50' haul, excludes material, add to placing costs above	4.23 cy	C18	-	12.37	1.43	-	-	13.79	58	117
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	112.00 sf	C10	-	0.95	-	-	-	0.95	106	212
	03					r03391.350	0300	Curing, sprayed membrane curing compound	1.12 csf	CLAB2	8.05	7.36	-	-	-	15.41	17	35
								03-10-13-12 Cast-In-Place Concrete, Equipment Pads, 12" thick	**4.23 CY**		**183.13**	**253.26**	**2.14**			**438.53**	**1,855**	**3,711**
								RW RECYCLED WATER	**1.00 LS**		**62,189.02**	**79,342.82**	**1,848.48**			**143,380.32**	**143,380**	**286,826**
								03-10 Cast-In-Place Concrete Work	**1.00 LS**		**62,189.02**	**79,342.82**	**1,848.48**			**143,380.32**	**143,380**	**286,826**
								03.0 Concrete Work	**1.00 LS**		**62,189.02**	**79,342.82**	**1,848.48**			**143,380.32**	**143,380**	**286,826**
		13.0						Buildings Complete										
			04-00					Masonry										
				RW				RECYCLED WATER										
					04-00-01-04			Masonry Brick, 4"										
	04					r04051.630	0800	Grout, door frames, 3' x 7' opening, 2.5 C.F. per opening	2.00 opng	D4	10.90	26.68	1.64	-	-	39.22	78	157
	04					r04051.630	0850	Grout, door frames, 6' x 7' opening, 3.5 C.F. per opening	1.00 opng	D4	15.25	35.58	2.18	-	-	53.01	53	106

MONTOPOLIS RECYCLED WATER SYSTEM

STORAGE TANK & PUMP STSTION

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					04-00-01-04			**Masonry Brick, 4"**										
	04					r04052.313	0050	Control joint, PVC, for double wythe 8" minimum wall (Brick/CMU)	176.00 lf	BRIC1	1.24	1.10	-	-	-	2.34	412	825
	04					r04211.313	2000	Brick venr masnry,std brick,select common,runnng bond,tl lots,6.75/s, 4"x2-2/3"8",inclds 3% brick and 25% mortar waste,exclds scffld,grout and rnfrcng	10,953.95 sf	D8	4.47	8.84	-	-	-	13.31	145,786	291,638
	04					r05122.340	0668	Channel framing, structural steel, field fabricated, C6x8.2, incl cutting & welding	37.00 lf	E3	6.20	27.26	1.96	-	-	35.42	1,311	2,622
	04					r07191.910	0300	Silicone water repellants, sprayed on CMU, 2 coat	5,476.98 sf	ROFC1	0.66	0.13	-	-	-	0.79	4,302	8,606
	04					r07712.610	0700	Reglet, zinc and copper alloy, 20 ounce	264.00 lf	CARP1	2.87	1.97	-	-	-	4.84	1,276	2,554
	04					r07712.610	1600	Reglet, counter flashing for zinc and copper alloy, 20 ounce, 12" wide	264.00 lf	SHEE1	5.25	3.50	-	-	-	8.75	2,309	4,619
	04					r07921.010	1800	Caulking and sealants, butyl based, bulk, in place, 77 LF per gallon, 1/2" x 1/2"	176.27 lf	BRIC1	0.40	1.61	-	-	-	2.01	353	707
								04-00-01-04 Masonry Brick, 4"	**1.00 LS**		**55,277.85**	**100,525.22**	**78.10**			**155,881.17**	**155,881**	**311,833**
					04-00-02-08			**Masonry Concrete Masonry Units, 8"**										
	04					r04051.630	0875	Grouting, interior door frame, average 3.0 cf/opening (single & pair)	1.00 opng	D4	15.25	35.58	2.18	-	-	53.01	53	106
	04					r04051.630	2025	Grout, C476. interior CMU cells/cores, bond beams and lintels	38.89 cf	D4	4.36	4.57	0.28	-	-	9.21	358	717
	04					r04051.926	0075	Reinforcing, steel bars A615, average #4 bar, interior CMU	91.78 lb	BRIC1	0.50	0.98	-	-	-	1.48	136	272
	04					r04051.926	0275	Joint reinforcing, regular truss, to 12" wide, mill galv, interior CMU	1.17 clf	BRIC1	23.50	22.07	-	-	-	45.56	53	106
	04					r04221.034	4200	Concrt block prttns,normal wt blocks,2000 psi,8"8"16",tooled joints both sides,inclds mortar,excluds scffldn,horzntl rnfrcng,verticl rnfrcng and grout	155.55 sf	D8	2.27	5.42	-	-	-	7.69	1,196	2,393
	04					r05122.340	0472	Angle framing, structural steel, 2-1/2"x2-1/2"x1/4", field fabricated, incl cutting & welding	16.00 lf	E3	3.20	20.82	1.50	-	-	25.52	408	817
	04					r05122.340	0625	Lightweight framing, channel, field fab, avg. 8 lbs/lf	25.00 lb	E3	0.78	3.00	0.22	-	-	4.00	100	200
								04-00-02-08 Masonry Concrete Masonry Units, 8"	**1.00 LS**		**681.92**	**1,580.71**	**42.48**			**2,305.11**	**2,305**	**4,611**
					04-00-02-12			**Masonry Concrete Masonry Units, 12"**										
	04					r01542.370	0090	Scaffolding, steel tubular, regular, labor only to erect & dismantle, building exterior, wall face, 6'-4" x 5' frames, 1 to 5 stories, excl. planks	17.48 csf	CARP3	-	165.79	-	-	-	165.79	2,898	5,797
	04					r01542.370	0090	Scaffolding, steel tubular, regular, labor only to erect & dismantle, building exterior, wall face, 6'-4" x 5' frames, 1 to 5 stories, excl. planks	58.17 csf	CARP3	-	165.79	-	-	-	165.79	9,644	19,293
	04					r01542.370	0906	Scaffolding, steel tubular, regular, rent/month only for complete system for face of walls, 6' -4" x 5' frames, excl. planks	17.48 csf		36.00	-	-	-	-	36.00	629	1,259
	04					r01542.370	0906	Scaffolding, steel tubular, regular, rent/month only for complete system for face of walls, 6' -4" x 5' frames, excl. planks	58.17 csf		36.00	-	-	-	-	36.00	2,094	4,189
	04					r01542.370	2850	Scaffolding, steel tubular, regular, accessory, plank, rent/mo, 2" x 10" x 16' long	45.00 ea		6.00	-	-	-	-	6.00	270	540
	04					r01542.370	2850	Scaffolding, steel tubular, regular, accessory, plank, rent/mo, 2" x 10" x 16' long	162.00 ea		6.00	-	-	-	-	6.00	972	1,944
	04					r01542.370	5700	Scaffolding, planks, labor only to install & remove, 2"x10"x16', up to 50' high	45.00 ea	CARP3	-	18.42	-	-	-	18.42	829	1,658
	04					r01542.370	5700	Scaffolding, planks, labor only to install & remove, 2"x10"x16', up to 50' high	162.00 ea	CARP3	-	18.42	-	-	-	18.42	2,984	5,970
	04					r04051.630	0800	Grout, door frames, 3' x 7' opening, 2.5 C.F. per opening	1.00 opng	D4	10.90	26.68	1.64	-	-	39.22	39	78
	04					r04051.630	0800	Grout, door frames, 3' x 7' opening, 2.5 C.F. per opening	2.00 opng	D4	10.90	26.68	1.64	-	-	39.22	78	157
	04					r04051.630	0850	Grout, door frames, 6' x 7' opening, 3.5 C.F. per opening	1.00 opng	D4	15.25	35.58	2.18	-	-	53.01	53	106
	04					r04051.630	2000	Grout, for bond beams, lintels and concrete masonry unit (CMU) cores, C476, includes material only	725.33 cf	D4	4.36	4.57	0.28	-	-	9.21	6,683	13,370
	04					r04051.630	2000	Grout, for bond beams, lintels and concrete masonry unit (CMU) cores, C476, includes material only	2,300.33 cf	D4	4.36	4.57	0.28	-	-	9.21	21,196	42,402
	04					r04051.905	0060	Anchor bolts, hooked type, 3/4" diameter x 8" long, installed fresh grout in cmu bond beam or filled core, includes nut and washer, excludes template	70.00 ea	BRIC1	3.82	3.48	-	-	-	7.30	511	1,021
	04					r04051.905	0060	Anchor bolts, hooked type, 3/4" diameter x 8" long, installed fresh grout in cmu bond beam or filled core, includes nut and washer, excludes template	528.00 ea	BRIC1	3.82	3.48	-	-	-	7.30	3,852	7,705

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					04-00-02-12			Masonry Concrete Masonry Units, 12"										
	04					r04051.926	0020	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed horizontally, ASTM A615	2,590.47 lb	BRIC1	0.50	0.55	-	-	-	1.05	2,724	5,450
	04					r04051.926	0020	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed horizontally, ASTM A615	8,215.46 lb	BRIC1	0.50	0.55	-	-	-	1.05	8,640	17,283
	04					r04051.926	0060	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed vertically, ASTM A615	1,347.04 lb	BRIC1	0.50	0.68	-	-	-	1.18	1,588	3,177
	04					r04051.926	0060	Masonry reinforcing bars, #5 and #6 reinforcing steel bars, placed vertically, ASTM A615	4,272.04 lb	BRIC1	0.50	0.68	-	-	-	1.18	5,037	10,076
	04					r04052.313	0180	Control joint, PVC, 12" wall	50.67 lf	BRIC1	3.33	1.84	-	-	-	5.17	262	524
	04					r04052.313	0180	Control joint, PVC, 12" wall	176.27 lf	BRIC1	3.33	1.84	-	-	-	5.17	911	1,823
	04					r04221.028	0350	Concrt block,high strngt,hollow,3500 psi,12"8"16",inclds mortar and horzntl joint rnfrcng every other course,excluds scffldn,grout and verticl rnfrcng	1,726.98 sf	D9	4.60	9.55	-	-	-	14.15	24,437	48,885
	04					r04221.028	0350	Concrt block,high strngt,hollow,3500 psi,12"8"16",inclds mortar and horzntl joint rnfrcng every other course,excluds scffldn,grout and verticl rnfrcng	5,476.98 sf	D9	4.60	9.55	-	-	-	14.15	77,500	155,034
	04					r05122.340	0672	Channel framing, structural steel, field fabricated, C8x11.5, incl cutting & welding	5.00 lf	E3	8.95	41.65	3.00	-	-	53.60	268	536
	04					r05122.340	0672	Channel framing, structural steel, field fabricated, C8x11.5, incl cutting & welding	37.00 lf	E3	8.95	41.65	3.00	-	-	53.60	1,983	3,967
	04					r07191.910	0300	Silicone water repellants, sprayed on CMU, 2 coat	345.00 sf	ROFC1	0.66	0.13	-	-	-	0.79	271	542
	04					r07712.610	0700	Reglet, zinc and copper alloy, 20 ounce	138.00 lf	CARP1	2.87	1.97	-	-	-	4.84	667	1,335
	04					r07712.610	0700	Reglet, zinc and copper alloy, 20 ounce	264.00 lf	CARP1	2.87	1.97	-	-	-	4.84	1,276	2,554
	04					r07712.610	1600	Reglet, counter flashing for zinc and copper alloy, 20 ounce, 12" wide	138.00 lf	SHEE1	5.25	3.50	-	-	-	8.75	1,207	2,414
	04					r07712.610	1600	Reglet, counter flashing for zinc and copper alloy, 20 ounce, 12" wide	264.00 lf	SHEE1	5.25	3.50	-	-	-	8.75	2,309	4,619
	04					r07921.010	1800	Caulking and sealants, butyl based, bulk, in place, 77 LF per gallon, 1/2" x 1/2"	50.67 lf	BRIC1	0.40	1.61	-	-	-	2.01	102	203
	04					r07921.010	1800	Caulking and sealants, butyl based, bulk, in place, 77 LF per gallon, 1/2" x 1/2"	176.27 lf	BRIC1	0.40	1.61	-	-	-	2.01	353	707
								04-00-02-12 Masonry Concrete Masonry Units, 12"	**1.00 LS**		**65,554.59**	**115,732.79**	**981.28**			**182,268.66**	**182,269**	**364,620**
								RW RECYCLED WATER	**1.00 LS**		**121,514.36**	**217,838.72**	**1,101.86**			**340,454.94**	**340,455**	**681,064**
								04-00 Masonry	**1.00 LS**		**121,514.36**	**217,838.72**	**1,101.86**			**340,454.94**	**340,455**	**681,064**
			05-00					Metals										
				RW				RECYCLED WATER										
					05-00-01-00			Metals, Structural Steel										
	05					r03621.350	0370	Grout, column base plate, non-shrink, non-metallic, 2" deep, average	36.00 sf	CEFI1	11.35	16.96	-	-	-	28.31	1,019	2,039
	05					r05052.305	0310	Anchor bolt, L-type, 2-bolt set, plain steel, 3/4" dia x 18" L, incl nut & washer, job-built 2-hole template	72.00 set	CARP1	14.55	22.11	-	-	-	36.66	2,639	5,280
	05					r05052.310	1800	Bolt, hex head, plain steel, 5/8" dia x 4" L, A307, incl nut & washer	2,000.00 ea	SSWK1	1.62	4.29	-	-	-	5.91	11,818	23,641
	05					r05122.375	1560	Structural steel member, 100-ton project, 1 to 2 story building, W12x50, A992 steel, shop fabricated, incl shop primer, bolted connections	207.00 lf	E2	71.50	4.51	1.53	-	-	77.53	16,050	32,106
	05					r05122.375	3100	Structural steel member, 100-ton project, 1 to 2 story building, W16x40, A992 steel, shop fabricated, incl shop primer, bolted connections	234.00 lf	E2	57.00	4.23	1.43	-	-	62.66	14,662	29,330
	05					r05122.375	4700	Structural steel member, 100-ton project, 1 to 2 story building, W21x68, A992 steel, shop fabricated, incl shop primer, bolted connections	894.00 lf	E5	97.00	4.71	1.21	-	-	102.92	92,010	184,061
								05-00-01-00 Metals, Structural Steel	**1.00 LS**		**119,552.70**	**16,914.13**	**1,730.23**			**138,197.06**	**138,197**	**276,457**
					05-00-03-00			Metals, Metal Decking										
	05					r05312.350	2600	Metal roof decking, steel, open type B wide rib, galvanized, under 50 Sq, 1-1/2" D, 20 gauge	4,200.00 sf	E4	2.25	0.52	0.03	-	-	2.79	11,733	23,471
								05-00-03-00 Metals, Metal Decking	**1.00 LS**		**9,450.00**	**2,165.36**	**117.37**			**11,732.73**	**11,733**	**23,471**
					05-00-08-00			Metals, Gratings										
	05					r03821.610	0400	Concrete impact drilling, for anchors, up to 4" D, 5/8" dia, in concrete or brick walls and floors, incl bit & layout, excl anchor	20.00 ea	CARP1	0.08	9.21	-	-	-	9.29	186	372
	05					r05052.315	1430	Chemical anchor, 3/4" dia x 9-1/2" L, in concrete, brick or stone, incl layout, drilling, sst threaded rod & epoxy cartridge	96.00 ea	B89A	8.90	29.80	3.12	-	-	41.82	4,015	8,031
	05					r05052.320	8300	Wedge anchor, stainless steel, 1/2" dia x 7" L, in concrete, brick or stone, excl layout & drilling	20.00 ea	CARP1	1.72	3.54	-	-	-	5.26	105	210
	05					r05122.340	0470	Grating support angle, stainless steel, 2"x2"x1/4", field fabricated, incl cutting & welding	28.00 lf	E3	2.49	16.66	1.20	-	-	20.35	570	1,140

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					05-00-08-00			**Metals, Gratings**										
	05					r05142.305	0010	Aluminum, structural shapes, 1" to 10" members, under 1 ton w/mounting plates on both ends	1,824.00 lb	E2	4.18	0.85	0.29	-	-	5.31	9,688	19,380
	05					r05531.350	0020	Grating frame, aluminum, 1" to 1-1/2" D, field fabricated	250.67 lf	SSWK1	3.72	7.05	-	-	-	10.77	2,699	5,398
	05					r05531.950	1800	Floor grating, aluminum, heavy duty extruded plank, 4.2 lb per S.F., 1-3/4" D, field fabricated from panels	919.11 sf	E4	36.50	2.15	0.12	-	-	38.77	35,634	71,285
								05-00-08-00 Metals, Gratings	**1.00 LS**		**43,064.47**	**8,869.68**	**962.23**			**52,896.38**	**52,896**	**105,817**
								RW RECYCLED WATER	**1.00 LS**		**172,067.17**	**27,949.17**	**2,809.83**			**202,826.17**	**202,826**	**405,744**
								05-00 Metals	**1.00 LS**		**172,067.17**	**27,949.17**	**2,809.83**			**202,826.17**	**202,826**	**405,744**
			07-00					**Thermal & Moisture Protection**										
				RW				**RECYCLED WATER**										
					07-00-03-00			**Thermal & Moisture Protection, Insulation**										
	07					r07211.310	1940	Extruded polystyrene insulation, rigid, for walls, 25 PSI compressive strength, 2" thick, R10	5,800.00 sf	CARP1	1.05	0.61	-	-	-	1.66	9,603	19,210
	07					r07221.610	1745	Polyisocyanurate Insulation, for roof decks, 3" thick, 2#/CF density	4,200.00 sf	ROFC1	1.22	0.29	-	-	-	1.51	6,338	12,678
								07-00-03-00 Thermal & Moisture Protection, Insulation	**1.00 LS**		**11,214.00**	**4,726.75**				**15,940.75**	**15,941**	**31,889**
					07-00-05-00			**Thermal & Moisture Protection, Metal Roofing**										
	07					r07411.320	0745	Steel roofing panels, on steel frame, flat profile, standard finish, 1-3/4" standing seams, 12" wide, 24 gauge	4,200.00 sf	G3	5.45	1.84	-	-	-	7.29	30,617	61,249
								07-00-05-00 Thermal & Moisture Protection, Metal Roofing	**1.00 LS**		**22,890.00**	**7,727.32**				**30,617.32**	**30,617**	**61,249**
					07-00-99-00			**Thermal & Moisture Protection, Other**										
	07					r07651.010	9000	Wall Cap, Sheet metal flashing, stainless steel, flexible sheets, .015" thick, 28 gauge, including up to 4 bends	666.00 sf	ROFC1	5.65	2.43	-	-	-	8.08	5,378	10,758
								07-00-99-00 Thermal & Moisture Protection, Other	**1.00 LS**		**3,762.90**	**1,615.12**				**5,378.02**	**5,378**	**10,758**
								RW RECYCLED WATER	**1.00 LS**		**37,866.90**	**14,069.19**				**51,936.09**	**51,936**	**103,896**
								07-00 Thermal & Moisture Protection	**1.00 LS**		**37,866.90**	**14,069.19**				**51,936.09**	**51,936**	**103,896**
			08-00					**Openings**										
				RW				**RECYCLED WATER**										
					08-00-01-00			**Openings, Doors, Windows & Hardware**										
	08					r08121.313	0100	Frames, steel, knock down, hollow metal, single, 16 ga., up to 5-3/4" deep, 7'-0" h x 3'-0" w	4.00 ea	CARP2	149.00	55.27	-	-	-	204.27	817	1,634
	08					r08121.313	0140	Frames, steel, knock down, hollow metal, double, 16 ga., up to 5-3/4" deep, 7'-0" h x 6'-0" w	1.00 ea	CARP2	194.00	63.16	-	-	-	257.16	257	514
	08					r08131.313	0400	Doors, commercial, steel, flush, half glass, hollow core, hollow metal, 20 ga., 3'-0" x 7'-0"	5.00 ea	CARP2	620.00	52.01	-	-	-	672.01	3,360	6,722
	08					r08131.313	0640	Doors, commercial, steel, flush, full panel, hollow core, hollow metal, 20 ga., 3'-0" x 7'-0" x 1-3/4" thick	1.00 ea	CARP2	435.00	52.01	-	-	-	487.01	487	974
	08					r08332.310	2500	Doors, rolling service, steel, manual, fire, class A, 20 gauge, 16' x 16' high, incl. hardware	1.00 ea	SSWK2	3,525.00	1,643.95	-	-	-	5,168.95	5,169	10,340
	08					r08332.310	3300	Doors, rolling service, steel, manual, for enamel finish, add	512.00 sf		1.75	-	-	-	-	1.75	896	1,792
	08					r08332.310	4000	Doors, rolling service, steel, manual, for weatherstripping, extruded rubber, jambs, add	32.00 lf		13.50	-	-	-	-	13.50	432	864
	08					r08332.310	4100	Doors, rolling service, steel, manual, for weatherstripping, hood, extruded rubber, add	16.00 lf		8.30	-	-	-	-	8.30	133	266
	08					r08332.310	4200	Doors, rolling service, steel, manual, for weatherstripping, sill, extruded rubber, add	16.00 lf		4.77	-	-	-	-	4.77	76	153
	08					r08332.310	4500	Doors, rolling service, steel, manual, motor operators for, to 16' x 16' opening	1.00 ea	SSWK2	1,075.00	197.27	-	-	-	1,272.27	1,272	2,545
	08					r08712.015	2250	Door hardware, industrial, single, exterior, incl. lever, panic device	4.00 door	CARP1	1,325.00	147.37	-	-	-	1,472.37	5,889	11,782
	08					r08712.015	5000	Average, door hardware, interior passage, single	2.00 set	CARP1	107.00	18.24	-	-	-	125.24	250	501
	08					r08712.065	0011	Thresholds, aluminum, 3' long door saddles	12.00 lf	CARP1	6.65	9.21	-	-	-	15.86	190	381
	08					r08712.095	0020	Door hardware, kick plate, stainless steel, .05", 16 ga, 8" x 28"	8.00 ea	CARP1	35.00	29.47	-	-	-	64.47	516	1,032
	08					r08712.510	2300	Weatherstripping, doors, metal frame, spring type, bronze, for 3' x 7' door	2.00 opng	CARP1	46.50	147.37	-	-	-	193.87	388	776

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					08-00-01-00			Openings, Doors, Windows & Hardware										
	08					r08712.510	2400	Weatherstripping, doors, metal frame, spring type, bronze, for 6' x 7' door	1.00 opng	CARP1	52.00	176.84	-	-	-	228.84	229	458
	08					r08811.010	3300	Float Glass, tempered, clear, 3/4" thick	31.25 sf	GLAZ2	40.50	24.39	-	-	-	64.89	2,028	4,056
								08-00-01-00 Openings, Doors, Windows & Hardware	1.00 LS		17,746.55	4,643.45				22,390.00	22,390	44,790
								RW RECYCLED WATER	**1.00 LS**		**17,746.55**	**4,643.45**				**22,390.00**	**22,390**	**44,790**
								08-00 Openings	1.00 LS		17,746.55	4,643.45				22,390.00	22,390	44,790
			09-00					Finishes										
				RW				**RECYCLED WATER**										
					09-00-01-00			Finishes, Building Finishes										
	09					09910.000	----	Coatings & Finishes	1.00 ls		-	-	-	25,000.00	-	25,000.00	25,000	50,011
								09-00-01-00 Finishes, Building Finishes	1.00 LS					25,000.00		25,000.00	25,000	50,011
								RW RECYCLED WATER	**1.00 LS**					**25,000.00**		**25,000.00**	**25,000**	**50,011**
								09-00 Finishes	1.00 LS					25,000.00		25,000.00	25,000	50,011
			10-00					Specialties										
				RW				**RECYCLED WATER**										
					10-00-05-00			Specialties Fire Protection Specialties										
	10					r10441.613	2080	Fire extinguishers, dry chemical, pressurized, ABC all purpose type, portable, 9-1/2 lb	6.00 ea		44.00	-	-	-	-	44.00	264	528
	10					r10441.613	9420	Fire extinguishers, installation of extinguishers, on masonry or concrete, 12 or more	6.00 ea	CARP1	-	29.47	-	-	-	29.47	177	354
								10-00-05-00 Specialties Fire Protection Specialties	1.00 LS		264.00	176.84				440.84	441	882
					10-00-07-00			Specialties Toilet & Bath Accessories										
	10					r10281.313	1000	Toilet Accessories, grab bars, straight, stainless steel, 30" long	1.00 ea	CARP1	31.50	20.10	-	-	-	51.60	52	103
	10					r10281.313	1100	Toilet Accessories, grab bars, straight, stainless steel, 36" long	1.00 ea	CARP1	38.50	22.11	-	-	-	60.61	61	121
	10					r10281.313	2400	Toilet Accessories, hand dryer, surface mounted, electric, 230 volt, 10 amp	1.00 ea	CARP1	745.00	110.53	-	-	-	855.53	856	1,711
	10					r10281.313	3200	Toilet Accessories, mirror, 48" x 24", with stainless steel 3/4" square frame	1.00 ea	CARP1	146.00	44.21	-	-	-	190.21	190	381
	10					r10281.313	4300	Toilet Accessories, robe hook, regular, single	4.00 ea	CARP1	18.10	12.28	-	-	-	30.38	122	243
	10					r10281.313	4600	Toilet Accessories, soap dispenser, chrome, surface mounted, liquid	1.00 ea	CARP1	46.50	22.11	-	-	-	68.61	69	137
	10					r10281.313	6050	Toilet Accessories, toilet seat cover dispenser, stainless steel, surface mounted	1.00 ea	CARP1	34.00	29.47	-	-	-	63.47	63	127
	10					r10281.313	6200	Toilet Accessories, toilet tissue dispenser, stainless steel, surface mounted, double roll	1.00 ea	CARP1	23.50	18.42	-	-	-	41.92	42	84
	10					r10281.313	6500	Toilet Accessories, towel bar, stainless steel, 30" long	2.00 ea	CARP1	111.00	21.06	-	-	-	132.06	264	528
	10					r10281.313	6700	Toilet Accessories, towel dispenser, stainless steel, surface mounted	1.00 ea	CARP1	44.50	27.63	-	-	-	72.13	72	144
	10					r10281.313	8000	Toilet Accessories, waste receptacle, stainless steel, w/top, 13 gallon	1.00 ea	CARP1	295.00	44.21	-	-	-	339.21	339	679
								10-00-07-00 Specialties Toilet & Bath Accessories	1.00 LS		1,698.90	430.02				2,128.92	2,129	4,259
								RW RECYCLED WATER	**1.00 LS**		**1,962.90**	**606.86**				**2,569.76**	**2,570**	**5,141**
								10-00 Specialties	1.00 LS		1,962.90	606.86				2,569.76	2,570	5,141
			22-00					Plumbing										
				RW				**RECYCLED WATER**										
					22-00-01-00			Mechanical, Plumbing										
	22					15100.905	----	Facility Washdowns, Drainage System, Etc.	1.00 ls	Pipe 61	25,000.00	13,926.20	-	-	-	38,926.20	38,926	77,870
								22-00-01-00 Mechanical, Plumbing	1.00 LS		25,000.00	13,926.20				38,926.20	38,926	77,870
								RW RECYCLED WATER	**1.00 LS**		**25,000.00**	**13,926.20**				**38,926.20**	**38,926**	**77,870**
								22-00 Plumbing	1.00 LS		25,000.00	13,926.20				38,926.20	38,926	77,870
			23-00					HVAC										
				RW				**RECYCLED WATER**										
					23-00-02-00			Mechanical, HVAC										
	23					r23341.410	----	Pump Room HVAC (M & S Sect 44)	3,283.00 sf		-	-	-	21.50	-	21.50	70,585	141,201
	23					r23341.410	----	Electrical Room HVAC (M & S Sect 44)	804.00 sf		-	-	-	21.50	-	21.50	17,286	34,580
								23-00-02-00 Mechanical, HVAC	1.00 LS					87,870.50		87,870.50	87,871	175,781
								RW RECYCLED WATER	**1.00 LS**					**87,870.50**		**87,870.50**	**87,871**	**175,781**
								23-00 HVAC	1.00 LS					87,870.50		87,870.50	87,871	175,781
			41-00					Material Handling										
				RW				**RECYCLED WATER**										
					41-00-02-01			Material Handling, Bridge Cranes										
	41					r41221.310	0200	Crane Rail, box beam bridge, running track only, 104 lb per yard, excl. equipment	4,646.00 lb	E4	0.65	0.36	0.02	-	-	1.03	4,761	9,525

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					41-00-02-01			**Material Handling, Bridge Cranes**										
	41					r41221.313	0525	Overhead Bridge Cranes, under hung hoist, electric operating, 2 girder, 5 ton, 48' span	1.00 ea	M4	48,400.00	4,877.57	65.32	-	-	53,342.89	53,343	106,710
								41-00-02-01 Material Handling, Bridge Cranes	**1.00 EA**		**51,419.90**	**6,529.40**	**155.01**			**58,104.31**	**58,104**	**116,235**
								RW RECYCLED WATER	**1.00 LS**		**51,419.90**	**6,529.40**	**155.01**			**58,104.31**	**58,104**	**116,235**
								41-00 Material Handling	**1.00 LS**		**51,419.90**	**6,529.40**	**155.01**			**58,104.31**	**58,104**	**116,235**
								13.0 Buildings Complete	**1.00 LS**		**427,577.78**	**285,562.99**	**4,066.70**	**112,870.50**		**830,077.97**	**830,078**	**1,660,532**
		21.0						**Mechanical Work**										
			22-00					**Plumbing**										
				RW				**RECYCLED WATER**										
					22-00-01-00			**Mechanical, Plumbing**										
	22					r22411.340	1100	Water closet, tank type, vitreous china, floor mounted, close coupled, two piece, includes seat, supply pipe with stop, ADA	1.00 ea	Q1	230.00	172.60	-	-	-	402.60	403	805
	22					r22411.340	1980	Water closet, tank type, vitreous china, floor mounted, rough-in, supply, waste and vent, one piece	1.00 ea	Q1	320.00	299.92	-	-	-	619.92	620	1,240
	22					r22411.344	0720	Toilet seat, molded wood, white, regular bowl, closed front, square back, includes cover	1.00 ea	PLUM1	10.90	22.88	-	-	-	33.78	34	68
	22					r22411.610	1900	Lavatory, vanity top, stainless steel, self-rimming, ledge, single bowl, 25" x 22", includes trim	1.00 ea	Q1	360.00	142.93	-	-	-	502.93	503	1,006
	22					r22411.610	6960	Lavatory, wall hung, rough-in, supply, waste and vent	1.00 ea	Q1	480.00	551.06	-	-	-	1,031.06	1,031	2,063
	22					r22413.910	2290	Faucets/fittings, lavatory faucet, center set with single control lever handle, polished chrome, with pop-up drain	1.00 ea	PLUM1	188.00	82.44	-	-	-	270.44	270	541
	22					r22421.330	3120	Urinal, wall hung, vitreous china, with hanger & self-closing valve, blowout type	1.00 ea	Q1	430.00	304.92	-	-	-	734.92	735	1,470
	22					r22423.910	0860	Faucets/fittings, flush valves, with vacuum breaker, water closet, exposed rear spud	1.00 ea	PLUM1	137.00	68.63	-	-	-	205.63	206	411
	22					r22423.910	0930	Faucets/fittings, flush valve, urinal, exposed stall	1.00 ea	PLUM1	126.00	68.63	-	-	-	194.63	195	389
								22-00-01-00 Mechanical, Plumbing	**1.00 LS**		**2,281.90**	**1,714.01**				**3,995.91**	**3,996**	**7,994**
								RW RECYCLED WATER	**1.00 LS**		**2,281.90**	**1,714.01**				**3,995.91**	**3,996**	**7,994**
								22-00 Plumbing	**1.00 LS**		**2,281.90**	**1,714.01**				**3,995.91**	**3,996**	**7,994**
								21.0 Mechanical Work	**1.00 LS**		**2,281.90**	**1,714.01**				**3,995.91**	**3,996**	**7,994**
		26.0						**Electrical Work**										
			26-00					**Electrical**										
				RW				**RECYCLED WATER**										
					26-15-11-00			**Process Electrical, Grounding**										
	26					r26052.680	0100	Grounding rod, copper clad, 10' long, 3/4" diameter	10.00 ea	ELEC1	38.50	117.30	-	-	-	155.80	1,558	3,117
	26					r26052.680	1000	Ground wire, copper wire, bare stranded, 4/0	4.00 clf	ELEC2	425.00	181.09	-	-	-	606.09	2,424	4,850
	26					r26052.680	2730	Exothermic weld, 4/0 wire to 1" ground rod	10.00 ea	ELEC1	11.45	73.73	-	-	-	85.18	852	1,704
	26					r26052.680	2740	Exothermic weld, to building steel, 4/0 wire	12.00 ea	ELEC1	9.15	73.73	-	-	-	82.88	995	1,990
	26					r26052.680	2760	Exothermic weld, 4/0 wire to 4/0 wire	12.00 ea	ELEC1	7.95	73.73	-	-	-	81.68	980	1,961
	26					r26052.680	5320	Protective boxes at grade level, round, fiberlyte, 12" long, incl breather slots	4.00 ea	ELEC1	64.00	16.13	-	-	-	80.13	321	641
								26-15-11-00 Process Electrical, Grounding	**1.00 LS**		**2,660.70**	**4,468.70**				**7,129.40**	**7,129**	**14,262**
					26-20-01-00			**Facility Electrical, Complete $/SF Cost**										
	26					r26050.535	----	Electrical & Lighting - Pump Room	3,283.00 sf		-	-	-	15.53	-	15.53	50,985	101,993
	26					r26050.535	----	Electrical & Lighting - Electrical Room	804.00 sf		-	-	-	15.53	-	15.53	12,486	24,978
								26-20-01-00 Facility Electrical, Complete $/SF Cost	**1.00 LS**					**63,471.11**		**63,471.11**	**63,471**	**126,971**
					26-25-03-00			**Electrical Equipment, Switchgear - General**										
	26					r26131.610	----	Switchgear, MCC's, Panels, Etc.	1.00 ls		-	-	-	200,000.00	-	200,000.00	200,000	400,090
								26-25-03-00 Electrical Equipment, Switchgear - General	**1.00 LS**					**200,000.00**		**200,000.00**	**200,000**	**400,090**
								RW RECYCLED WATER	**1.00 LS**		**2,660.70**	**4,468.70**		**263,471.11**		**270,600.51**	**270,601**	**541,323**
								26-00 Electrical	**1.00 LS**		**2,660.70**	**4,468.70**		**263,471.11**		**270,600.51**	**270,601**	**541,323**
								26.0 Electrical Work	**1.00 LS**		**2,660.70**	**4,468.70**		**263,471.11**		**270,600.51**	**270,601**	**541,323**
		31.0						**Site/Civil**										
			03-10					**Cast-In-Place Concrete Work**										
				RW				**RECYCLED WATER**										
					03-10-02-12			**Cast-In-Place Concrete, Continuous Footings, 12" thick**										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					03-10-02-12			**Cast-In-Place Concrete, Continuous Footings, 12" thick**										
	03					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	3.67 lcy	B6	30.50	7.67	1.84	-	-	40.00	147	293
	03					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	3.67 ecy	A1D	-	3.88	0.29	-	-	4.17	15	31
								03-10-02-12 Cast-In-Place Concrete, Continuous Footings, 12" thick	**3.67 CY**		**30.47**	**11.54**	**2.13**			**44.14**	**162**	**324**
					03-10-02-18			**Cast-In-Place Concrete, Continuous Footings, 18" thick**										
	03					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	19.56 lcy	B6	30.50	7.67	1.84	-	-	40.00	782	1,565
	03					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	19.56 ecy	A1D	-	3.88	0.29	-	-	4.17	82	163
								03-10-02-18 Cast-In-Place Concrete, Continuous Footings, 18" thick	**19.56 CY**		**30.49**	**11.55**	**2.13**			**44.17**	**864**	**1,728**
					03-10-05-08			**Cast-In-Place Concrete, Slabs on Grade, 8" thick**										
	03					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	64.26 lcy	B6	30.50	7.67	1.84	-	-	40.00	2,570	5,142
	03					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	64.26 ecy	A1D	-	3.88	0.29	-	-	4.17	268	536
								03-10-05-08 Cast-In-Place Concrete, Slabs on Grade, 8" thick	**64.26 CY**		**30.50**	**11.55**	**2.13**			**44.17**	**2,839**	**5,678**
					03-10-05-12			**Cast-In-Place Concrete, Slabs on Grade, 12" thick**										
	03					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	10.49 lcy	B6	30.50	7.67	1.84	-	-	40.00	419	839
	03					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	11.98 lcy	B6	30.50	7.66	1.84	-	-	40.00	479	959
	03					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	10.49 ecy	A1D	-	3.88	0.29	-	-	4.17	44	88
	03					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	11.98 ecy	A1D	-	3.88	0.29	-	-	4.17	50	100
								03-10-05-12 Cast-In-Place Concrete, Slabs on Grade, 12" thick	**22.47 CY**		**30.50**	**11.55**	**2.13**			**44.17**	**993**	**1,986**
								RW RECYCLED WATER	**1.00 LS**		**3,353.53**	**1,269.84**	**233.68**			**4,857.05**	**4,857**	**9,716**
								03-10 Cast-In-Place Concrete Work	**1.00 LS**		**3,353.53**	**1,269.84**	**233.68**			**4,857.05**	**4,857**	**9,716**
			31-17					**Piling and Caissons**										
				RW				**RECYCLED WATER**										
					31-17-02-00			**Earthworks, Caissons**										
	31					r31632.613	0200	Fixd end cssn pils,open styl stbl grnd,50'd,24"dm,0.116 cy/lf, machn drlld,incld excvt,cncrt,50lb rnfr/, excld mblzt,bldr remvl,dspsl,csngs grnd water	840.00 vlf	B43	14.15	12.18	9.75	-	-	36.08	30,304	60,621
								31-17-02-00 Earthworks, Caissons	**1.00 LS**		**11,886.00**	**10,229.97**	**8,187.61**			**30,303.58**	**30,304**	**60,621**
								RW RECYCLED WATER	**1.00 LS**		**11,886.00**	**10,229.97**	**8,187.61**			**30,303.58**	**30,304**	**60,621**
								31-17 Piling and Caissons	**1.00 LS**		**11,886.00**	**10,229.97**	**8,187.61**			**30,303.58**	**30,304**	**60,621**
								31.0 Site/Civil	**1.00 LS**		**15,239.53**	**11,499.81**	**8,421.29**			**35,160.63**	**35,161**	**70,337**
		40.0						**Process Piping**										
			40-00					**Process Pipe - Furnish and Install**										
				RW				**RECYCLED WATER**										
					40-10-01-10			**Process Pipe, Ductile Iron, 10"**										
	40					09870.020	0100	Paint process pipe and fittings, subcontracted, priced per LF, 10" dia.	12.00 lf		-	-	-	13.50	-	13.50	162	324
	40					15205.070	0010	FURNISH 10" DI pipe	8.00 lf		25.20	-	-	-	-	25.20	202	403
	40					15205.070	0030	Install 10" DI, flanged, spool <= 10'	8.00 ea	Pipe 51	-	331.93	-	-	-	331.93	2,655	5,312
	40					15205.070	5100	FURNISH 10" DI flange	12.00 ea		145.08	-	-	-	-	145.08	1,741	3,483
	40					15205.085	0020	10" DI, mechanical coupling	4.00 ea	Pipe 51	100.00	206.60	-	-	-	306.60	1,226	2,453
	40					15290.060	0120	10" Bolt & Gasket Kits, CS, 150#	8.00 ea	Pipe 51	18.00	151.51	-	-	-	169.51	1,356	2,713
								40-10-01-10 Process Pipe, Ductile Iron, 10"	**8.00 LF**		**310.82**	**586.74**		**20.25**		**917.81**	**7,342**	**14,688**
					40-10-01-12			**Process Pipe, Ductile Iron, 12"**										
	40					09870.020	0110	Paint process pipe and fittings, subcontracted, priced per LF, 12" dia.	175.00 lf		-	-	-	18.00	-	18.00	3,150	6,301
	40					15205.090	0010	FURNISH 12" DI pipe	115.75 lf		32.13	-	-	-	-	32.13	3,719	7,440
	40					15205.090	0030	Install 12" DI, flanged, spool <= 10'	30.00 ea	Pipe 51	-	378.76	-	-	-	378.76	11,363	22,731
	40					15205.090	0040	Install 12" DI, flanged, spool > 10'	2.00 ea	Pipe 51	-	473.80	-	-	-	473.80	948	1,896

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					40-10-01-12			**Process Pipe, Ductile Iron, 12"**										
	40					15205.090	5100	FURNISH 12" DI flange	85.00 ea		223.20	-	-	-	-	223.20	18,972	37,953
	40					15205.100	1110	12" DI, FL, Ell, 90	8.00 ea	Pipe 51	552.50	378.76	-	-	-	931.26	7,450	14,904
	40					15205.100	1210	12" DI, FL, tee, 12" x 12"	3.00 ea	Pipe 51	688.50	473.80	-	-	-	1,162.30	3,487	6,975
	40					15205.100	1630	12" DI, FL, reducer, 12" x 10"	4.00 ea	Pipe 51	280.50	378.76	-	-	-	659.26	2,637	5,275
	40					15205.105	0020	12" DI, mechanical coupling	4.00 ea	Pipe 51	120.00	241.03	-	-	-	361.03	1,444	2,889
	40					15290.020	6160	Pipe stand support, CS, 12"	14.00 ea	Pipe 51	333.00	206.60	-	-	-	539.60	7,554	15,112
	40					15290.020	7160	Strap at conc. support, CS, 12" - Need Material $	14.00 ea	Pipe 51		51.65	-	-	-	51.65	723	1,447
	40					15290.060	0130	12" Bolt & Gasket Kits, CS, 150#	63.00 ea	Pipe 51	20.00	151.51	-	-	-	171.51	10,805	21,615
	40					15290.070	1055	Wall Sleeve, fabricated steel, 12" long, 16"	1.00 ea	Pipe 51	267.00	206.60	-	-	-	473.60	474	947
	40					15290.070	5055	Link Seal set, 16"	2.00 ea	Pipe 51	134.00	165.28	-	-	-	299.28	599	1,197
	40					15290.090	0010	Pipe Information Labels	15.00 ea	Pipe 51	10.00	11.50	-	-	-	21.50	323	645
								40-10-01-12 Process Pipe, Ductile Iron, 12"	**115.75 LF**		**322.99**	**286.06**		**27.21**		**636.26**	**73,647**	**147,327**
					40-10-01-16			**Process Pipe, Ductile Iron, 16"**										
	40					09870.020	0130	Paint process pipe and fittings, subcontracted, priced per LF, 16" dia.	14.00 lf		-	-	-	22.50	-	22.50	315	630
	40					15205.130	0010	FURNISH 16" DI pipe	10.00 lf		43.07	-	-	-	-	43.07	431	862
	40					15205.130	0030	Install 16" DI, flanged, spool <= 10'	8.00 ea	Pipe 51	-	594.31	-	-	-	594.31	4,755	9,511
	40					15205.130	5100	FURNISH 16" DI flange	12.00 ea		236.98	-	-	-	-	236.98	2,844	5,689
	40					15205.145	0020	16" DI, mechanical coupling	4.00 ea	Pipe 51	160.00	309.90	-	-	-	469.90	1,880	3,760
	40					15290.060	0150	16" Bolt & Gasket Kits, CS, 150#	8.00 ea	Pipe 51	47.00	234.15	-	-	-	281.15	2,249	4,499
								40-10-01-16 Process Pipe, Ductile Iron, 16"	**10.00 LF**		**429.05**	**786.73**		**31.50**		**1,247.27**	**12,473**	**24,951**
					40-10-01-20			**Process Pipe, Ductile Iron, 20"**										
	40					09870.020	0150	Paint process pipe and fittings, subcontracted, priced per LF, 20" dia.	40.00 lf		-	-	-	27.00	-	27.00	1,080	2,160
	40					15205.170	0010	FURNISH 20" DI pipe	28.00 lf		56.64	-	-	-	-	56.64	1,586	3,173
	40					15205.170	0030	Install 20" DI, flanged, spool <= 10'	8.00 ea	Pipe 51	-	690.73	-	-	-	690.73	5,526	11,054
	40					15205.170	5100	FURNISH 20" DI flange	28.00 ea		329.46	-	-	-	-	329.46	9,225	18,454
	40					15205.180	1110	20" DI, FL, Ell, 90	4.00 ea	Pipe 51	2,632.50	690.73	-	-	-	3,323.23	13,293	26,592
	40					15205.180	1645	20" DI, FL, reducer, 20" x 16"	4.00 ea	Pipe 51	1,251.25	690.73	-	-	-	1,941.98	7,768	15,539
	40					15290.020	6200	Pipe stand support, CS, 20"	4.00 ea	Pipe 51	762.00	275.47	-	-	-	1,037.47	4,150	8,302
	40					15290.020	7200	Strap at conc. support, CS, 20" - Need Material $	4.00 ea	Pipe 51		68.87	-	-	-	68.87	275	551
	40					15290.060	0170	20" Bolt & Gasket Kits, CS, 150#	20.00 ea	Pipe 51	80.00	282.35	-	-	-	362.35	7,247	14,497
	40					15290.090	0010	Pipe Information Labels	4.00 ea	Pipe 51	10.00	11.50	-	-	-	21.50	86	172
								40-10-01-20 Process Pipe, Ductile Iron, 20"	**28.00 LF**		**1,108.35**	**647.21**		**38.57**		**1,794.13**	**50,236**	**100,494**
					40-10-01-36			**Process Pipe, Ductile Iron, 36"**										
	40					09870.020	0180	Paint process pipe and fittings, subcontracted, priced per LF, 36" dia.	60.00 lf		-	-	-	45.00	-	45.00	2,700	5,401
	40					09870.020	0180	Paint process pipe and fittings, subcontracted, priced per LF, 36" dia.	40.00 lf		-	-	-	45.00	-	45.00	1,800	3,601
	40					15205.230	0010	FURNISH 36" DI pipe	53.00 lf		130.39	-	-	-	-	130.39	6,911	13,824
	40					15205.230	0010	FURNISH 36" DI pipe	37.00 lf		130.39	-	-	-	-	130.39	4,824	9,651
	40					15205.230	0030	Install 36" DI, flanged, spool <= 10'	6.00 ea	Pipe 51	-	1,245.79	-	-	-	1,245.79	7,475	14,953
	40					15205.230	0030	Install 36" DI, flanged, spool <= 10'	5.00 ea	Pipe 51	-	1,245.79	-	-	-	1,245.79	6,229	12,461
	40					15205.230	0040	Install 36" DI, flanged, spool > 10'	1.00 ea	Pipe 51	-	1,557.06	-	-	-	1,557.06	1,557	3,115
	40					15205.230	5100	FURNISH 36" DI flange	28.00 ea		1,512.57	-	-	-	-	1,512.57	42,352	84,723
	40					15205.230	5100	FURNISH 36" DI flange	23.00 ea		1,512.57	-	-	-	-	1,512.57	34,789	69,594
	40					15205.240	1235	36" DI, FL, tee, red, 36" x 12"	1.00 ea	Pipe 51	5,967.50	1,557.06	-	-	-	7,524.56	7,525	15,053
	40					15205.240	1235	36" DI, FL, tee, red, 36" x 12"	5.00 ea	Pipe 51	5,967.50	1,557.06	-	-	-	7,524.56	37,623	75,263
	40					15205.240	1255	36" DI, FL, tee, red, 36" x 20"	4.00 ea	Pipe 51	6,091.25	1,557.06	-	-	-	7,648.31	30,593	61,200
	40					15205.240	1510	36" DI, FL, blind flange	1.00 ea	Pipe 51	3,388.00	1,163.15	-	-	-	4,551.15	4,551	9,104
	40					15205.240	5005	Wall Pipe, DI, FLxFL, 36"	2.00 ea	Pipe 51	1,997.00	309.90	-	-	-	2,306.90	4,614	9,230
	40					15205.240	5005	Wall Pipe, DI, FLxFL, 36"	1.00 ea	Pipe 51	1,997.00	309.90	-	-	-	2,306.90	2,307	4,615
	40					15290.020	6230	Fabricated pipe stand support, CS, 36" - Verify Material $	6.00 ea	Pipe 51	1,819.00	344.33	-	-	-	2,163.33	12,980	25,966
	40					15290.020	6230	Fabricated pipe stand support, CS, 36" - Verify Material $	5.00 ea	Pipe 51	1,819.00	344.33	-	-	-	2,163.33	10,817	21,638
	40					15290.020	7230	Strap at conc. support, CS, 36" - Need Material $	6.00 ea	Pipe 51		68.87	-	-	-	68.87	413	827
	40					15290.020	7230	Strap at conc. support, CS, 36" - Need Material $	5.00 ea	Pipe 51		68.87	-	-	-	68.87	344	689
	40					15290.060	0200	36" Bolt & Gasket Kits, CS, 150#	14.00 ea	Pipe 51	280.00	592.25	-	-	-	872.25	12,211	24,428
	40					15290.060	0200	36" Bolt & Gasket Kits, CS, 150#	13.00 ea	Pipe 51	280.00	592.25	-	-	-	872.25	11,339	22,684
	40					15290.090	0010	Pipe Information Labels	4.00 ea	Pipe 51	10.00	11.50	-	-	-	21.50	86	172
	40					15290.090	0010	Pipe Information Labels	4.00 ea	Pipe 51	10.00	11.50	-	-	-	21.50	86	172
								40-10-01-36 Process Pipe, Ductile Iron, 36"	**90.00 LF**		**2,067.49**	**595.02**		**50.00**		**2,712.51**	**244,126**	**488,363**
					40-10-02-01			**Process Pipe, Carbon Steel, 1/2" to 1"**										
	40					r22052.320	3450	Valves, bronze, gate, non-rising stem, threaded, class 150, 1"	4.00 ea	PLUM1	99.50	28.90	-	-	-	128.40	514	1,027

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					40-10-02-01			Process Pipe, Carbon Steel, 1/2" to 1"										
	40					r22111.345	4814	Nipple, steel, galvanized, threaded, standard weight, 1" x 4" long	8.00 ea	PLUM1	4.49	36.60	-	-	-	41.09	329	658
								40-10-02-01 Process Pipe, Carbon Steel, 1/2" to 1"	4.00 EA		108.48	102.10				210.58	842	1,685
					40-10-03-01			Process Pipe, Stainless Steel, 1/2" to 1"										
	40					r22111.366	7500	Short nipple, stainless steel, straight, threaded, 150 lb., 1/2", type 316	26.00 ea	PLUM1	19.30	28.90	-	-	-	48.20	1,253	2,507
	40					r23052.390	1630	Valves, stainless steel, ball, threaded, 1/2"	13.00 ea	STPI1	47.00	25.36	-	-	-	72.36	941	1,882
								40-10-03-01 Process Pipe, Stainless Steel, 1/2" to 1"	13.00 EA		85.60	83.15				168.75	2,194	4,389
					40-20-01-12			Gate Valves, 12"										
	40					15300.020	0160	Install gate valve, Flgd, DIP, 12"	3.00 ea	Pipe 51	-	413.20	-	-	-	413.20	1,240	2,480
	40					15300.020	3060	FURNISH Gate valve, iron body, dbl disk, Flgd, 150#, HWO, 12"	3.00 ea		750.00	-	-	-	-	750.00	2,250	4,501
								40-20-01-12 Gate Valves, 12"	3.00 EA		750.00	413.20				1,163.20	3,490	6,981
					40-20-01-20			Gate Valves, 20"										
	40					15300.020	0200	Install gate valve, Flgd, DIP, 20"	4.00 ea	Pipe 51	-	723.09	-	-	-	723.09	2,892	5,786
	40					15300.020	3100	FURNISH Gate valve, iron body, dbl disk, Flgd, 150#, HWO, 20"	4.00 ea		7,500.00	-	-	-	-	7,500.00	30,000	60,014
								40-20-01-20 Gate Valves, 20"	4.00 EA		7,500.00	723.09				8,223.09	32,892	65,800
					40-20-01-36			Gate Valves, 36"										
	40					15300.020	0230	Install gate valve, Flgd, DIP, 36"	2.00 ea	Pipe 51	-	1,129.40	-	-	-	1,129.40	2,259	4,519
	40					15300.020	3130	FURNISH Gate valve, iron body, dbl disk, Flgd, 150#, HWO, 36"	2.00 ea		27,500.00	-	-	-	-	27,500.00	55,000	110,025
								40-20-01-36 Gate Valves, 36"	2.00 EA		27,500.00	1,129.40				28,629.40	57,259	114,544
					40-20-04-12			Ball Valves, 12"										
	40					15300.040	0220	Install ball valve, Flgd, DIP, 12"	5.00 ea	Pipe 51	-	413.20	-	-	-	413.20	2,066	4,133
	40					15300.040	2130	FURNISH Ball valve, AWWA C-507, CS body, Flgd, 150#, 12" w/Elect Op	5.00 ea		7,650.00	-	-	-	-	7,650.00	38,250	76,517
								40-20-04-12 Ball Valves, 12"	5.00 EA		7,650.00	413.20				8,063.20	40,316	80,650
					40-20-08-12			Ball Check Valves, 12"										
	40					15300.080	0160	Install check valve, Flgd, DIP, 12"	4.00 ea	Pipe 51	-	413.20	-	-	-	413.20	1,653	3,306
	40					15300.080	3660	FURNISH Check valve, iron body, ball, Flgd, 150#, 12"	4.00 ea		2,088.00	-	-	-	-	2,088.00	8,352	16,708
								40-20-08-12 Ball Check Valves, 12"	4.00 EA		2,088.00	413.20				2,501.20	10,005	20,014
					40-20-10-01			Air and Vacuum Relief Valves, 1/2" to 1"										
	40					09870.020	0030	Paint process pipe and fittings, subcontracted, priced per LF, 1" dia.	8.00 lf		-	-	-	4.50	-	4.50	36	72
	40					15213.610	1130	Ball valve, bronze, screwed, 1"	8.00 ea	Pipe 51	5.20	27.55	-	-	-	32.75	262	524
	40					r22052.320	5650	Valves, bronze, relief, pressure & temperature, self-closing, threaded, 1", ASME	8.00 ea	PLUM1	236.00	22.88	-	-	-	258.88	2,071	4,143
	40					r22111.345	4814	Nipple, steel, galvanized, threaded, standard weight, 1" x 4" long	16.00 ea	PLUM1	4.49	36.60	-	-	-	41.09	657	1,315
								40-20-10-01 Air and Vacuum Relief Valves, 1/2" to 1"	8.00 EA		250.18	123.63		4.50		378.31	3,026	6,054
					40-20-13-12			Pressure Relief Valves, 12"										
	40					15300.185	0160	Install Pressure Relief Control Valve, 12" (300mm)	1.00 ea	Pipe 51	-	1,652.78	-	-	-	1,652.78	1,653	3,306
	40					15300.185	1160	FURNISH Pressure Relief Control Valve, 12" (300mm)	1.00 ea		17,500.00	-	-	-	-	17,500.00	17,500	35,008
								40-20-13-12 Pressure Relief Valves, 12"	1.00 EA		17,500.00	1,652.78				19,152.78	19,153	38,314
								RW RECYCLED WATER	1.00 LS		416,170.70	131,586.95		9,243.00		557,000.65	557,001	1,114,253
								40-00 Process Pipe - Furnish and Install	1.00 LS		416,170.70	131,586.95		9,243.00		557,000.65	557,001	1,114,253
			40-90					Instrumentation & Controls										
				RW				RECYCLED WATER										
					40-90-01-03			I&C, Flow / Indicators & Transmitters, Non MAG										
	40					17001.050	0070	Venturi Flow Meter, 12" Flgd	5.00 ea	Pipe 51	6,000.00	1,239.59	-	-	-	7,239.59	36,198	72,412
	40					17121.000	0070	Flow Meter: Electrical Hookup Only, 12"	5.00 ea	Instr 01	-	605.06	-	-	-	605.06	3,025	6,052
	40					17210.100	2020	Field Calibration - Simple	5.00 ea	Instr 01		31.85	-	-	-	31.85	159	319
								40-90-01-03 I&C, Flow / Indicators & Transmitters, Non MAG	5.00 LS		6,000.00	1,876.50				7,876.50	39,382	78,783
								RW RECYCLED WATER	1.00 LS		30,000.00	9,382.49				39,382.49	39,382	78,783
								40-90 Instrumentation & Controls	1.00 LS		30,000.00	9,382.49				39,382.49	39,382	78,783
								40.0 Process Piping	1.00 LS		446,170.70	140,969.44		9,243.00		596,383.14	596,383	1,193,036
		40.9						Instrumentation & Controls										
			40-90					Instrumentation & Controls										
				RW				RECYCLED WATER										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					40-90-01-01			**I&C, Analyzers / Analyzers Transmitters**										
	40					17115.000	0151	AT / AIT - Analyzer Transmitter - Chlorine	1.00 ea	Q1	9,000.00	343.04		-	-	9,343.04	9,343	18,690
								40-90-01-01 I&C, Analyzers / Analyzers Transmitters	**1.00 EA**		**9,000.00**	**343.04**				**9,343.04**	**9,343**	**18,690**
					40-90-01-09			**I&C, Pressure / Indicators & Transmitters**										
	40					17110.000	1601	PE - Pressure Element / Sensor	8.00 ea	Instr 01	275.00	63.69	-	-	-	338.69	2,710	5,420
	40					17120.000	1601	PT / PIT - Pressure Transmitter	1.00 ea	Instr 01	1,100.00	254.76	-	-	-	1,354.76	1,355	2,710
	40					17130.000	1601	PS - Pressure Switch	4.00 ea	Instr 01	850.00	191.07	-	-	-	1,041.07	4,164	8,330
	40					17160.000	1602	PI - Pressure Indicator - Stem Mounted	8.00 ea	Instr 01	120.00	95.54	-	-	-	215.54	1,724	3,449
								40-90-01-09 I&C, Pressure / Indicators & Transmitters	**1.00 LS**		**7,660.00**	**2,292.87**				**9,952.87**	**9,953**	**19,910**
					40-90-99-01			**I&C, Other**										
	40					17010.100	----	Pump Station Control Panel (PSCP-01)	1.00 ea		-	-	-	50,000.00	-	50,000.00	50,000	100,023
	40					17010.100	----	SCADA System	1.00 ls		-	-	-	50,000.00	-	50,000.00	50,000	100,023
								40-90-99-01 I&C, Other	**1.00 EA**					**100,000.00**		**100,000.00**	**100,000**	**200,045**
					44-05-40-24			**Horizontal Split-Case Pump: 101hp-500hp**										
	46					11099.100	1010	Local control panel	4.00 ea	Elec 01	1,500.00	382.15	-	-	-	1,882.15	7,529	15,061
								44-05-40-24 Horizontal Split-Case Pump: 101hp-500hp	**4.00 EA**		**1,500.00**	**382.15**				**1,882.15**	**7,529**	**15,061**
								RW RECYCLED WATER	**1.00 LS**		**22,660.00**	**4,164.49**		**100,000.00**		**126,824.49**	**126,824**	**253,706**
								40-90 Instrumentation & Controls	**1.00 LS**		**22,660.00**	**4,164.49**		**100,000.00**		**126,824.49**	**126,824**	**253,706**
								40.9 Instrumentation & Controls	**1.00 LS**		**22,660.00**	**4,164.49**		**100,000.00**		**126,824.49**	**126,824**	**253,706**
		43.0						**Process Equipment**										
			43-00					**Process Equipment - General Items**										
				RW				**RECYCLED WATER**										
					43-05-36-00			**Expansion Tanks**										
	46					11371.005	----	Hydropneumatic Tank w/Air Compressor System	1.00 ls	Q22A		6,542.40	2,408.07	-	100,000.00	108,950.47	108,950	217,950
								43-05-36-00 Expansion Tanks	**1.00 LS**			**6,542.40**	**2,408.07**		**100,000.00**	**108,950.47**	**108,950**	**217,950**
					44-05-40-24			**Horizontal Split-Case Pump: 101hp-500hp**										
	46					11001.400	0040	Functional Testing, Pumps, 101-500 hp	4.00 ea	Equip 01	100.00	226.38	-	-	-	326.38	1,306	2,552
	46					11001.400	1040	Align Pump & Motor, 101-500 hp	4.00 ea	Equip 01	-	339.57	-	1,050.00	-	1,389.57	5,558	11,119
	46					11001.400	2040	Vibration Testing, Pumps, 101-500 hp	4.00 ea	Equip 01	-	113.19	-	350.00	-	463.19	1,853	3,706
	46					11001.400	3010	Witnessed factory test	4.00 ea		-	-	-	500.00		500.00	2,000	4,001
	46					11099.200	0020	Sleeved anchor bolts - Medium	32.00 ea	Equip 01	21.00	19.81	-	-	-	40.81	1,306	2,511
	46					11099.300	0010	Non-Shrink Machine Grout	32.00 cuft	Equip 01	74.00	53.76	-	-	-	127.76	4,088	7,824
	46					11099.600	0140	Grease, Oil, and Lube Pumps, 101-500 hp	4.00 ea	Equip 01	75.00	226.38	-	-	-	301.38	1,206	2,367
								44-05-40-24 Horizontal Split-Case Pump: 101hp-500hp	**4.00 EA**		**935.00**	**1,494.08**		**1,900.00**		**4,329.08**	**17,316**	**34,079**
					44-05-49-00			**Submersible Pump: 1hp- 5hp**										
	46					11001.400	0110	Functional Testing, Submersible Pumps, 1 - 5 hp	4.00 ea	Equip 01	50.00	226.38	-	-	-	276.38	1,106	2,181
	46					11099.100	1020	System panel	2.00 ea	Equip 01	6,000.00	452.75	-	-	-	6,452.75	12,906	24,017
	46					11099.100	3010	Float switch	16.00 ea	Equip 01	-	113.19	-	-	-	113.19	1,811	3,623
	46					11099.100	3020	Float switch bracket	4.00 ea	Equip 01	150.00	226.38	-	-	-	376.38	1,506	2,922
	46					11099.100	4010	Pump check valve @ 2.5 mh per pump	4.00 ea	Equip 01	-	141.49	-	-	-	141.49	566	1,132
	46					11212.050	0010	FURNISH Submersible Pump, 1 - 5 hp	4.00 EA			-	-	-	2,500.00	2,500.00	10,000	20,005
	46					11212.050	1010	Set base elbow / pump assembly, 1 - 5 hp	4.00 ea	Equip 01	50.00	905.51	-	-	-	955.51	3,822	7,616
	46					11212.050	1140	Install upper guide rail bracket	4.00 ea	Equip 01	10.00	84.89	-	-	-	94.89	380	753
								44-05-49-00 Submersible Pump: 1hp-5hp	**4.00 EA**		**3,260.00**	**2,263.76**			**2,500.00**	**8,023.76**	**32,095**	**62,249**
								RW RECYCLED WATER	**1.00 LS**		**16,780.00**	**21,573.75**	**2,408.07**	**7,600.00**	**110,000.00**	**158,361.82**	**158,362**	**314,278**
								43-00 Process Equipment - General Items	**1.00 LS**		**16,780.00**	**21,573.75**	**2,408.07**	**7,600.00**	**110,000.00**	**158,361.82**	**158,362**	**314,278**
			43-05					**Furnish and Install Process Equipment**										
				RW				**RECYCLED WATER**										
					44-05-40-24			**Horizontal Split-Case Pump: 101hp-500hp**										
	46					11212.020	0040	FURNISH Horizontal Split-Case Pump, 101 - 500 hp	4.00 EA			-	-	-	100,000.00	100,000.00	400,000	800,181
	46					11212.020	1040	Set pump assembly, 101 - 500 hp	4.00 ea	Equip 01	50.00	3,395.64	-	-	-	3,445.64	13,783	27,541
								44-05-40-24 Horizontal Split-Case Pump: 101hp-500hp	**4.00 EA**		**50.00**	**3,395.64**			**100,000.00**	**103,445.64**	**413,783**	**827,722**
								RW RECYCLED WATER	**1.00 LS**		**200.00**	**13,582.56**			**400,000.00**	**413,782.56**	**413,783**	**827,722**
								43-05 Furnish and Install Process Equipment	**1.00 LS**		**200.00**	**13,582.56**			**400,000.00**	**413,782.56**	**413,783**	**827,722**

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
								43.0 Process Equipment	**1.00 LS**		**16,980.00**	**35,156.31**	**2,408.07**	**7,600.00**	**510,000.00**	**572,144.38**	**572,144**	**1,142,001**
								01 Pump Station	**1.00 LS**		**995,759.63**	**562,878.57**	**16,744.54**	**493,184.61**	**510,000.00**	**2,578,567.35**	**2,578,567**	**5,155,755**
02								**Water Storage Tank**										
		26.0						**Electrical Work**										
			26-00					**Electrical**										
				RW				**RECYCLED WATER**										
					26-15-11-00			**Process Electrical, Grounding**										
	26					r26052.680	0100	Grounding rod, copper clad, 10' long, 3/4" diameter	2.00 ea	ELEC1	38.50	117.30	-	-	-	155.80	312	623
	26					r26052.680	1000	Ground wire, copper wire, bare stranded, 4/0	5.00 clf	ELEC2	425.00	181.09	-	-	-	606.09	3,030	6,062
	26					r26052.680	2730	Exothermic weld, 4/0 wire to 1" ground rod	2.00 ea	ELEC1	11.45	73.73	-	-	-	85.18	170	341
	26					r26052.680	2740	Exothermic weld, to building steel, 4/0 wire	4.00 ea	ELEC1	9.15	73.73	-	-	-	82.88	332	663
	26					r26052.680	2760	Exothermic weld, 4/0 wire to 4/0 wire	4.00 ea	ELEC1	7.95	73.73	-	-	-	81.68	327	654
	26					r26052.680	5320	Protective boxes at grade level, round, fiberlyte, 12" long, incl breather slots	1.00 ea	ELEC1	64.00	16.13	-	-	-	80.13	80	160
								26-15-11-00 Process Electrical, Grounding	**1.00 LS**		**2,357.30**	**1,893.49**				**4,250.79**	**4,251**	**8,504**
								RW RECYCLED WATER	**1.00 LS**		**2,357.30**	**1,893.49**				**4,250.79**	**4,251**	**8,504**
								26-00 Electrical	**1.00 LS**		**2,357.30**	**1,893.49**				**4,250.79**	**4,251**	**8,504**
			27-30					**Communications**										
				RW				**RECYCLED WATER**										
					27-30-01-00			**Communications Systems**										
	27					r27411.910	1910	Radio, antenna, 10 mast type	1.00 ea	ELEC1	2,500.00	1,548.34	-	-	-	4,048.34	4,048	8,099
								27-30-01-00 Communications Systems	**1.00 LS**		**2,500.00**	**1,548.34**				**4,048.34**	**4,048**	**8,099**
								RW RECYCLED WATER	**1.00 LS**		**2,500.00**	**1,548.34**				**4,048.34**	**4,048**	**8,099**
								27-30 Communications	**1.00 LS**		**2,500.00**	**1,548.34**				**4,048.34**	**4,048**	**8,099**
								26.0 Electrical Work	**1.00 LS**		**4,857.30**	**3,441.83**				**8,299.13**	**8,299**	**16,602**
		31.0						**Site/Civil**										
			31-17					**Piling and Caissons**										
				RW				**RECYCLED WATER**										
					31-17-02-00			**Earthworks, Caissons**										
	31					r31632.613	0200	Fixd end cssn pils,open styl stbl grnd,50'd,24"dm,0.116 cy/lf, machn drlld,incld excvt,cncrt,50lb rnfr/, excld mblzt,bldr remvl,dspsl,csngs grnd water	1,760.00 vlf	B43	14.15	12.18	9.75	-	-	36.08	63,493	127,015
								31-17-02-00 Earthworks, Caissons	**1.00 LS**		**24,904.00**	**21,434.22**	**17,155.00**			**63,493.22**	**63,493**	**127,015**
								RW RECYCLED WATER	**1.00 LS**		**24,904.00**	**21,434.22**	**17,155.00**			**63,493.22**	**63,493**	**127,015**
								31-17 Piling and Caissons	**1.00 LS**		**24,904.00**	**21,434.22**	**17,155.00**			**63,493.22**	**63,493**	**127,015**
								31.0 Site/Civil	**1.00 LS**		**24,904.00**	**21,434.22**	**17,155.00**			**63,493.22**	**63,493**	**127,015**
		33.5						**Tank Construction**										
			33-90					**Tanks**										
				RW				**RECYCLED WATER**										
					33-70-01-01			**Ground Water Storage Tank**										
	33					r33161.313	1600	Aboveground water utility storage tanks, steel, ground level, ht./diam. less than 1, 4,000,000 gallons, incl oundation, excl pumps or piping	1.00 ea		-	-	-	-	1,950,000.00	1,950,000.00	1,950,000	3,608,382
								33-70-01-01 Ground Water Storage Tank	**1.00 LS**						**1,950,000.00**	**1,950,000.00**	**1,950,000**	**3,608,382**
								RW RECYCLED WATER	**1.00 LS**						**1,950,000.00**	**1,950,000.00**	**1,950,000**	**3,608,382**
								33-90 Tanks	**1.00 LS**						**1,950,000.00**	**1,950,000.00**	**1,950,000**	**3,608,382**
								33.5 Tank Construction	**1.00 LS**						**1,950,000.00**	**1,950,000.00**	**1,950,000**	**3,608,382**
		40.9						**Instrumentation & Controls**										
			40-90					**Instrumentation & Controls**										
				RW				**RECYCLED WATER**										
					40-90-01-03			**I&C, Flow / Indicators & Transmitters, Non MAG**										
	40					17110.000	1201	LE - Level Element / Sensor	1.00 ea	Instr 01	800.00	127.38	-	-	-	927.38	927	1,855
	40					17120.000	1202	LT / LIT - Level Transmitter - w/4 Probe	1.00 ea	Instr 01	1,800.00	254.76	-	-	-	2,054.76	2,055	4,110
	40					17120.000	1231	LT / LIT - Level Transmitter, Ultrasonic - Top of Tank	1.00 ea	Instr 01	1,200.00	191.07	-	-	-	1,391.07	1,391	2,783
								40-90-01-03 I&C, Flow / Indicators & Transmitters, Non MAG	**1.00 LS**		**3,800.00**	**573.21**				**4,373.21**	**4,373**	**8,748**
								RW RECYCLED WATER	**1.00 LS**		**3,800.00**	**573.21**				**4,373.21**	**4,373**	**8,748**
								40-90 Instrumentation & Controls	**1.00 LS**		**3,800.00**	**573.21**				**4,373.21**	**4,373**	**8,748**
								40.9 Instrumentation & Controls	**1.00 LS**		**3,800.00**	**573.21**				**4,373.21**	**4,373**	**8,748**
		43.0						**Process Equipment**										
			43-05					**Furnish and Install Process Equipment**										
				RW				**RECYCLED WATER**										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					44-05-38-50			**Submersible Mixers**										
	46					11220.005	1010	FURNISH Active Vortex Mixer	1.00 ea			-	-	-	35,000.00	35,000.00	35,000	70,016
	46					11220.005	2010	Install Active Vortex Mixer	1.00 ea	Q22A	-	2,180.80	642.15	-	-	2,822.95	2,823	5,647
								44-05-38-50 Submersible Mixers	**1.00 EA**			**2,180.80**	**642.15**		**35,000.00**	**37,822.95**	**37,823**	**75,663**
								RW RECYCLED WATER	**1.00 LS**			**2,180.80**	**642.15**		**35,000.00**	**37,822.95**	**37,823**	**75,663**
								43-05 Furnish and Install Process Equipment	**1.00 LS**			**2,180.80**	**642.15**		**35,000.00**	**37,822.95**	**37,823**	**75,663**
								43.0 Process Equipment	**1.00 LS**			**2,180.80**	**642.15**		**35,000.00**	**37,822.95**	**37,823**	**75,663**
								02 Water Storage Tank	**1.00 LS**		**33,561.30**	**27,630.06**	**17,797.15**		**1,985,000.00**	**2,063,988.51**	**2,063,989**	**3,836,411**
04								**Site Civil**										
		03.0						**Concrete Work**										
			03-10					**Cast-In-Place Concrete Work**										
				RW				**RECYCLED WATER**										
					03-10-05-24			**Cast-In-Place Concrete, Slabs on Grade, 24" thick**										
	03					r03211.060	0600	Reinforcing Steel, in place, slab on grade, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	17.50 ton	RODM4	1,000.00	853.41	-	-	-	1,853.41	32,435	64,884
	03					r03211.060	2005	Reinforcing in place, unloading & sorting, add to above - slabs	17.50 ton	C5	-	33.69	7.35	-	-	41.04	718	1,437
	03					r03211.060	2215	Reinforcing in place, crane cost for handling, add to above, slabs	17.50 ton	C5	-	36.62	7.99	-	-	44.61	781	1,562
	03					r03310.535	0305	Concrete, ready mix, regular weight, slabs/mats, 4000 psi	204.00 cy		102.00	-	-	-	-	102.00	20,808	41,625
	03					r03310.570	4650	Structural concrete, placing, slab on grade, pumped, over 6" thick, includes strike off & consolidation, excludes material	204.00 cy	C20	-	16.26	3.17	-	-	19.43	3,964	7,931
	03					r03352.930	0200	Concrete finishng,floors,basic finishng for unspecfd flatwork,bull float,manual float&manual steel trowel,excludes placing,striking off&consolidating	2,700.00 sf	C10	-	0.95	-	-	-	0.95	2,556	5,113
	03					r03391.350	0300	Curing, sprayed membrane curing compound	27.00 csf	CLAB2	8.05	7.36	-	-	-	15.41	416	832
	03					r31221.610	1100	Fine grading, fine grade for slab on grade, machine	300.00 sy	B11L	-	0.79	0.51	-	-	1.30	390	780
								03-10-05-24 Cast-In-Place Concrete, Slabs on Grade, 24" thick	**204.00 CY**		**188.85**	**110.16**	**5.24**			**304.25**	**62,068**	**124,163**
					03-10-06-18			**Cast-In-Place Concrete, Straight Walls, 18" thick**										
	03					r03111.385	0500	C.I.P. concrete forms, wall, wood bulkhead with 2 piece keyway, 1 use, includes erecting, bracing, stripping and cleaning	69.73 lf	C2	1.69	9.74	-	-	-	11.43	797	1,594
	03					r03111.385	9260	Cip concret forms,walls,steel framed plywd,over 8'16'hg,based 50 us purchsd forms,4 us bracing lumber,includes erecting,bracing,stripping and cleaning	5,229.90 sfca	C2	0.60	5.73	-	-	-	6.33	33,123	66,260
	03					r03150.595	3050	Form oil, coverage varies greatly, maximum, includes material only	13.95 gal		19.85	-	-	-	-	19.85	277	554
	03					r03151.350	3500	Waterstop, rubber, center bulb, split, 3/8" thick x 6" wide	69.73 lf	CARP1	13.40	3.05	-	-	-	16.45	1,147	2,295
	03					r03151.350	5205	Waterstop, rubber, field union, 3/8" x 6" wide, walls	6.00 ea	CARP1	33.00	8.84	-	-	-	41.84	251	502
	03					r03211.060	0700	Reinforcing Steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories	12.71 ton	RODM4	1,000.00	654.28	-	-	-	1,654.28	21,029	42,068
	03					r03211.060	2010	Reinforcing in place, unloading & sorting, add - walls, cols, beams	12.71 ton	C5	-	33.69	7.35	-	-	41.04	522	1,044
	03					r03211.060	2225	Reinforcing, crane cost for handling, add to above, walls, cols, beams	12.71 ton	C5	-	36.62	7.99	-	-	44.61	567	1,134
	03					r03310.535	0320	Concrete, ready mix, regular weight, walls/cols/beams, 4000 psi	148.18 cy		102.00	-	-	-	-	102.00	15,114	30,236
	03					r03310.570	5350	Structural concrete, placing, walls, pumped, 15" thick, includes strike off & consolidation, excludes material	148.18 cy	C20	-	25.07	4.89	-	-	29.96	4,439	8,881
	03					r03352.960	0050	Concrete finishing, walls, burlap rub with grout, includes breaking ties and patching voids	2,614.95 sf	CEFI1	0.04	0.94	-	-	-	0.98	2,569	5,139
								03-10-06-18 Cast-In-Place Concrete, Straight Walls, 18" thick	**148.18 CY**		**219.98**	**312.59**	**6.20**			**538.77**	**79,835**	**159,706**
								RW RECYCLED WATER	**1.00 LS**		**71,121.44**	**68,793.22**	**1,987.93**			**141,902.59**	**141,903**	**283,869**
								03-10 Cast-In-Place Concrete Work	**1.00 LS**		**71,121.44**	**68,793.22**	**1,987.93**			**141,902.59**	**141,903**	**283,869**
								03.0 Concrete Work	**1.00 LS**		**71,121.44**	**68,793.22**	**1,987.93**			**141,902.59**	**141,903**	**283,869**
		26.0						**Electrical Work**										
			26-10					**Site Electrical**										
				RW				**RECYCLED WATER**										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					26-10-06-00			**Site Electrical, Lighting**										
	26					r26561.310	3000	Light poles, anchor base, aluminum, 20' high, excl concrete bases	6.00 ea	R3	910.00	440.45	35.46	-	-	1,385.91	8,315	16,635
	26					r26561.310	3800	Light poles, aluminum, bracket arms, 1 arm, excl concrete bases	6.00 ea	ELEC1	119.00	64.51	-	-	-	183.51	1,101	2,203
	26					r26561.920	9120	Roadway area luminaire, LED fixture, 144 LEDS, 120 V AC or 12 V DC, equal to 120 watt, incl lamp	6.00 ea	ELEC1	840.00	191.15	-	-	-	1,031.15	6,187	12,377
	26					r26562.310	7000	Avg cost, concrete pole base, max. 6'0" buried, 2'0" exposed, 18" dia.	6.00 ea	ELEC1	805.00	172.04	-	-	-	977.04	5,862	11,727
	26					r26611.310	0350	Photoelectric control, D.P.S.T., 120 V	2.00 ea	ELEC1	171.00	86.02	-	-	-	257.02	514	1,028
	26					r31632.613	0110	Fixd end cssn pils,open styl stbl grnd,50'd,18"dm,0.065 cy/lf, machn drlld,incld excvt,cncrt,50lb rnfr/, excld mblzt,bldr remvl,dspsl,csngs grnd water	36.00 vlf	B43	7.90	11.57	9.26	-	-	28.73	1,034	2,069
								26-10-06-00 Site Electrical, Lighting	**1.00 LS**		**16,670.40**	**5,797.46**	**546.06**			**23,013.92**	**23,014**	**46,038**
								RW RECYCLED WATER	**1.00 LS**		**16,670.40**	**5,797.46**	**546.06**			**23,013.92**	**23,014**	**46,038**
								26-10 Site Electrical	**1.00 LS**		**16,670.40**	**5,797.46**	**546.06**			**23,013.92**	**23,014**	**46,038**
			26-35					**Electronic Safety & Security**										
				RW				**RECYCLED WATER**										
					28-35-01-00			**Electronic Safety and Security**										
	28					r28161.650	0800	Detection Systems, card reader, flush type, standard, excl. wires & conduit	3.00 ea	ELEC1	910.00	191.15	-	-	-	1,101.15	3,303	6,608
	28					r28161.650	1400	Detection Systems, door switches, magnetic switch, excl. wires & conduit	5.00 ea	ELEC1	67.50	97.38	-	-	-	164.88	824	1,649
	28					r28161.650	3000	Detection Systems, infrared photoelectric motion detector, excl. wires & conduit	5.00 ea	ELEC1	186.00	129.03	-	-	-	315.03	1,575	3,151
	28					r28231.310	2400	Closed circuit television system (CCTV), industrial quality, one station (camera & monitor)	1.00 totl	ELEC2	2,775.00	397.01	-	-	-	3,172.01	3,172	6,345
	28					r28231.310	2600	Closed circuit television system (CCTV), industrial quality, for additional camera stations, add	7.00 ea	ELEC1	1,700.00	191.15	-	-	-	1,891.15	13,238	26,482
	28					r28231.310	2610	Closed circuit television system (CCTV), industrial quality, for low light, add	7.00 ea	ELEC1	1,375.00	191.15	-	-	-	1,566.15	10,963	21,931
	28					r28231.310	2800	Closed circuit television system (CCTV), industrial quality, for weatherproof camera station, add	4.00 ea	ELEC1	1,050.00	397.01	-	-	-	1,447.01	5,788	11,579
	28					r28231.310	----	Electrical Conduit, wire, boxes, connections, Etc.	1.00 ls		-	-	-	25,000.00	-	25,000.00	25,000	50,011
								28-35-01-00 Electronic Safety and Security	**1.00 LS**		**32,497.50**	**6,366.69**		**25,000.00**		**63,864.19**	**63,864**	**127,757**
								RW RECYCLED WATER	**1.00 LS**		**32,497.50**	**6,366.69**		**25,000.00**		**63,864.19**	**63,864**	**127,757**
								26-35 Electronic Safety & Security	**1.00 LS**		**32,497.50**	**6,366.69**		**25,000.00**		**63,864.19**	**63,864**	**127,757**
								26.0 Electrical Work	**1.00 LS**		**49,167.90**	**12,164.15**	**546.06**	**25,000.00**		**86,878.11**	**86,878**	**173,796**
		31.0						**Site/Civil**										
			03-10					**Cast-In-Place Concrete Work**										
				RW				**RECYCLED WATER**										
					03-10-05-24			**Cast-In-Place Concrete, Slabs on Grade, 24" thick**										
	03					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	50.00 lcy	B6	30.50	7.67	1.84	-	-	40.00	2,000	4,001
	03					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	50.00 ecy	A1D	-	3.88	0.29	-	-	4.17	209	417
								03-10-05-24 Cast-In-Place Concrete, Slabs on Grade, 24" thick	**204.00 CY**		**7.48**	**2.83**	**0.52**			**10.83**	**2,209**	**4,418**
								RW RECYCLED WATER	**1.00 LS**		**1,525.00**	**577.46**	**106.26**			**2,208.72**	**2,209**	**4,418**
								03-10 Cast-In-Place Concrete Work	**1.00 LS**		**1,525.00**	**577.46**	**106.26**			**2,208.72**	**2,209**	**4,418**
			31-15					**Site Preparation**										
				RW				**RECYCLED WATER**										
					31-15-01-00			**Site Preparation, Clearing and Grubbing**										
	31					r31111.010	0150	Clearing & grubbing, grub stumps and remove	1.93 acre	B30	-	592.92	907.80	-	-	1,500.72	2,893	5,788
	31					r31131.320	3100	Selective clearing and grubbing, 8" to 12" diameter, remove selective trees, on site using chain saws and chipper, excludes stumps	45.00 ea	B7	-	186.27	110.21	-	-	296.48	13,342	26,689
								31-15-01-00 Site Preparation, Clearing and Grubbing	**1.00 LS**			**9,525.21**	**6,709.85**			**16,235.06**	**16,235**	**32,477**
								RW RECYCLED WATER	**1.00 LS**			**9,525.21**	**6,709.85**			**16,235.06**	**16,235**	**32,477**
								31-15 Site Preparation	**1.00 LS**			**9,525.21**	**6,709.85**			**16,235.06**	**16,235**	**32,477**
			31-20					**Earthworks, Site**										
				RW				**RECYCLED WATER**										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					31-20-07-00			Earthworks, Sitework, Cut/Fill										
	31					r31221.610	0012	Fine grading, finish grading, small area, to be paved with grader	2,250.00 sy	B11L	-	2.04	1.34	-	-	3.38	7,602	15,207
	31					r31231.642	0305	Excavating, bulk bank measure, 3-1/2 C.Y. capacity = 300 C.Y./hr., backhoe, hydraulic, crawler mounted, excluding truck loading	2,250.00 bcy	B12D	-	0.35	0.77	-	-	1.11	2,502	5,005
	31					r31232.314	2220	Backfill, structural, common earth, 80 H.P. dozer, 150' haul, from existing stockpile, excludes compaction	2,700.00 lcy	B10L	-	1.31	0.74	-	-	2.05	5,526	11,054
	31					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	4,500.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	8,964	17,932
	31					r31232.324	0300	Compaction, structural, common fill, 8" lifts, sheepsfoot or wobbly wheel roller	2,700.00 ecy	B10G	-	0.49	0.67	-	-	1.16	3,130	6,262
								31-20-07-00 Earthworks, Sitework, Cut/Fill	1.00 LS		5,355.00	12,217.14	10,151.67			27,723.81	27,724	55,460
								RW RECYCLED WATER	1.00 LS		5,355.00	12,217.14	10,151.67			27,723.81	27,724	55,460
								31-20 Earthworks, Site	1.00 LS		5,355.00	12,217.14	10,151.67			27,723.81	27,724	55,460
			31-25					Earthworks, Structural										
				RW				RECYCLED WATER										
					31-25-01-00			Earthworks, Structural, Excavation										
	31					r01543.650	0100	Mobilization or demobilization, dozer, loader, backhoe or excavator, above 150 H.P., up to 50 miles	4.00 ea	B34K	-	119.72	240.41	-	-	360.13	1,441	2,882
	31					r31231.642	1500	Excavating, bulk bank measure, 3/4 C.Y. capacity = 45 C.Y./hour, wheel mounted, excluding truck loading	2,750.00 bcy	B10R	-	1.78	0.62	-	-	2.40	6,602	13,206
	31					r31231.642	3900	Excavating, bulk bank measure, 3 C.Y. capacity = 250 C.Y./hour, shovel, excluding truck loading	900.00 bcy	B12T	-	0.42	0.58	-	-	1.00	899	1,799
	31					r31232.313	1600	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	1,850.00 ecy	B10C	-	0.80	1.63	-	-	2.43	4,504	9,009
	31					r31232.314	2220	Backfill, structural, common earth, 80 H.P. dozer, 150' haul, from existing stockpile, excludes compaction	1,850.00 lcy	B10L	-	1.31	0.74	-	-	2.05	3,786	7,574
	31					r31232.318	0400	Hauling, excavated or borrow material, loose cubic yards, 1 mile round trip, 2.2 loads/hour, 12 C.Y. truck, highway haulers, excludes loading	900.00 lcy	B34B	-	2.00	2.89	-	-	4.88	4,392	8,786
	31					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	1,850.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	3,685	7,372
	31					r31232.324	0300	Compaction, structural, common fill, 8" lifts, sheepsfoot or wobbly wheel roller	1,850.00 ecy	B10G	-	0.49	0.67	-	-	1.16	2,145	4,291
								31-25-01-00 Earthworks, Structural, Excavation	1.00 LS		2,201.50	13,188.07	12,063.59			27,453.16	27,453	54,919
								RW RECYCLED WATER	1.00 LS		2,201.50	13,188.07	12,063.59			27,453.16	27,453	54,919
								31-25 Earthworks, Structural	1.00 LS		2,201.50	13,188.07	12,063.59			27,453.16	27,453	54,919
			31-35					Site Landscaping										
				RW				RECYCLED WATER										
					32-35-03-00			Site Improvements, Landscaping										
	32					02950.010	----	Landscaping Allowance	1.00 ls		-	-	-	50,000.00	-	50,000.00	50,000	100,023
								32-35-03-00 Site Improvements, Landscaping	1.00 LS					50,000.00		50,000.00	50,000	100,023
								RW RECYCLED WATER	1.00 LS					50,000.00		50,000.00	50,000	100,023
								31-35 Site Landscaping	1.00 LS					50,000.00		50,000.00	50,000	100,023
			31-45					Fencing										
				RW				RECYCLED WATER										
					32-45-01-00			Fencing, Chain Link										
	32					r32311.320	0920	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2-1/2" posts @ 10' OC, 8' high, includes excavation, in concrete, excludes barbed wire	580.00 lf	B80C	31.50	5.83	1.14	-	-	38.47	22,312	44,633
	32					r32311.320	3120	Fence, chain link industrial, overhead slide gate, cantilever type, chain link, 8' high, to 24' wide, includes excavation, in concrete	24.00 lf	B80	171.00	63.30	23.72	-	-	258.02	6,193	12,388
								32-45-01-00 Fencing, Chain Link	1.00 LS		22,374.00	4,899.18	1,230.97			28,504.15	28,504	57,021
								RW RECYCLED WATER	1.00 LS		22,374.00	4,899.18	1,230.97			28,504.15	28,504	57,021
								31-45 Fencing	1.00 LS		22,374.00	4,899.18	1,230.97			28,504.15	28,504	57,021
			31-50					Site, Improvements										
				RW				RECYCLED WATER										
					32-40-06-00			Site Improvements, Flatwork, Sidewalk										

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					32-40-06-00			**Site Improvements, Flatwork, Sidewalk**										
	32					r32061.010	0350	Sidewalks, driveways, and patios, sidewalk, concrete, cast-in-place with 6 x 6 - W1.4 x W1.4 mesh, broomed finish, 3000 psi, 5" thick, excludes base	812.00 sf	B24	2.16	2.23	-	-	-	4.39	3,565	7,132
	32					r32061.010	0450	Sidewalks, driveways, and patios, sidewalks, concrete, excludes base, for 4" thick bank run gravel base, add	812.00 sf	B18	0.56	0.43	0.01	-	-	1.00	813	1,626
								32-40-06-00 Site Improvements, Flatwork, Sidewalk	**1.00 LS**		**2,208.64**	**2,158.51**	**10.82**			**4,377.97**	**4,378**	**8,758**
					32-50-06-00			**Site Improvements, Other Improvements**										
	31					r33411.350	----	Storm Water & Site Drainage	1.00 ls		-	-	-	50,000.00	-	50,000.00	50,000	100,023
								32-50-06-00 Site Improvements, Other Improvements									**50,000**	**100,023**
								RW RECYCLED WATER	**1.00 LS**		**2,208.64**	**2,158.51**	**10.82**	**50,000.00**		**54,377.97**	**54,378**	**108,781**
								31-50 Site, Improvements	**1.00 LS**		**2,208.64**	**2,158.51**	**10.82**	**50,000.00**		**54,377.97**	**54,378**	**108,781**
			32-40					**Asphalt Paving**										
				RW				**RECYCLED WATER**										
					32-40-01-00			**Site Improvements, Paving, Asphaltic Concrete**										
	32					r31221.610	0100	Fine grading, for roadway, base or leveling course, large area, 6,000 S.Y. or more	2,840.00 sy	B11L	-	0.41	0.27	-	-	0.68	1,919	3,839
	32					r31221.610	0200	Fine grading, grade subgrade for base course, roadways	2,840.00 sy	B11L	-	0.23	0.15	-	-	0.39	1,097	2,195
	32					r32112.323	0200	Base course drainage layers, aggregate base course for roadways and large paved areas, stone base, compacted, 3/4" stone base, to 9" deep	2,840.00 sy	B36C	9.00	0.46	0.67	-	-	10.13	28,768	57,548
	32					r32121.613	0120	Plant-mix asphalt paving, for highways and large paved areas, binder course, 2" thick, no hauling included	2,840.00 sy	B25	7.20	0.67	0.32	-	-	8.18	23,236	46,483
	32					r32121.613	0380	Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	2,840.00 sy	B25B	8.05	0.74	0.34	-	-	9.13	25,937	51,886
								32-40-01-00 Site Improvements, Paving, Asphaltic Concrete	**1.00 LS**		**68,870.00**	**7,125.66**	**4,961.19**			**80,956.85**	**80,957**	**161,950**
					32-40-05-00			**Site Improvements, Curbs and Gutters**										
	32					r32161.313	0415	Cast-in place concrete ribbon curbs, concrete, machine formed, straight, 6" t x 18" w, includes concrete	1,700.00 lf	B69A	5.95	1.16	0.30	-	-	7.41	12,589	25,184
								32-40-05-00 Site Improvements, Curbs and Gutters	**1.00 LS**		**10,115.00**	**1,963.21**	**510.77**			**12,588.98**	**12,589**	**25,184**
								RW RECYCLED WATER	**1.00 LS**		**78,985.00**	**9,088.87**	**5,471.96**			**93,545.83**	**93,546**	**187,134**
								32-40 Asphalt Paving	**1.00 LS**		**78,985.00**	**9,088.87**	**5,471.96**			**93,545.83**	**93,546**	**187,134**
			33-15					**Yard Structures**										
				RW				**RECYCLED WATER**										
					33-15-01-06			**Buried Structures, Manholes, 72" Dia**										
	33					11212.060	0010	FURNISH Submersible Chopper Pump, 1 - 5 hp	2.00 EA			-	-	-	5,000.00	5,000.00	10,000	20,005
	33					11212.060	1010	Set base elbow / pump assembly, 1 - 5 hp	2.00 ea	Equip 01	50.00	905.51	-	-	-	955.51	1,911	3,823
	33					11212.060	1070	Stainless steel guide rails, 2", (labor & material)	32.00 lf	Equip 01	9.00	14.15	-	-	-	23.15	741	1,482
	33					11212.060	1130	Install intermediate guide rail bracket	4.00 ea	Equip 01	10.00	84.89	-	-	-	94.89	380	759
	33					r33441.313	2100	Utility area drains,catch basins manholes frames and covers,cast iron,heavy traffic,24"diameter,400lb, excludes footing,excavation,and backfill	1.00 ea	B6	230.00	147.40	35.33	-	-	412.73	413	826
	33					r33491.310	1210	San Sewer Manholes, Frames, and Covers, concrete, precast, 6' inside diameter, 8' deep, excludes footing, excavation, backfill, frame and cover	1.00 ea	B6	3,175.00	1,149.72	275.55	-	-	4,600.27	4,600	9,203
								33-15-01-06 Buried Structures, Manholes, 72" Dia	**1.00 LS**		**3,833.00**	**3,900.44**	**310.88**		**10,000.00**	**18,044.32**	**18,044**	**36,097**
								RW RECYCLED WATER	**1.00 LS**		**3,833.00**	**3,900.44**	**310.88**		**10,000.00**	**18,044.32**	**18,044**	**36,097**
								33-15 Yard Structures	**1.00 LS**		**3,833.00**	**3,900.44**	**310.88**		**10,000.00**	**18,044.32**	**18,044**	**36,097**
								31.0 Site/Civil	**1.00 LS**		**116,482.14**	**55,554.88**	**36,056.00**	**100,000.00**	**10,000.00**	**318,093.02**	**318,093**	**636,330**
		33.0						**Buried Piping**										
			33-00					**Yard Piping**										
				RW				**RECYCLED WATER**										
					33-00-04-06			**Buried Pipe, Ductile Iron, 6"**										
	33					02001.200	0160	25 tn Rough Terrain (per day)	5.00 day	Const Equip 06	-	493.26	582.74	-	-	1,076.01	5,380	10,763
	33					02502.040	5550	6" pipe, DI, RJ, excav/bkfill not included, 350#	900.00 LF	Pipe 02	18.37	10.52	6.65	-	-	35.54	31,988	63,990
	33					02502.045	1065	6" DI, RJ, Ell, 90	2.00 ea	Pipe 02	150.00	167.05	105.69	-	-	422.74	845	1,691

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					33-00-04-06			**Buried Pipe, Ductile Iron, 6"**										
	33					02502.045	1070	6" DI, RJ, Ell, 45	2.00 ea	Pipe 02	140.00	167.05	105.69	-	-	412.74	825	1,651
	33					02502.045	1085	6" DI, RJ, tee	2.00 ea	Pipe 02	230.00	247.48	156.57	-	-	634.05	1,268	2,537
	33					02502.050	0010	Dresser Coupling, 6"	4.00 ea	Pipe 02	137.50	122.50	77.50	-	-	337.51	1,350	2,701
	33					02502.060	1150	8" DI, RJ, reducer, 8" x 6"	1.00 ea	Pipe 02	94.00	185.61	117.43	-	-	397.04	397	794
	33					02518.007	0015	Megalugs for DI Pipe w/ Accessories, 6"	60.00 ea	Pipe 02	61.11	61.87	39.14	-	-	162.12	9,727	19,459
	33					02518.011	0020	6" Thrust Block	10.00 ea	Pipe 02	25.00	31.55		-	-	56.55	566	1,131
	33					02518.020	0030	Polywrap, 6" pipe	900.00 lf		0.32	-	-	-	-	0.32	288	576
	33					02518.200	0010	Add for tie-in to existing (Adjust productivity)	1.00 ea	Pipe 02	750.00	1,484.88	939.42	-	-	3,174.30	3,174	6,350
	33					02518.500	1010	Pipe Marking, ID Tape	900.00 lf	Pipe 61	0.13	0.70	-	-	-	0.83	744	1,488
	33					15300.020	0520	Install gate valve, MJ, 6"	2.00 ea	Pipe 51	-	144.62	-	-	-	144.62	289	579
	33					15300.020	3330	FURNISH Gate valve, iron body, dbl disk, MJ, 150#, NO, 6"	2.00 ea		25.00	-	-	-	-	25.00	50	100
	33					15300.160	0030	Valve accessory, extension stem	10.00 lf	Pipe 51	5.00	6.89	-	-	-	11.89	119	238
	33					15300.160	1010	Valve accessory, cast iron valve box & cover @ deck	2.00 ea	Pipe 51	65.00	68.87	-	-	-	133.87	268	536
	33					15300.200	0010	Fire Hydrant	2.00 ea	Pipe 51	600.00	344.33	-	-	-	944.33	1,889	3,778
	33					r31231.613	0620	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	500.00 bcy	B12S	-	0.83	1.35	-	-	2.18	1,090	2,180
	33					r31231.642	1500	Excavating, bulk bank measure, 3/4 C.Y. capacity = 45 C.Y./hour, wheel mounted, excluding truck loading	140.00 bcy	B10R	-	1.78	0.62	-	-	2.40	336	672
	33					r31232.313	0100	Backfill, heavy soil, by hand, no compaction	360.00 lcy	CLAB1	-	31.78	-	-	-	31.78	11,441	22,887
	33					r31232.313	0900	Backfill, 12" layers, compaction in layers, roller compaction with operator walking, add to above	360.00 ecy	B10A	-	4.28	0.87	-	-	5.15	1,855	3,710
	33					r31232.313	1600	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	360.00 ecy	B10C	-	0.80	1.63	-	-	2.43	876	1,753
	33					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	194.00 lcy	B6	30.50	7.67	1.84	-	-	40.00	7,760	15,524
	33					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	194.00 ecy	A1D	-	3.88	0.29	-	-	4.17	810	1,619
	33					r31232.318	0320	Hauling, excavated or borrow material, loose cubic yards, 1/2 mile round trip, 3.2 loads/hour, 12 C.Y. dump truck, highway haulers, excludes loading	140.00 lcy	B34B	-	1.44	2.08	-	-	3.51	492	984
	33					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	554.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	1,104	2,208
								33-00-04-06 Buried Pipe, Ductile Iron, 6"	**900.00 LF**		**34.77**	**41.91**	**17.69**			**94.37**	**84,931**	**169,901**
					33-00-04-36			**Buried Pipe, Ductile Iron, 36"**										
	33					02001.200	0160	25 tn Rough Terrain (per day)	6.00 day	Const Equip 06	-	493.26	582.74	-	-	1,076.01	6,456	12,915
	33					02001.200	0160	25 tn Rough Terrain (per day)	4.00 day	Const Equip 06	-	493.27	582.75	-	-	1,076.01	4,304	8,610
	33					02502.190	5550	36" pipe, DI, RJ, excav/bkfill not included, 250#	1,200.00 LF	Pipe 02	199.76	30.32	19.18	-	-	249.26	299,108	598,351
	33					02502.190	5550	36" pipe, DI, RJ, excav/bkfill not included, 250#	260.00 LF	Pipe 02	199.76	30.32	19.18	-	-	249.26	64,807	129,643
	33					02502.195	1195	36" DI, RJ, Ell, 90	2.00 ea	Pipe 02	5,380.00	717.69	454.06	-	-	6,551.75	13,104	26,213
	33					02502.195	1195	36" DI, RJ, Ell, 90	4.00 ea	Pipe 02	5,380.00	717.69	454.06	-	-	6,551.75	26,207	52,426
	33					02502.195	1200	36" DI, RJ, Ell, 45	2.00 ea	Pipe 02	4,610.00	717.69	454.06	-	-	5,781.75	11,564	23,132
	33					02502.195	1200	36" DI, RJ, Ell, 45	4.00 ea	Pipe 02	4,610.00	717.69	454.06	-	-	5,781.75	23,127	46,264
	33					02502.195	1215	36" DI, RJ, tee	1.00 ea	Pipe 02	7,830.00	996.11	630.20	-	-	9,456.31	9,456	18,917
	33					02502.195	1215	36" DI, RJ, tee	3.00 ea	Pipe 02	7,830.00	996.11	630.20	-	-	9,456.31	28,369	56,751
	33					02502.195	1220	36" DI, RJ, red. tee, 36" x 12"	2.00 ea	Pipe 02	5,406.00	996.11	630.20	-	-	7,032.31	14,065	28,136
	33					02502.200	0010	Dresser Coupling, 36"	2.00 ea	Pipe 02	1,430.00	371.22	234.86	-	-	2,036.08	4,072	8,146
	33					02502.200	0010	Dresser Coupling, 36"	4.00 ea	Pipe 02	1,430.00	371.22	234.86	-	-	2,036.08	8,144	16,292
	33					02518.007	0065	Megalugs for DI Pipe w/ Accessories, 36"	75.00 ea	Pipe 01	1,932.91	122.59	83.92	-	-	2,139.42	160,457	320,986
	33					02518.007	0065	Megalugs for DI Pipe w/ Accessories, 36"	30.00 ea	Pipe 01	1,932.91	122.59	83.92	-	-	2,139.42	64,183	128,394
	33					02518.020	0130	Polywrap, 36" pipe	1,200.00 lf		1.60	-	-	-	-	1.60	1,920	3,841
	33					02518.020	0130	Polywrap, 36" pipe	260.00 lf		1.60	-	-	-	-	1.60	416	832
	33					02518.200	0010	Add for tie-in to existing (Adjust productivity)	1.00 ea	Pipe 02	750.00	1,484.88	939.42	-	-	3,174.30	3,174	6,350
	33					02518.200	0020	Add for tie-in to existing, wet tap by subcontractor	1.00 ea		-	-	-	5,000.00	-	5,000.00	5,000	10,002
	33					02518.500	1010	Pipe Marking, ID Tape	1,200.00 lf	Pipe 61	0.13	0.70	-	-	-	0.83	992	1,984
	33					02518.500	1010	Pipe Marking, ID Tape	260.00 lf	Pipe 61	0.13	0.70	-	-	-	0.83	215	430
	33					r31231.613	0620	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	2,000.00 bcy	B12S	-	0.83	1.35	-	-	2.18	4,360	8,721
	33					r31231.613	0620	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	350.00 bcy	B12S	-	0.83	1.35	-	-	2.18	763	1,526
	33					r31231.642	1500	Excavating, bulk bank measure, 3/4 C.Y. capacity = 45 C.Y./hour, wheel mounted, excluding truck loading	1,040.00 bcy	B10R	-	1.78	0.62	-	-	2.40	2,497	4,994
	33					r31231.642	1500	Excavating, bulk bank measure, 3/4 C.Y. capacity = 45 C.Y./hour, wheel mounted, excluding truck loading	246.00 bcy	B10R	-	1.78	0.62	-	-	2.40	591	1,181

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					33-00-04-36			**Buried Pipe, Ductile Iron, 36"**										
	33					r31232.313	0100	Backfill, heavy soil, by hand, no compaction	960.00 lcy	CLAB1	-	31.78	-	-	-	31.78	30,510	61,033
	33					r31232.313	0100	Backfill, heavy soil, by hand, no compaction	104.00 lcy	CLAB1	-	31.78	-	-	-	31.78	3,305	6,612
	33					r31232.313	0900	Backfill, 12" layers, compaction in layers, roller compaction with operator walking, add to above	960.00 ecy	B10A	-	4.28	0.87	-	-	5.15	4,946	9,894
	33					r31232.313	0900	Backfill, 12" layers, compaction in layers, roller compaction with operator walking, add to above	104.00 ecy	B10A	-	4.28	0.87	-	-	5.15	536	1,072
	33					r31232.313	1600	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	960.00 ecy	B10C	-	0.80	1.63	-	-	2.43	2,337	4,675
	33					r31232.313	1600	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	104.00 ecy	B10C	-	0.80	1.63	-	-	2.43	253	506
	33					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	886.00 lcy	B6	30.50	7.67	1.84	-	-	40.00	35,442	70,899
	33					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	192.00 lcy	B6	30.50	7.67	1.84	-	-	40.00	7,680	15,364
	33					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	886.00 ecy	A1D	-	3.88	0.29	-	-	4.17	3,697	7,396
	33					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	192.00 ecy	A1D	-	3.88	0.29	-	-	4.17	801	1,603
	33					r31232.318	0320	Hauling, excavated or borrow material, loose cubic yards, 1/2 mile round trip, 3.2 loads/hour, 12 C.Y. dump truck, highway haulers, excludes loading	1,040.00 lcy	B34B	-	1.44	2.08	-	-	3.51	3,654	7,311
	33					r31232.318	0320	Hauling, excavated or borrow material, loose cubic yards, 1/2 mile round trip, 3.2 loads/hour, 12 C.Y. dump truck, highway haulers, excludes loading	246.00 lcy	B34B	-	1.44	2.08	-	-	3.51	864	1,729
	33					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	1,846.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	3,677	7,356
	33					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	296.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	590	1,180
								33-00-04-36 Buried Pipe, Ductile Iron, 36"	**1,460.00 LF**		**441.07**	**95.95**	**45.61**	**3.43**		**586.06**	**855,640**	**1,711,667**
					33-00-04-42			**Buried Pipe, Ductile Iron, 42"**										
	33					02001.200	0160	25 tn Rough Terrain (per day)	4.00 day	Const Equip 06	-	493.27	582.75	-	-	1,076.01	4,304	8,610
	33					02502.205	5550	42" pipe, DI, RJ, excav/bkfill not included, 250#	900.00 LF	Pipe 02	257.73	35.27	22.31	-	-	315.31	283,777	567,682
	33					02502.210	1165	42" DI, RJ, Ell, 90	2.00 ea	Pipe 02	6,420.00	829.06	524.52	-	-	7,773.58	15,547	31,101
	33					02502.210	1170	42" DI, RJ, Ell, 45	2.00 ea	Pipe 02	5,510.00	829.06	524.52	-	-	6,863.58	13,727	27,461
	33					02502.210	1185	42" DI, RJ, tee	1.00 ea	Pipe 02	7,600.00	1,194.09	755.46	-	-	9,549.55	9,550	19,103
	33					02502.210	1220	42" DI, RJ, reducer, 42" x 30"	2.00 ea	Pipe 02	4,400.00	829.06	524.52	-	-	5,753.58	11,507	23,020
	33					02502.215	0010	Dresser Coupling, 42"	2.00 ea	Pipe 02	1,650.00	423.19	267.74	-	-	2,340.93	4,682	9,366
	33					02518.007	0070	Megalugs for DI Pipe w/ Accessories, 42"	60.00 ea	Pipe 01	2,711.91	153.24	104.91	-	-	2,970.05	178,203	356,487
	33					02518.020	0140	Polywrap, 42" pipe	900.00 lf		1.71	-	-	-	-	1.71	1,539	3,079
	33					02518.200	0010	Add for tie-in to existing (Adjust productivity)	1.00 ea	Pipe 02	750.00	1,484.88	939.42	-	-	3,174.30	3,174	6,350
	33					02518.200	0020	Add for tie-in to existing, wet tap by subcontractor	1.00 ea		-	-	-	5,000.00	-	5,000.00	5,000	10,002
	33					02518.500	1010	Pipe Marking, ID Tape	900.00 lf	Pipe 61	0.13	0.70	-	-	-	0.83	744	1,488
	33					r31231.613	0620	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	1,734.00 bcy	B12S	-	0.83	1.35	-	-	2.18	3,780	7,561
	33					r31231.642	1500	Excavating, bulk bank measure, 3/4 C.Y. capacity = 45 C.Y./hour, wheel mounted, excluding truck loading	954.00 bcy	B10R	-	1.78	0.62	-	-	2.40	2,290	4,581
	33					r31232.313	0100	Backfill, heavy soil, by hand, no compaction	780.00 lcy	CLAB1	-	31.78	-	-	-	31.78	24,789	49,590
	33					r31232.313	0900	Backfill, 12" layers, compaction in layers, roller compaction with operator walking, add to above	780.00 ecy	B10A	-	4.28	0.87	-	-	5.15	4,019	8,039
	33					r31232.313	1600	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	780.00 ecy	B10C	-	0.80	1.63	-	-	2.43	1,899	3,798
	33					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	763.00 lcy	B6	30.50	7.67	1.84	-	-	40.00	30,521	61,056
	33					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	763.00 ecy	A1D	-	3.88	0.29	-	-	4.17	3,184	6,369
	33					r31232.318	0320	Hauling, excavated or borrow material, loose cubic yards, 1/2 mile round trip, 3.2 loads/hour, 12 C.Y. dump truck, highway haulers, excludes loading	954.00 lcy	B34B	-	1.44	2.08	-	-	3.51	3,352	6,706
	33					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	1,543.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	3,074	6,149
								33-00-04-42 Buried Pipe, Ductile Iron, 42"	**900.00 LF**		**517.50**	**105.32**	**47.92**	**5.56**		**676.29**	**608,661**	**1,217,598**
					33-00-07-04			**Buried Pipe, PVC, 4"**										
	33					02509.510	1110	4" pipe, PVC, SDR 26, B & S, excav/bkfill not included	1,200.00 LF	Pipe 03	0.76	4.39	2.34	-	-	7.48	8,980	17,963
	33					02509.515	1110	4" PVC, SDR 26, B & S, Ell, 90	2.00 ea	Pipe 03	22.87	54.53	29.03	-	-	106.43	213	426

Facility	CSI Div	Work Pkg	Trade Pkg	Work Activ	Unit Price	Phase	Item	Description	Takeoff Quantity	Crew	Material Cost/Unit	Labor Cost/Unit	Equip Cost/Unit	Sub Cost/Unit	Other Cost/Unit	Total Cost/Unit	Total Direct Cost	Grand Total w/Markups
					33-00-07-04			**Buried Pipe, PVC, 4"**										
	33					02509.515	1210	4" PVC, SDR 26, B & S, Ell, 45	2.00 ea	Pipe 03	18.17	54.53	29.03	-	-	101.73	203	407
	33					02518.500	1020	Pipe Marking, Detection Tape	1,200.00 lf	Pipe 61	0.13	0.70	-	-	-	0.83	992	1,984
	33					02518.500	1030	Pipe Marking, Copper Wire	1,200.00 lf	Pipe 61	0.22	0.70	-	-	-	0.92	1,100	2,200
	33					r31231.613	0620	Excavating, trench or continuous footing, common earth, 2-1/2 C.Y. excavator, 6' to 10' deep, excludes sheeting or dewatering	667.00 bcy	B12S	-	0.83	1.35	-	-	2.18	1,454	2,909
	33					r31231.642	1500	Excavating, bulk bank measure, 3/4 C.Y. capacity = 45 C.Y./hour, wheel mounted, excluding truck loading	187.00 bcy	B10R	-	1.78	0.62	-	-	2.40	449	898
	33					r31232.313	0100	Backfill, heavy soil, by hand, no compaction	480.00 lcy	CLAB1	-	31.78	-	-	-	31.78	15,255	30,517
	33					r31232.313	0900	Backfill, 12" layers, compaction in layers, roller compaction with operator walking, add to above	480.00 ecy	B10A	-	4.28	0.87	-	-	5.15	2,473	4,947
	33					r31232.313	1600	Backfill, bulk, 6" to 12" lifts, dozer backfilling, compaction with vibrating roller	480.00 ecy	B10C	-	0.80	1.63	-	-	2.43	1,168	2,337
	33					r31232.316	0100	Fill by borrow and utility bedding, for pipe and conduit, crushed stone, 3/4" to 1/2", excludes compaction	263.00 lcy	B6	30.50	7.67	1.84	-	-	40.00	10,520	21,046
	33					r31232.316	0500	Fill by borrow and utility bedding, for pipe and conduit, compacting bedding in trench	263.00 ecy	A1D	-	3.88	0.29	-	-	4.17	1,097	2,195
	33					r31232.318	0320	Hauling, excavated or borrow material, loose cubic yards, 1/2 mile round trip, 3.2 loads/hour, 12 C.Y. dump truck, highway haulers, excludes loading	187.00 lcy	B34B	-	1.44	2.08	-	-	3.51	657	1,314
	33					r31232.323	9000	Compaction, water for, 3000 gallon truck, 3 mile haul	747.00 ecy	B45	1.19	0.44	0.36	-	-	1.99	1,488	2,977
								33-00-07-04 Buried Pipe, PVC, 4"	**1,200.00 LF**		**8.60**	**24.48**	**5.30**			**38.37**	**46,049**	**92,119**
								RW RECYCLED WATER	**1.00 LS**		**1,151,325.57**	**301,961.20**	**131,994.70**	**10,000.00**		**1,595,281.47**	**1,595,281**	**3,191,285**
								33-00 Yard Piping	**1.00 LS**		**1,151,325.57**	**301,961.20**	**131,994.70**	**10,000.00**		**1,595,281.47**	**1,595,281**	**3,191,285**
								33.0 Buried Piping	**1.00 LS**		**1,151,325.57**	**301,961.20**	**131,994.70**	**10,000.00**		**1,595,281.47**	**1,595,281**	**3,191,285**
		40.0						**Process Piping**										
			40-00					**Process Pipe - Furnish and Install**										
				RW				**RECYCLED WATER**										
					40-20-08-36			**Check Valves, 36"**										
	40					15300.080	0230	Install check valve, Flgd, DIP, 36"	1.00 ea	Pipe 51	-	1,129.40	-	-	-	1,129.40	1,129	2,259
	40					15300.080	3130	FURNISH Check valve, iron body, cushioned, Flgd, 150#, 36"	1.00 ea		34,800.00	-	-	-	-	34,800.00	34,800	69,616
	40					r33051.613	0530	Utility structures, utility vaults precast concrete, meter pit, 6' x 6', 8' deep, excludes excavation and backfill	1.00 ea	B6	4,200.00	1,149.72	275.55	-	-	5,625.27	5,625	11,253
								40-20-08-36 Check Valves, 36"	**1.00 EA**		**39,000.00**	**2,279.12**	**275.55**			**41,554.67**	**41,555**	**83,128**
					40-20-17-18			**Control Valves, 18"**										
	40					15300.185	----	Altitude Valve - 18" (at WWTP)	1.00 ea	Q22A	15,300.00	1,526.56	449.51	-	-	17,276.07	17,276	34,560
	40					r33051.613	0480	Utility structures, utility vaults precast concrete, meter pit, 4' x 4', 8' deep, excludes excavation and backfill	1.00 ea	B6	2,225.00	821.23	196.82	-	-	3,243.05	3,243	6,488
								40-20-17-18 Control Valves, 18"	**1.00 EA**		**17,525.00**	**2,347.79**	**646.33**			**20,519.12**	**20,519**	**41,048**
					40-20-17-30			**Control Valves, 30"**										
	40					15300.185	----	Altitude Valve - 30" w/Elect Solenoid Op'd	1.00 ea	Q22A	30,000.00	2,180.80	642.15	-	-	32,822.95	32,823	65,661
	40					r33051.613	0530	Utility structures, utility vaults precast concrete, meter pit, 6' x 6', 8' deep, excludes excavation and backfill	1.00 ea	B6	4,200.00	1,149.72	275.55	-	-	5,625.27	5,625	11,253
								40-20-17-30 Control Valves, 30"	**1.00 EA**		**34,200.00**	**3,330.52**	**917.70**			**38,448.22**	**38,448**	**76,914**
								RW RECYCLED WATER	**1.00 LS**		**90,725.00**	**7,957.43**	**1,839.58**			**100,522.01**	**100,522**	**201,090**
								40-00 Process Pipe - Furnish and Install	**1.00 LS**		**90,725.00**	**7,957.43**	**1,839.58**			**100,522.01**	**100,522**	**201,090**
								40.0 Process Piping	**1.00 LS**		**90,725.00**	**7,957.43**	**1,839.58**			**100,522.01**	**100,522**	**201,090**
								04 Site Civil	**1.00 LS**		**1,478,822.05**	**446,430.88**	**172,424.27**	**135,000.00**	**10,000.00**	**2,242,677.20**	**2,242,677**	**4,486,369**

Estimate Totals

Construction Costs	Amount	Totals	Hours	Rate	% of Total
Labor	1,036,940		18,836.688 l		7.69%
Material	2,508,143				18.61%
Subcontract	628,185				4.66%
Equipment	206,966		4,450.086 l		1.54%
Other	2,505,000				18.59%
Total Before Markups	**6,885,234**	**6,885,234**			51.08
Existing Conditions OH&P				15.000 %	
Concrete Work OH&P	42,792			15.000 %	0.32%
Architectural OH&P				15.000 %	
Building Complete OH&P	124,512			15.000 %	0.92%
Mechanical Work OH&P	599			15.000 %	0.00%
Electrical Work OH&P	54,867			15.000 %	0.41%
Site/Civil OH&P	62,512			15.000 %	0.46%
Buried Piping OH&P	239,292			15.000 %	1.78%
Tank Construction OH&P				15.000 %	
Process Piping OH&P	104,536			15.000 %	0.78%
Instruments & Controls OH&P	19,680			15.000 %	0.15%
Material Handling OH&P				15.000 %	
Process Equipment OH&P	88,948			15.000 %	0.66%
Total Subcontractor OH&P	**737,738**	**7,622,972**			5.47
Project Staff & Home Office OH	228,689			3.000 %	1.70%
Total Overhead	**228,689**	**7,851,661**			1.70
General Conditions	785,166			10.000 %	5.83%
Total General Conditions	**785,166**	**8,636,827**			5.83
Material Sales & Use Tax - %					
Construction Equip Tax - %					
Total Taxes		**8,636,827**			
Profit on Previous Subtotal	518,210			6.000 %	3.84%
Total Profit	**518,210**	**9,155,037**			3.84
Mobilization/Demobilization	673,927			5.000 %	5.00%
Blder's Risk & Gen Liab Ins -%	269,571			2.000 %	2.00%
Payment & Performance Bonds	269,571			2.000 %	2.00%
Total Bonds and Insurances	**1,213,069**	**10,368,106**			9.00
Contingency - %	3,110,431			30.000 %	23.08%
Total Contingency	**3,110,431**	**13,478,537**			23.08
Escalation on Estimate Total					
Total Escalation to Mid-Point		**13,478,537**			
Construction Total		**13,478,537**			

Austin SWIFT Loan
Application
Part D, Item 54a

Texas Water
Development Board
P.O. Box 13231, Austin, Texas 78711-3231

SWIFT

Engineering Feasibility Report
for
South Austin Regional Wastewater Treatment Plant Tertiary Filter
and
Walnut Creek Wastewater Treatment Plant Tertiary Filters

Submitted by:
Facility Engineering Division
Engineering Services Program Area
Austin Water
City of Austin

May 11, 2016

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I. General Description

The City of Austin is submitting an application for a TWDB SWIFT Loan to comply with the 2016 Region K reuse strategy. . Austin's direct reuse strategy in the approved 2016 Region K Plan includes a series of projects to expand and enhance Austin's reclaimed water system infrastructure over the next 50 years. The reuse projects included in this SWIFT loan application are:

- Rehabilitation and expansion of the tertiary filtration system at South Austin Regional WWTP to improve effluent quality and increase capacity to 72 MGD

- Rehabilitation of the tertiary filtration system at Walnut Creek WWTP to improve effluent quality, increase reliability, and improve capacity to 75 MGD

GENERAL INFORMATION

Name of Entity	County	Regional Water Planning Area
City of Austin	Travis	K

Entity Contact Information			
Contact Person	**Name**	**Heather Cooke**	
	Title	**Legislative and Environmental Program Coordinator**	
Mailing Address		Austin Water	
		625 E. 10th Street, Suite 300	
		Austin, Texas 70701	
Phone Number	512-972-0083	**Fax Number**	N/A
Email Address	heather.cooke@austintexas.gov		

PROJECT DESCRIPTION

Name of Project *(As it appears in the 2016 regional water plan)*	**Direct Reuse**			
Where can the project be found in the most recent Regional Water Plan?	**Project described on page:**	**5-54 and 5-55**	**Capital costs listed on page:**	**5-56**

Please attach a list of all water systems served by the proposed project. Not applicable

Phase(s) Applied For	☒ Planning ☐ Acquisition ☒ Design ☒ Construction
Population Served When Fully Operational	**Austin Population from 2016 Region K Plan** 2030: 1,158,346 (retail customers only)

A. South Austin Regional WWTP Tertiary Filter Improvement

The tertiary filters at the South Austin Regional Wastewater Treatment Plant (SAR) serve as the final step in the wastewater treatment process before effluent is discharged to the Colorado River or reused through the City's water reuse initiative. This final filtration stage is required in order to comply with Texas Commission on Environmental Quality (TCEQ) wastewater discharge and water reuse requirements. The Filter Building and 12 granular media gravity filters were constructed in 1988 with expansion of Treatment Train B and have an average day capacity of 48 million gallons per day (MGD). Many of the filter components and ancillary equipment are in need of replacement due to age and deterioration.

AECOM has completed the preliminary engineering phase of this project. The Preliminary Engineering Report (PER) includes an evaluation of the current granular media gravity filters and condition assessment of pumps, piping, valves, electrical, instrumentation, controls and other equipment in the Filter Building. The PER recommends converting 4 of the existing 12 filters from granular media filters to cloth media disk filters. It further recommends converting 2 additional filters to disk filter technology within 5 years to more closely match the plant's treatment capacity of 75 MGD. Converting the filters to cloth media technology will allow increased filtration capacity within the existing building footprint.

The effluent filters at the South Austin Regional Wastewater Treatment Plant (SAR) serve as the final step in the wastewater treatment process before the effluent is discharged to the Colorado River or reused through the City's water reuse initiative. This final filtration stage, or tertiary filtration, is required in order to comply with Texas Commission on Environmental Quality wastewater discharge and water reuse requirements. The Filter Building and 12 granular media gravity filters were constructed in 1988 with expansion of Treatment Train B and have an average day capacity of 40 million gallons per day (MGD). Many of the filter components and ancillary equipment are in need of replacement due to age and deterioration.

The purpose of this contract is to make improvements to the filter system to provide reliable treatment and performance for an estimated 25-year planning horizon. The work included in the base bid consists of converting four of the existing 12 filter bays from granular media filters to cloth media disk filters. The existing gravity filters will be removed and four 3 MGD disk filter units will be placed in each of the four filter basins. These sixteen disk filter units will provide sufficient capacity to replace the existing filtration system at SAR.

The construction project will consist of complex activities requiring multiple shutdowns of the filter system and the three treatment trains at SAR while existing piping and equipment is removed and replaced with larger equipment, piping and disk filter components. Demolition of existing equipment will be completed to ensure that the new filter system will be functional and conducive to maintenance. Extensive planning and changes to the operation of the plant will be required to mitigate risks of treatment process upsets due to the construction related activities. Additionally, temporary filtration will be provided during the construction process to ensure commitments under the Water Reuse Initiative are met at all times.

B. Walnut Creek WWTP Tertiary Filter Improvement

The tertiary filters at the Walnut Creek Wastewater Treatment Plant serve as the final step in the wastewater treatment process before effluent is discharged to the Colorado River or reused through the City's water reuse initiative. The filters were originally built in 1974 and expanded in 1989, and many of the filter components are in need of replacement due to age and deterioration. Black and Veatch has completed the preliminary engineering phase of the project identifying improvements necessary to ensure the long-term reliability of the filters; final design of improvements is currently underway. As a result of detailed analysis and hydraulic and process modeling performed during design, it was determined that certain components of the filter systems had to be replaced or redesigned to accommodate the planned improvements. This work was not in the original scope of work as it was not apparent until analysis and design of the improvements was well underway.

The proposed contract amendment will authorize Black and Veatch to complete work related to design of filter improvements. This additional work includes:

1. Hydraulic Improvements - Complex hydraulic issues required additional analyses and changes to the flow regime including the replacement of water troughs in Filters 5-10 and modifications of the weir in the northwest junction box. Additionally hydraulic analysis of the filter system during final design was required to ensure proper flow through the filter during the construction phase.

2. Replacement of additional equipment and appurtenances in Filter Gallery - Replace two additional filter gallery valves and effluent meters and complete refurbishing of the vacuum priming system for the backwash system was identified during final design. Additionally, one restraint for backwash drain pipe that was determined to be too corroded to re-use and requires replacement.

3. Relocation of Sodium Bisulfite feed system - Relocation of the Sodium Bisulfite chemical feed system was anticipated in the original scope of work. However, analysis of the proposed location revealed many underground obstructions and utilities. An alternate site was identified requiring additional surveying and design work.

4. Other additional work - Including additional work on filter control, further evaluation of construction sequencing to accommodate operational constraints and architectural work including replacement of doors and flooring, and repainting areas of the filter building.

II. Alternatives

The available filter technologies and cost effective analysis was completed for both SAR WWTP and Walnut Creek WWTP. This report can be found in the Appendix of the SAR WWTP Tertiary Filter Preliminary Engineering Report and Technical Memorandum No. 2.

A. Proposed Collection System

Both the SAR WWTP and Walnut Creek Tertiary Filter Improvements do not have a proposed collection system.

B. On-site Systems

Both the SAR WWTP and Walnut Creek Tertiary Filter Improvements do not have a proposed collection system.

C. Proposed treatment plant

The attached preliminary engineering report attached to this application includes:

1. Quantity and quality of existing sewage influent
2. Influent wastewater characterizes
3. Design Flow and Peak Flow
4. Treatment Unit capacities
5. Site Layout and analysis

Both plants have an annual average effluent limitations of 5 mg/I CBOD5, 5 mg/I TSS, and 2 mg/I NH3-N,

D. Sludge management

The sludge from the SAR and WC WWTP treated process is sent via pipeline to the Hornsby Bend Biosolids Management Plant (HB BMP), Permit No. WQ0003823000 to be digested, dewatered and then disposed of with the bulk of the sludge from the plant accepting the sludge.

E. Control of Bypassing

The SAR and WC WWTP have dual feed power from Austin Energy to provide standby capability, provide flexibility of operation, or prevent discharges of partially treated or untreated wastewater. Additionally, during construction of the tertiary filters the construction sequence will prevent discharges of partially treated or untreated wastewater.

F. Alternative Methods for Project Delivery

The sludge from the SAR and WC WWTP treated process is sent via pipeline to the Hornsby Bend Biosolids Management Plant (HB BMP), Permit No. WQ0003823000 to be digested, dewatered and then disposed of with the bulk of the sludge from the plant accepting the sludge.

III. Cost of the Project

The total project cost for the SAR WWTP Tertiary Filters is $28,332,909 and WC WWTP Tertiary Filters is $20,000,547. See attachment for the TWDB-1201 Project Budget.

IV. Environmental Assessment

The SAR WWTP Tertiary Filters has a Categorical Exclusion (CE) Determination.

The WC WWTP Tertiary Filters is eligible for a Categorical Exclusion (CE) Determination because it involves only minor rehabilitation and replacement of existing equipment There is no or minimal potentially adverse environmental or social impacts that may require mitigation or extensive regulatory agency or public coordination

V. Appendix

A. South Austin Regional Wastewater Treatment Plant Tertiary Filter Preliminary Engineering Report (under Separate Cover)

B. Walnut Creek Wastewater Treatment Plant Tertiary Filter Preliminary Engineering Report (under Separate Cover)

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT FILTER BUILDING IMPROVEMENTS

C.I.P. No. 3333.015

Austin SWIFT Loan Application
Part D, Item 54

PRELIMINARY ENGINEERING REPORT

Prepared for:

CITY OF AUSTIN **AUSTIN WATER UTILITY**

SHELBY G. ECKOLS
41485

Shelby G. Eckols
3/30/12

Submitted by:

AECOM

400 West 15th Street, Suite 500
Austin, Texas 78701

TBPE Reg. No. F-3580

Volume 1 of 1

March 2012

AECOM

City of Austin
South Austin Regional Wastewater Treatment Plant
Filter Improvements

Preliminary Engineering Report

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Appendix 2: SARWWTP Filters – Structural

Appendix 3: SARWWTP Filter Abandonment Plan Cost Estimate

Appendix 4: Hydraulic Measurements and Hydraulic Calculation Verification

Technical Memorandum No. 1: Filter System Hydraulic Evaluation

Technical Memorandum No. 2: Mechanical / Electrical / Instrumentation & Control Evaluation

Technical Memorandum No. 3: Process Evaluation

City of Austin
South Austin Regional Wastewater Treatment Plant
Filter Improvements

Preliminary Engineering Report

Executive Summary

This Preliminary Engineering Report (PER) was prepared for the Preliminary Engineering Phase of the South Austin Regional Wastewater Treatment Plant (SARWWTP) Filter Improvements Project under a Professional Engineering Services agreement between AECOM Technical Services (AECOM) and the City of Austin (COA). This report addresses improvements that are currently needed to the existing Filter Building complex in order to either maintain the originally designed treatment level by rehabilitating the current Deep Bed filtration system or provide increased filtration capacity by converting to a newer filtration technology.

The Technical Memorandums (TMs) produced under this agreement include the following:

TM No. 1 reports the results from hydraulic evaluations on the filter system. The study found that the existing filter system has sufficient hydraulic capacity to carry the maximum design flow of 80 MGD when the water level in the Colorado River is below the critical depth of the effluent pipe (elevation 397.5-ft above MSL), and if all gates in Junction Box No. 6 (JB6) are fully open. In order to maintain 18-inches of freeboard in the Clearwells No. 1 and No. 2, TM No. 1 also reports specific maximum and minimum elevations that shall be maintained in JB6. The hydraulic calculations performed in TM No. 1 were verified as described in Appendix 4.

TM No. 2 reports that major rehabilitations of the existing Deep Bed Sand Filtration System are required to return the SAR filters to their original design and operations and to extend another 25+ years of reliable and cost-effective filtration services. The proposed rehabilitation work includes repairs and/or replacement of all existing pipes, valves, pumps, motors, blowers, meters, electrical and instrumentation equipment, as well as removal and replacement of the filter underdrain system and sand media for the Deep Beds. This work results in an estimated Probable Construction Cost of approximately $17,780,000.

TM No. 3 Filter System Process Evaluation reports on the most cost-effective and appropriate filtration technology that will provide SAR WWTP with the ability to consistently meet desired effluent quality of the plant. The process evaluation includes a joint effort for the technology assessment that was conducted for both SARWWTP and Walnut WWTP as a part of this assignment. This assessment is located in Appendix 3.3 of TM 3, in the Process Technical Memorandum entitled "Alternative Filtration Technologies". Based on the joint technology workshop with the COA, many of the newer available technologies presented were eliminated from consideration for the SARWWTP. The technology being considered for application at SAR Filters includes the conversion to Disc Filters, a newer surface filtration technology. If selected, this proposed conversion will cost approximately $17,670,000 to match the current filtration capacity (with two disc units in standby) provided by the existing Deep Bed filter system (40 MGD Design Average; 80 MGD Peak) by converting 4 filter cells (Filters No. 3 through No. 6). This proposed Disc Filter conversion also provides potential for future filtration capacity increase up to 72 MGD Design Average and 144 MGD Design Peak if Filters No. 1 and No. 2 are also converted to completely retrofit all of the East Bay Filters; and/or a maximum of 144 MGD Design Average if all twelve (12) Filters (Nos. 1 through 12) are converted. However, limiting filtration capacity to 72 MGD Design Average complements the design flow of existing Treatment Trains A, B and C and minimizes modifications to the existing facilities.

The following table ES.1 summarizes the contents of the three Technical Memoranda.

Table ES.1 Summary of Technical Memoranda Contents

Technical Memorandum	*Title*	Result
No. 1	*Filter System Hydraulic Evaluation*	Identifies Current Hydraulic Capacities/Limitations of the Filtration System
No. 2	*Filter System Mechanical & Electrical Evaluation*	Identifies all components to be repaired/replaced for a complete Rehab of the existing Deep Bed Filtration System
No. 3	*Filter System Process Evaluation*	Addresses Alternative Technologies available & applicable to SARWWTP and provides conversion costs associated with Disc Filters

This PER summarizes the findings of TM No. 1, 2, and 3 including identification and evaluation of alternatives for the existing filters as well as associated filter system improvements including replacing slab over clearwells, new splitter box and backwash water system, expansion joint repair, control room floor repair and tile replacement, and equipment abandonment plan. Two improvement alternatives have been identified for the existing Deep Bed Sand Filters. These are as follows:

1. Modifications and Upgrading of the existing Deep Bed Sand Filters (TM No.2); and
2. Retrofitting of new Disc Filters inside the existing Deep Bed Sand Filters (TM No.3).

This PER also presents study results on estimates of Probable Construction Costs, annual O&M costs, and present worth costs for the two identified alternatives, compares these two alternatives and makes a recommendation for upgrading the existing Filters at SARWWTP. Based on the evaluation, retrofitting existing four sand bed filters with sixteen new disc filters (Alternative 2) will provide slightly more capacities (about 4% more) than restoration and upgrading of existing twelve deep bed sand filters (Alternative 1) but the disc filter (Alternative 2) option will be slightly cheaper (about 4% less) than the retrofitting (Alternative 1) option comparing the present worth value of combined construction and O&M costs. Installation of Disc Filters in four (4) of the existing Deep Bed Filters at the SARWWTP have the following advantages:

1. It would provide the City with state-of-the-art Filtration Technology;
2. It would provide better quality with expected turbidity in the filtered effluent below 2.0 NTU;
3. It would provide more than the current filtration capacity in a much smaller foot print;
4. It would provide the city with ability to significantly increase future filtration capacity using only one bay of the existing filters in one Filter Building in the future;
5. It will provide operators easier access to equipment and controls; and
6. It will simplify, reduce and fully automate O&M requirements.

Considering all of these factors and their impact on the City and Plant Operators, AECOM recommends the following:

1. **Convert existing Deep Bed Sand Filter Nos. 3 – 6 to Disc Filters.**
2. **Replace mudwell pumps and revise pipeline.**
3. **Add chlorine line.**
4. **Repair expansion joints.**
5. **Replace slab over clearwell.**
6. **Replace floor tile.**
7. **Abandon existing filter facilities.**

The following is a summary of the estimated Probable Construction Costs for the recommended filter improvements at the SARWWTP. The costs have been prepared using current costs without consideration of inflation. This opinion is linked to the July 2011 Engineering News Record (ENR) Construction Cost Index value of 9080.15.

A.	Installing Disc Filters in four Sand Filters	$17,670,000
B.	New Splitter Box and Backwash Water System	$ 900,000
C.	Expansion Joint Repair	$ 250,000
D.	Replacing Slab over Clearwells	$ 500,000
E.	Control Room Floor Repair and Tile Replacement	$ 100,000
F.	Equipment Abandonment Plan	$ 250,000
	Total	**$19,670,000**

City of Austin
South Austin Regional Wastewater Treatment Plant
Filter Improvements

Preliminary Engineering Report

1. Introduction

The SARWWTP is located at 13009 Falwell Lane in East Travis County, 2 miles north of State Highway 71 near the new SH 130 Toll Road (2008). The treatment plant is located adjacent to the Colorado River, which is also the permitted plant discharge waterway. The plant is currently permitted to discharge a monthly average flow of 75 MGD.

The current treatment trains in operation at the SARWWTP include:

1. Train A: built in 1984-86 with a design flow of 18 MGD, re-rated to 20 MGD, and ultimately re-rated to 25 MGD
2. Train B: built in 1986-88 with a design flow of 20 MGD, re-rated to 25 MGD
3. Train C: built in 2003 with a design flow of 25 MGD

The Filter Building was constructed in 1988, along with the Train B facilities, for an average design capacity of 40 MGD and a peak flow of 80 MGD. At the time of construction, only the effluent from Trains A and B were directed to this effluent filter facility. Since the construction of the Filter Building, Trains A and B have been re-rated to 25 MGD each and during 2003 an additional 25 MGD capacity effluent flow stream was added to Junction Box No. 5. Junction Box No. 5 serves as the influent splitter box to the Filter Building. On this basis, even at full filtration capacity, the existing effluent filtration system is undersized to treat the full treatment plant capacity of 75 MGD Average Design flow.

The majority of the existing Filter facility is in need of significant repair and/or replacement. While it has consistently served the needs of the City of Austin and SARWWTP for over 23 years and met the TCEQ effluent requirements with few exceptions; the filters, filter media, mechanical equipment, electrical equipment, pipe coatings, and some building finishes have reached their useful life and/or are in need of maintenance far beyond typical maintenance activities. The effort and estimated costs required to reinstate the facility to its original condition is significant. Therefore, it is in the best interest of the plant to also consider other newer filtration technologies that could be used within the footprint of the existing filter building. By analyzing alternative improvement options, the SARWWTP staff along with the Austin Water Utility Management will be able to make the best selection to both fit current effluent and permit needs while also considering the future potential of SAR filters.

The current operating procedure for the SARWWTP is to use the existing Deep Bed Sand Filters consistently to meet the desired effluent quality of the plant and to meet the permit requirements established by the TCEQ. Current permitted discharge limits (TPDES Permit No WQ0010543012) for daily average, 7-day average, daily maximum and single grab samples are as follows:

Parameter	Daily Average Limit, mg/L	7-Day Average Limit, mg/L	Daily Maximum Limit, mg/L	Single Grab Limit, mg/L	Annual Average Limit, mg/L
$CBOD_5$	10	15	25	35	5
TSS	15	25	40	60	5
NH_3-N	2	5	10	15	2

Records provided by SARWWTP staff from the SCADA and LIMS systems indicate that the filtered effluent meets the permit limits listed above.

This PER addresses the restoration and upgrading needs of the existing Deep Bed Sand Filters, identifies an alternative filtration technology applicable to the SAR Filters, evaluates the pros and cons of the two alternative filtration systems, estimates Probable Construction Costs for the two filtration alternatives, and recommends the filtration technology appropriate for the SARWWTP Filters for providing an additional service life of another 20 to 25 years.

The Black & Veatch Technical Memorandum 2 (TM2) presents Alternative Filter Technologies. AECOM has prepared several sections of the Black & Veatch TM2 and provided these to Black & Veatch for incorporation into their TM2. Details of Alternative Filtration Technologies can be found in the Black & Veatch Report.

A geotechnical investigation was not included as part of Preliminary Engineering Report because of the following reasons:

1. All work for modifications and upgrading of the existing Filters are inside the existing Filter Building;
2. No new structures are anticipated for the rehabilitation and upgrading of the existing Filters; and
3. Modifications and upgrading of existing Filters are not expected to change loading or loading conditions of the existing structures.

Only a general permit is expected to be required for this project. A site development permit is not anticipated at this time. Further, no special variances or waivers are expected to be required.

2. Proposed Filter System Improvement Options Comparison

Two alternatives have been identified for the existing Deep Bed Sand Filters. These are as follows:

1. Modifications and Upgrading of the existing Deep Bed Sand Filters; and
2. Retrofitting of new Disc Filters inside the existing Deep Bed Sand Filters.

Details of these two alternatives are discussed in the following two sections.

Alternative 1 - Modifications and Upgrading of existing Deep Bed Sand Filters

TM No. 2 outlines the rehabilitation, replacement, remediation, and re-construction of equipment and facilities at the SARWWTP Filter Building required for restoration of the full filtration capacity of the existing Deep Bed Sand Filter System. These proposed improvements will also modernize the existing system by bringing the filters and associated appurtenances up to more current mechanical, electrical, instrumentation and control standards.

In general, all components of the existing filter complex, with the exception of the structure itself, are in need of extensive rehabilitation and/or replacement in order to provide more reliable operation, and to restore the facility's full filtration capacity. TM No. 2 outlines all of the specific components to be improved or replaced, along with the associated estimated Probable Construction Cost of $17,780,000. Restoration of the existing Deep Bed Sand Filter System is the first option to be considered. It would allow the Filters at the SARWWTP to continue to provide 40 MGD average filtration capacity as was originally designed with an 80 MGD peak filtration capacity. The limitation of this restoration alternative is that any future re-use programs by the City requiring increase in filtration capacity and/or expansions of Train D and Train E requiring filtration capacities in excess of 40 MGD average will necessitate the construction of an entirely new filtration facility at SARWWTP.

Modifications, upgrading and restoration of the existing Deep Bed Sand Filters include:

1. All original equipment (pumps, motors, valves, electric operators, etc.);
2. New electrical supply facilities and motor control center;
3. New instrumentation and control system for restoring fully automatic operations;
4. Replacement of the existing filter underdrain system (includes precast concrete slabs and air/water backwash nozzles):
5. Replacement of the old filter media with new media;
6. Backwash system modifications to assure maintaining an unstratified filter bed;
7. Sand blasting and recoating of the existing pipes in the Upper and Lower Pipe Galleries;
8. Modification and extension of the existing lifting hoist and monorail system;
9. Enclosure and installation of covers over the filters to prevent algal growth due to sun light.

AECOM has developed Probable Construction Costs estimates for the above mentioned tasks for modifications, upgrading and restoration of the Deep Bed Sand Filters. Probable Construction Costs estimate includes Contractor's Overhead and Profit (20 percent), Bonds and Insurance (2 percent) and 40 percent Contingencies at Preliminary Design. Table 1 presents a summary of these cost estimates. As seen from Table 1 the Probable Construction Costs estimate for modifications, upgrading and restoration of the existing Deep Bed Sand Filters is $17.78 million.

Table 1 Summary of Cost Estimates for Modifications and Upgrading of Existing Deep Bed Sand Filters

Divisions	Details	Estimated Costs
Division 2 – Site Work	Misc. Site Work	$200,000
Division 3 - Concrete	Filter Underdrains	$156,000
Division 9 - Finishes	Sand Blasting and Re-Coating of All Pipes and Fittings	$308,000
Division 10 Specialties	Filter Media and Underdrain Replacement and New Roof Structures	$2,570,300
Division 11 - Equipment	Pumps & Motors, Valves Operators	$1,362,400
Division 15 - Mechanical	Pipes, Valves and Fittings	$996,300
Division 16 - Electrical	Electrical and I&C Equipment	$4,814,200
Sub-Total 1		**$10,407,100**
Contractor's Overhead & Profit (20%)		$2,081,400
Bonds & Insurance (2%)		$208,100
Sub-Total 2		**$12,696,700**
Contingencies 40% at Preliminary Design		$5,078,700
Total		**$17,780,000**

AECOM has also developed estimates of annual Operations and Maintenance (O&M) costs for the Deep Bed Sand Filtration System after these filters are modified, upgraded and restored for operation per original Design Criteria. Operating costs are escalated at 2.5 percent per year to cover inflation. Over a 20-year operating period, the estimated annual O&M costs varied from $216,120 during the first year to $354,140 at the end of the 20-year life cycle with an average annual operations and maintenance cost of $279,800. The present worth of the estimated annual O&M costs is $3,766,700. The combined present worth of Probable Construction Costs and Annual O&M costs using an interest rate of 4.5 percent for a 20-year life cycle is estimated at $21.5 million.

Appendix 2.8 of TM 2 provides details on this present worth life cycle evaluation. This appendix also contains the calculation for the present worth of a 30-year life cycle cost, estimated at $22.8 million.

Alternative 2 - Disc Filter Conversion

TM No. 3 outlines the current Deep Bed Filtration Process, summarizes available alternative filtration technologies applicable to SARWWTP, and lists details of the improvements that would be required to convert the facility to Disc Filtration.

If considered, initial conversion to Disc Filters would entail the use of Filters No. 3, 4, 5 and 6. This conversion would include retrofitting four (4), existing deep bed filters to disc filtration units with four (4) disc units per filter converted and provide an average hydraulic capacity of 3 MGD per unit. It would provide a total design average filtration capacity of 48 MGD and a peak filtration capacity of 96 MGD with all Disc Filter units in operation. With two Disc Filter units on standby, the remaining fourteen (14) Disc Filters would provide and average capacity of 42 mgd and a peak flow capacity of 84 mgd slightly exceeding the capacities of the Deep Bed Sand Filters. This proposed conversion would include the following:

1. Addition of two 42" diameter Isolation Valves on the two influent lines to the East and West side Filter Bays;
2. Use of both 42" diameter East Bay and West Bay influent pipes to feed Filters No. 3, 4, 5 and 6;
3. Addition of a new 42" pipe connection between the East Bay and the West Bay influent lines at the south end of the existing Filter Building;
4. Addition of a new 42" diameter isolation valve on the new 42" diameter connection line;
5. Structural modifications to the filter cells to accommodate the new Disc Filters, weirs, an effluent channel, Disc Filter equipment, and a canopy system for the filters;
6. New mechanical, electrical, instrumentation and control systems for the Disc Filters; and
7. Implementation of an abandonment plan for all remaining mechanical, electrical and structural components that will become obsolete upon completion of the Disc Filter conversion.

Modifications to the existing Deep Bed Sand Filters to retrofit new Cloth Media Disc Filters would include:

1. Structural modifications of four of the twelve existing Deep Bed Sand Filters (Nos. 3, 4, 5 and 6) to provide the same (or slightly more) capacity as the twelve existing filters;
2. Demolition and removal of the existing influent and washwater gullets in these four filters;
3. Building a new concrete effluent channel through the middle of these four filters;
4. Installation of a blind flanged wall pipe in the existing wall between existing Filter No. 2 and Filter No. 3 for possible future connection for conversion of existing Filters No. 1 and 2 to retro-fit new Disc Filters;
5. Removal of a part of the existing concrete wall between existing Filter No. 6 and the existing Flow Splitter Box for the two Clearwells;
6. Relocation of one of the two existing slide gates on the inlets to the two Clearwells;
7. Building four (4) new influent channels inside these four filters at the locations of the existing influent and washwater gullets;
8. Installation of gratings over the new influent channels for access to suction pipes and influent valves;
9. Building four new filter cells in each of the four existing Deep Bed Sand Filters for installation of sixteen (16) new Disc Filter units together with their filtered effluent discharge pipes and their drive units;
10. Installation of an influent valve including a hand wheel operator in each Disc Filter for isolation of units;
11. Installation of influent and effluent weirs for level control in the individual filter cells;

12. Installation of sixteen (16) new Backwash Pumps (one for each Disc Filter), together with their associated valves and controls;
13. Installation of settled solids extraction manifolds in each Disc Filter cell;
14. Installation of backwash water discharge pipes from each pump to a discharge manifold;
15. Installation of pressure transducers for level indication and floats for high-high level alarm in each filter cell; and
16. Installation of sixteen (16) new Filter Control Panels. Control Panels would include motor starters, VFD for pump, all instruments and control systems and Ethernet connections to the Main Control Panel for data transmission to the Plant's SCADA system.
17. New electrical supply facilities and motor control center;
18. New instrumentation and control system specific to operation of Disc Filters.

AECOM has developed Probable Construction Costs estimate for the above mentioned tasks for modifications to four (4) of the twelve (12) existing Deep Bed Filters to install sixteen (16) new Disc Filter Units. Table 2 presents a summary of these cost estimates. As seen from Table 2 the Probable Construction Costs estimate for modifications of the four (4) existing Deep Bed Sand Filters to retrofit sixteen (16) Disc Filter Units is $17.67 million.

Table 2 Summary of Cost Estimates for Retro-Fitting Disc Filters in Four Existing Deep Bed Sand Filters

Divisions	Details	Estimated Costs
Division 2 – Site Work	Misc. Site Work and Demolition of Filter Gullets and Underdrains	$180,000
Division 3 - Concrete	New Partition Walls, Channel Walls and Bottom Slabs	$489,000
Division 5 – Metals	Aluminum Gratings and Supports	$98,800
Division 9 - Finishes	Sand Blasting and Re-Coating of Influent Pipes & Fittings only	$66,000
Division 10 Specialties	New Disc Filter Equipment and New Roof Structure	$5,965,200
Division 11 - Equipment	Mudwell Pumps, Motors, Valve Operators	$378,900
Division 15 - Mechanical	Pipes, Valves and fittings	$683,800
Division 16 - Electrical	Electrical and I&C Equipment	$2,481,700
Sub-Total 1		**$10,343,400**
Contractor's Overhead & Profit (20%)		$2,068,700
Bonds & Insurance (2%)		$206,900
Sub-Total 2		**$12,618,900**
Contingencies 40% at Preliminary Design		$5,047,600
Total		**$17,670,000**

AECOM also prepared estimates for retrofitting twenty-four (24) Disc Filter Units in six (6) existing Deep Bed Filters (Nos. 1, 2, 3, 4, 5 and 6) to provide an average treatment capacity of 72 mgd and a peak treatment capacity of 144 mgd. Estimates of Probable Construction Costs for retrofitting twenty-four (24) Disc Filter Units in six (6) existing Deep Bed Sand Filters are presented in Table 3. Total estimated cost for this option is $ 23.96 million.

Table 3 Summary of Cost Estimates for Retrofitting Twenty Four Disc Filters in Six Existing Deep Bed Sand Filters

Divisions	Details	Estimated Costs
Division 2 – Site Work	Misc. Site Work & Demolition	$205,000
Division 3 - Concrete	New Partition & Channel Walls and Slabs	$735,800
Division 5 - Metals	Aluminum Gratings and Supports	$148,300
Division 9 - Finishes	Sand Blasting and Re-Coating of Influent Pipe & Fittings only	$66,000
Division 10 Specialties	New Disc Filter Equipment and New Roof Structure	$8,825,200
Division 11 - Equipment	Mudwell Pumps, Motors, Valve Operators, Crane and Hoist	$401,000
Division 15 - Mechanical	Pipes, Valves and Fittings	$871,400
Division 16 - Electrical	Electrical and I&C Equipment	$2,777,600
Sub-Total 1		**$14,030,400**
Contractor's Overhead & Profit (20%)		$2,806,100
Bonds & Insurance (2%)		$280,600
Sub-Total 2		**$17,117,000**
Contingencies 40% at Preliminary Design		$6,846,800
Total		**$23,960,000**

AECOM has also developed estimates of annual Operations and Maintenance (O&M) costs for the New Disc Filters retrofitted in four of the twelve existing Deep Bed Sand Filters. Operating costs are escalated at 2.5 percent per year to account for inflation. Over a 20-year operating period the estimated annual O&M costs varied from $127,250 during the first year to $237,660 at the end of the 20-year life cycle with an average annual O&M cost of $167,190. It is estimated that the Disc Filters, after the initial placement, would also require replacement of the cloth media two times (in the 7th year and in the 14th year) during the 20-year life cycle. The estimated cost of cloth media replacement on the 7th year is $377,550 and on the 14th year is $448,780. The present worth of the estimated annual O&M coast including the costs of two replacements of the cloth media is $2,764,320. The combined present worth of the Probable Construction Costs and annual O&M costs including replacements of the cloth media using an interest rate of 4.5 percent amounts to $20.4 million.

The 20-year present worth life cycle cost evaluation is included in Appendix 3.2. This appendix also contains the calculation for the present worth of a 30-year life cycle cost, estimated at $21.6 million.

3. Associated Filter System Improvements

In addition to the improvements to the overall filtration systems for either the Deep Bed Sand Filter rehabilitation, or conversion to a Disc Filtration System, there are additional improvements required within the filter building complex and associated piping that need to be considered for inclusion within the final design package. The sections below outline these improvements, their applicability to both filtration systems, and associated costs.

Filter Backwash Handling System Upgrades

Filter backwash effluent collected in the Filter Building Mudwell is currently pumped via one (1) of three (3) Non-Clog Vertical Centrifugal Pumps into a 24-inch diameter forcemain. This 24" diameter force main reduces down to a 14-inch diameter forcemain for installation of a Magnetic Flow Meter. The 14" diameter force main increases to a 24" diameter force main before it exists out of the Mudwell Room. This 24" diameter force main discharges into an existing 9'- 6" by 9'- 6" by 16'- 9" high Filter Backwash Splitter Box located between Trains A and B of the plant. From this Splitter Box, the backwash water flows over a weir plate into the discharge box and exits via two (2) 12-inch gravity sewers to the flow equalization structures of both Train A and Train B. Currently, pipe connectivity is only provided to Train A because (according to plant staff) a section of the 12-inch sewer to Train B was removed in a previous repair project and was not replaced. The Filter Improvements project shall include reconstruction of the filter backwash handling system in order to provide backwash discharge connectivity to Trains A, B, and C.

The routing options for this backwash discharge system were developed. In determining the suitable route for the backwash discharge systems for the three Treatment Trains, the congested nature of the existing yard piping that are located along these routes has been taken into account.

Routing of New Backwash Water Discharge Lines

Various routing alternatives were developed based on the following variables:

1. Investigations of several locations for construction of a new Backwash Water Splitter Box.
2. **In Alternative 1** a large part of the existing force main will be abandoned and remainder will be extended to a New Backwash Water Splitter Box (located at the northeast corner of existing Primary Clarifier No. 2A). New gravity sewer lines will be built from this New Backwash Water Splitter Box to the existing Backwash Water Splitter Box for Trains A and B and to the Influent Box of Train C.
3. **In Alternative 2** the existing force main from the existing Mudwell Pumps will discharge flow to two Backwash Water Splitter Boxes. Two-third of the total Backwash Water flow will be discharged by the existing force main to the existing Backwash Water Splitter Box (located between Trains A and B). The remaining one-third of the flow will be discharged first to a New Backwash Water Splitter Box to be located northeast of the existing Primary Clarifier No. 2A and then by a gravity sewer to the Influent Box of Train C.
4. **In Alternative 3** the existing force main from the existing Mudwell Pumps will discharge flow to two Backwash Water Splitter Boxes as in Alternative 2. Two-third of the total Backwash Water flow will be discharged by the existing force main to the existing Backwash Water Splitter Box (located between Trains A and B). A new gravity sewer line from the new Backwash Water Splitter Box will be built to deliver one-third of the Backwash Water flow to the influent Box of Train C.
5. **In Alternative 4** two Force mains will deliver the Backwash Water from the existing Mudwell Pumps to the three Treatment Trains. One of the two force mains will be the existing force main to the existing Backwash Water Splitter Box (located between Trains A and B) delivering two-third of the total flow. A new force main from the existing Mudwell Pumps to the Influent Box of Train C will deliver one-third of the total backwash Water Flow to this Train.
6. One new gravity sewer line will connect from the New Backwash Water Splitter Box to the existing Backwash Water Splitter Box (located between Trains A and B) for discharge of the combined backwash water flows for Trains A and B; and
7. Another gravity sewer line will connect from the New Backwash Water Splitter Box to the Influent Box for Train C.

The recommended alternative includes the following:

1. A new Backwash Water Splitter Box to be constructed at a location in between all three (3) trains on the west side of the access road between the two existing Flow Equalization Basins 1A and 2A to the east side of the Access Road;
2. The existing 24" diameter force main will be extended along the Access Road from the point where it turns west towards Treatment Train A to the new Backwash Water Splitter Box;
3. The remainder of the existing 24" force main from this new connection point to the existing Backwash Water Splitter Box will be abandoned;
4. Following completion of this new section of 24" diameter force main, the Backwash Water will be pumped to this new Backwash Water Splitter Box;
5. The new Backwash Water Splitter Box will have two overflow weir plates, and two outlet boxes;
6. One outlet box will connect to Treatment Train C through a new 12-inch gravity sewer pipe;
7. Second Outlet Box will connect to the existing Splitter Box between Treatment Trains A and B through a new 18" diameter gravity sewer pipe;
8. The disconnected (for repair) 12" diameter sewer pipe from the existing Backwash Water Splitter Box to Treatment Train B will be reconnected and restored; and
9. The existing Backwash Water Splitter Box will then feed both Treatment Trains A and B.

Estimates of probable construction costs for the selected Backwash Water Line were developed, including the (a) New Force Main, (b) New Backwash Water Splitter Box, (c) the New 18" diameter Gravity Line from the New Splitter Box to the Existing Splitter Box, and (d) the New Gravity 12"gravity line to Train C. Engineer's opinion of Probable Construction Cost including costs of borings, Contractor's overhead and profit, bonds and insurance, and 40 percent contingency for Preliminary Engineering is estimated at $900,000. The complete analysis is presented in Appendix 1 of this PER and a layout of the recommended option is also presented in the Alternative 1 figure of this appendix.

Splitter Box Sizing and Structural Requirements

Based on the recommended alternative layout of the filter backwash system improvements for delivery to the three Treatment Trains, the proposed splitter box was initially sized to accommodate the incoming 24" forcemain, and the two outgoing gravity sewer lines. One 12" diameter sewer line will connect the New Backwash Water Splitter Box to Treatment Train C and another 18" diameter gravity sewer line will connect it to the existing Backwash Water Splitter Box feeding the two Treatment Trains A and B. The weirs in the new Backwash Water Splitter Box will be sized to allow one-third of the incoming flow to Treatment Train C and the remaining two-third of the incoming flow going to the existing Splitter Box feeding Treatment Train A and B. On this basis, the geometry of the splitter box is estimated to be approximately 15 feet long, 10 feet wide and 22 feet deep.

Chlorine Line Addition to Filter Building

Currently, an existing 6" chlorine line enters the filter building in the Blower Room and connects into the two 42" diameter effluent lines located inside the Lower Pipe Gallery, prior to the connections of these two 42" lines to the Clearwell Splitter Box. Plant staff requested a redundant Chlorine Feed line. Based on review of the record drawings, AECOM identified an existing Chlorine Solution Line on the East Side of the Filter Building. This Chlorine Line is the feed for the Plant Drain, and therefore is only used during overflow situations. This line can be tapped into for a new chlorine feed into the Filter Building. The location of this connection point will depend on the Filter Technology (either improvements and upgrading of the existing Deep Bed Filters or retro-fitting of new Disc Filters in some of the existing Filters) selected by the City. A plan drawing, showing the route of the existing

Auxiliary CS-6" line and the proposed location of the new tap for the Filter Building is presented in Exhibit 4.1.

Chlorine Line Addition for Deep Bed Filter System

For the rehabilitation of the Deep Bed Filter System, the Chlorine Feed Line is proposed to enter on the North Side of the Filter Building in the vicinity of the stairwell to the Lower Pipe Gallery. From there, the piping would be routed along the walls. The Chlorine Feed Pipe will be supported by a new support system installed on the walls and/or the ceiling to the proposed connection points to the east of the two (2) 42" effluent pipes.

Chlorine Line Addition and Existing Chlorine Line Extension for Disc filters

For the proposed conversion of the existing Deep Bed Filters to retrofit new Disc Filters, the existing effluent piping in the Lower Pipe Gallery will no longer be used. As a result the layout for the proposed Chlorine Line would be different. For this option the Chlorine Feed Line is proposed to enter the Filter Building on the South Side of the Filter Building. The pipe penetrations for the two Chlorine Lines will be through the wall in the East Side Filter area. The two Chlorine Feed Lines would be supported on the walls along their length to the proposed connection points of the two diffusers installed directly into the Clearwell Flow Splitter Box. Only one of the two Chlorine Feed Lines and one chlorine diffuser will be in use while the second Chlorine Feed Line and the second diffuser will be on stand-by.

Filter Complex Structural Modifications

For this project, structural investigations and preliminary analyses of the structural components, issues of concern, and/or improvements being considered within the SARWWTP Filter Building complex were provided. The discussion below lists the items considered and their components.

Expansion Joint Repair

Record drawings indicate an existing expansion joint that "joins" the northern and southern halves of the building horizontally, and vertically from the control room floor (El. 419) down to the floor slabs of the Lower Pipe Gallery, Mudwell, and the two Clearwells (El. 389). Visual inspection of the expansion joint in some locations of the Filter Building indicates expansion and separation. A separate inspection of both Clearwells No. 1 and No. 2 was performed by plant staff shortly before the onset of this Filter Rehabilitation and Upgrading Project. The inspection and investigation by plant staff indicated:

1. Various levels of sediment accumulation in both Clearwells;
2. Significant leaking along the expansion joint in Clearwell No. 1: and
3. Some minor leaking of the expansion joint in Clearwell No. 2.

The expansion joint was investigated based on both record drawings and a site visit to the Filter Building in order to develop a repair approach that will include a sealing system for the expansion joint. The Probable Construction cost of the expansion joint repair is estimated to be approximately $250,000.

Clearwell Hydraulic Modifications

Through the process of evaluating the filter system hydraulics, identifying hydraulic limitations, controlling elevations for discharging design flows, and other "bottlenecks" in the piping and building systems, a potential improvement option is developed. This improvement option requires modifications of the Clearwells in the vicinity of the Backwash Pump Room.

TM No. 1 for the Hydraulic Evaluation defined that maintaining a minimum 18 inches of freeboard at the outlet of the Clearwells is a limiting criterion. Currently the record drawings show that the Clearwell roof is at El. 408 with stairs going up to an intermediate level in the backwash pump room. The floor level at this location above the Clearwells is at El. 412. This floor slab acts to limit the maximum water level in the two Clearwells in order to insure 18" of clear freeboard. In order to eliminate this hydraulic limitation a section of the concrete slab in the Backwash Pump Room and over the Clearwells need to be removed. By removing a section (17'- 6" wide by 40'- 8" long) of the concrete slab in the Backwash Pump Room floor and the roof over part of the two Clearwells at El. 408 and reconstructing this concrete slab at a new El. 412, significant hydraulic head can be gained. This increase in hydraulic head increases capacity of the filter building by allowing more elevation head in the Clearwells, and reducing the frequency of potential building flooding from high levels in the Colorado River or other flooding events. Removal of the existing stairs leading to the Backwash Pump Room and their reconstruction from El. 404 to the new floor elevation at El.412 would be required. In addition new stairs from the raised floor at El. 412, back down to the Backwash Pump Room floor level at El. 408 would be required.

The structural modifications required to accomplish this change were investigated. The following approach is proposed:

1. Saw cut and Remove existing slab & reinforcing, etc.;
2. Build new Backwash Pump Room floor and new roof over part of the two Clearwells;
3. Build a new Stair from existing floor El. 404 to new roof slab over the Clearwells at El. 412; and
4. Build another new stair from the new roof over the Clearwells at El. 412 down to the top of the Backwash Pump Room floor at El. 408.

The Probable Construction Cost of the proposed modifications of the roof over the Clearwells was estimated to be about $500,000.

The results of these investigations are included in Appendix 2.

Control Room Tile Replacement

The upper level Control Room at El. 419 of the Filter Building is a large open room, approximately 26'- 8" wide by 185'- 9" long. The walls on both sides are glass window-walls built to allow observation of the filters on both sides of the building. There are also four (4) doors from the Control Room to the outside for access to the filter catwalks.
The existing flooring system consists of 12"x12" vinyl tiles. These tiles were installed in 1988 during construction of the Filter Building. Review of the record drawings and specifications, and AECOM inspection of the floor tiles during site visits confirmed this. In general, the tiles are in poor condition with a good portion of the tiles being cracked, some have peeled, some are missing, and others are in the process of peeling.

It is believed that the cause of the current poor condition of the tiles is either inadequate or improper or degraded sealing of the floor slab beneath the tiles and above the upper gallery roof slab. Because of the potential for high level of moisture in the Filter Building, the sealant used during construction has likely deteriorated over time. Another potential cause for the degradation of the tiles is the exposure to sunlight and UV coming into the Control Room through the glass windows along the two walls of the Control Room gallery.

The current condition of the floor tiles is a serious tripping and safety hazard.
To eliminate this tripping and safety hazard, the filter building improvements need to include removal of the original tiles, repair the floor and replace these tiles with new UV resistant floor tiles as part of the Rehabilitation and Upgrading of the Filters. The recommended improvement option is to remove the existing tiles, re-seal the floor with an epoxy system and place new vinyl tiles to be selected by the plant staff.

The Probable Construction Cost for the Control Room floor repair and replacement is estimated by Guerra to be approximately $100,000. The results of these investigations are included in Appendix 2.

Abandonment Plan for Disc Filter Conversion

As discussed in TM No. 3 in the conversion to new Disc Filters alternative, much of the existing piping, valves, pumps, flow meters, valve operators, west side filter cells, and electrical components will no longer be required for service once the east side filters are converted to Disc Filters. These equipment items and other facilities would have to be abandoned and left in place to minimize the cost of upgrading and retro-fitting the existing filters with new Disc Filters. The abandonment plan for unused equipment and facilities would include:

1. Draining of the unused filter cells;
2. Pumping out the original sand media;
3. Draining and dewatering all pipes not needed in the future;
4. Capping off unused pipes with blind flanges;
5. Closing all unused valves; and
6. Disconnecting power supply to all valve operators not needed in the future.

The Probable Construction Cost of implementing this abandonment plan for unused equipment and facilities was conceptually estimated. A tabulation of this estimate is included in Appendix 3. This potential cost is difficult to accurately define and suggest that ultimately this be a cost allowance with final design defining a prioritized list of abandonment tasks to be performed. This will provide the most effective use of this allowance.

4. Comparison of Estimated Costs for the Two Alternatives

A comparison of the estimated costs for the two alternatives considered for the SARWWTP Filters is presented in Table 4. The estimated Probable Construction Costs for restoration and upgrading of the existing Deep Bed Sand Filters is $17.78 million. The estimated Probable Construction Costs for retrofitting new Disc Filters in four (4) of the twelve (12) existing filters is $17.67 million.

As seen from the costs presented in Table 4 the Probable Construction Costs of the Disc Filters is slightly lower than the Probable Construction Costs for Restoration and Upgrading of the Existing Deep Bed Sand Filters. The differential in estimated costs is approximately $110,000. This is about 0.6 percent of the Probable Construction Costs of Restoration and Upgrading the Existing Deep Bed Sand Filters.

The estimated average Annual Energy Cost (using $0.11 per KWH) for the Existing Deep Bed Sand Filters is significantly higher (about $107,000) than that for the Disc Filters. This difference in annual average energy costs for the two Alternatives would increase further if electrical power costs go up in the future. However, the Disc Filters have equipment replacement costs over the 20-year life cycle for replacement of V-Ring Seals and the Cloth Media. The average annual cost for equipment replacement for the Disc Filters is less than $42,000. As presented in Table 4 the present worth of the annual O&M Costs including equipment replacement for the Disc Filters is approximately $2.8 million while the present worth of annual O&M Costs for the existing Deep Bed Sand Filters is approximately $3.8 million over the 20-year life cycle. The difference between the two alternatives is about $1,000,000 and is higher for the alternative for restoration and upgrading of the existing Deep Bed Sand Filters than that for the Disc Filters. The higher O&M cost for the existing Deep Bed Sand Media Filters is primarily due to the high energy costs.

Table 4 Comparison of Capital and O&M Costs For 20-Year Life Cycle

Alternative	Probable Construction Costs	Average Annual O&M Costs	Estimated Average Annual Equipment Replacement Costs	Present Worth of Annual O&M Costs	Present Worth of Probable Construction Costs and O&M Costs
Restoration and Upgrading of Existing Deep Bed Sand Filters	$17,780,000	$279,760	0	$3,766,700	$21,500,000
Retro-fitting Sixteen Disc Filters in four Existing sand Bed Filters	$17,670,000	$167,190	$41,316[1]	$2,764,300	$20,400,000

1 Two time replacements of V-Ring Seals and Cloth Media for Disc Filters

Appendix 3.2 contains the calculations for the 20-year present worth life cycle cost evaluation for both alternatives. This appendix also contains the calculations for the present worth of a 30-year life cycle cost for both alternatives. Since the O&M costs for the Existing Deep Bed Sand Filters alternative are greater than those for the Disc Filters alternative, the cost savings for the Disc Filters alternative increases with the longer 30-year analysis.

5. Available Alternatives and Recommendations

There are two feasible alternatives available to the City of Austin for the existing filters at the SARWWTP. These are as follows:

1. Restore and Upgrade the existing Single Media Deep Bed Sand Filters to meet the Original Design Basis; or

2. Modify the existing filters to retrofit new Cloth Media Disc Filters within the existing foot print.

The existing Single Media Deep Bed Sand Filters have provided reliable filtration of the secondary effluent for more than 20 years meeting the Permit discharge limits. Only in recent years these filters have indicated reduced performance and periodic excursions.

There are several possible reasons for this deterioration of performance. AECOM investigations and evaluations indicate that the following factors may have negatively impacted the existing filters:

1. Changed operations that has gradually deviated from Original Design Basis;
2. Manual and excessive filter backwashing not conforming to Design Criteria;
3. Media stratification due to excessive and higher rates of filter backwashing;
4. Possible deterioration of filter underdrain system and possible breaks in the precast concrete underdrain slab;

5. Significant media loss in some filter(s) due possibly to breakage in underdrain system;
6. Possible localized encrustation of the media and carbonate formation in the filter bed due to inadequate backwashing and media stratification; and
7. Possible non-uniform distribution of backwash air and water flows.

All of these causes of deterioration of the filters can be corrected. Draining of some of the filters, removal of filter media to inspect the condition of the filter underdrian system including the precast concrete slabs and air/water backwash nozzles are necessary. Removal and replacement of the existing filter underdrain system in some or all of the filters is a distinct possibility. In addition, replacement of the filter media with new media would be necessary to restore the filters to original condition with an unstratified media. All of these will require time and effort. As presented in Section 3.4.1 the estimated Probable Construction Costs for these filter restoration efforts are high.

Restoration of the existing Deep Bed Sand Media Filters to their Original Design condition would provide an average design flow of about 40 mgd and a peak design flow of about 80 mgd with eleven (11) filters operating and one filter on standby mode or backwashing. In the future, if the City of Austin decides to filter wastewater effluent from existing Treatment Trains A, B, and C at the SARWWTP, then a new Filter Building, and appurtenant influent and effluent conduits would be needed to provide the required additional capacity.

The alternative to restoration of the existing Deep Bed Sand Media Filters would be conversion of the existing filters to retrofit new Cloth Media Disc Filters. Retrofitting four (4) of the existing filters with Disc Filters to install sixteen (16) units would provide an average filtration capacity of 48 mgd and a peak filtration capacity of 96 mgd. With two (2) Disc Filter units in standby mode and the remaining fourteen (14) Disc Filters operating, the average filtration capacity would be 42 mgd and the peak filtration capacity would be 88 mgd. These capacities of the Disc Filters exceed the capacities of the twelve (12) existing Deep Bed Filters. If the City desires to have additional filtration capacity in the future, then conversion of a few more of the existing Deep Bed Filters would provide that capacity. The exact number of Deep Bed Filters requiring conversion and retrofitting with Disc Filters in the future would depend on the filtration capacity required by the City.

Conversion and retrofitting of all six (6) existing Deep Bed Filters on the East Filter Bay to retro-fit twenty-four (24) new Disc Filter units would give an average filtration capacity of 72 mgd and a peak filtration capacity of 144 mgd. This would provide sufficient capacity to treat effluent from Treatment Trains A, B, and C.

Conversion and retrofitting of all twelve (12) existing Deep Bed Filters into Disc Filters would give an average filtration capacity of 144 mgd and a peak filtration capacity of 288 mgd. These filtration capacities are far more than the capacities the City would ever need at the SARWWTP. However, attaining these high capacities would require building additional incoming conduits to and outgoing conduits from the existing Filter Building.

The potential for increasing filtration capacity at the SARWWTP without constructing an additional Filter Building makes the Disc Filters alternative more attractive.

6. Recommendation

As presented in Section 4.3, the Probable Construction Costs of modifications, restoration and upgrading of the existing Deep Bed Sand Filters at the SARWWTP to restore the Filtration Capacity of 40 mgd average and 80 mgd peak with one filter out of service is estimated at $17.78 million. To provide additional filtration capacity beyond the 40 mgd average and 80 mgd peak a new Filter Building would be required.

The probable construction costs for conversion, retrofitting and installation of sixteen (16) Cloth Media Disc Filters in four (4) of the twelve (12) existing Deep Bed Filters (Nos. 3, 4, 5 and 6) is estimated at $17.67 million. This probable construction cost for retro-fitting sixteen (16) new Disc Filter units is about 0.6 percent lower than the probable construction cost of upgrading and restoration of the twelve (12) existing Deep Bed Sand Filters.

The present worth of Probable Construction Costs and estimated 20-year annual O&M costs for the restoration, modifications and upgrading of the existing Deep Bed Sand Filters is about $21.42 million and the same for retro-fitting sixteen (16) new Disc Filter units is about $20.43 million. The present worth of costs for retro-fitting the Disc Filters is about 4.6 percent lower than restoration and upgrading of the Deep Bed Sand Filters. This difference in present worth costs between the two alternatives is small and would be increase slightly if the energy and power costs increase in the future.

Installation of Disc Filters in four (4) of the existing Deep Bed Filters at the SARWWTP have the following advantages:

1. It would provide the City with state-of-the-art Filtration Technology;
2. It would provide better quality effluent with expected turbidity in the filtered effluent below 2.0 NTU;
3. It would provide more than the current filtration capacity in a much smaller foot print;
4. It would provide the city with ability to significantly increase future filtration capacity using only one bay of the existing filters in one Filter Building;
5. It will provide operators easier access to equipment and controls; and
6. It will simplify, reduce and fully automate O&M requirements.

Considering all of these factors and their impact on the City and Plant Operators, AECOM recommends the following:

1. **Convert existing Deep Bed Sand Filter Nos. 3 – 6 to Disc Filters.**
2. **Replace mudwell pumps and revise pipeline.**
3. **Add chlorine line.**
4. **Repair expansion joints.**
5. **Replace slab over clearwell.**
6. **Replace floor tile.**
7. **Abandon existing filter facilities.**

Exhibits 3.1, 3.2, 3.3, and 3.4 from TM No. 3 are attached for reference. Exhibit 3.1 shows a Preliminary Process Flow Schematic for retrofitting new Disc Filters within existing Filters No. 3, 4, 5, and 6. Exhibits 3.2, 3.3, and 3.4 show a plan and sections for the proposed improvements.

The Alternative 1 figure in Appendix 1 shows the recommended backwash piping layout.

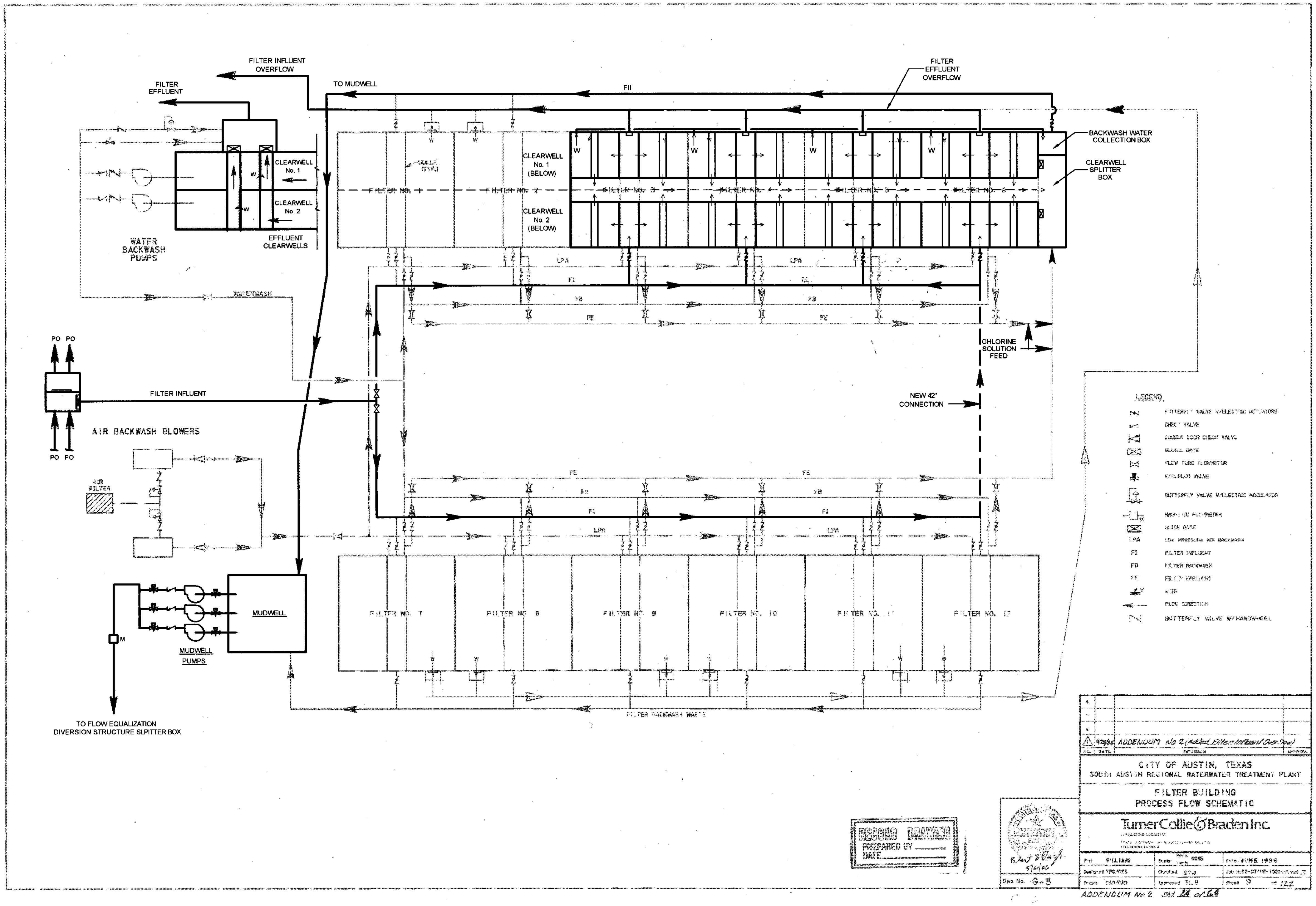
7. Cost Summary

The following is a summary of the estimated Probable Construction Costs for the recommended filter improvements at the SARWWTP.

A.	Installing Disc Filters in four Sand Filters	$17,670,000
B.	New Splitter Box and Backwash Water System	$ 900,000
C.	Expansion Joint Repair	$ 250,000
D.	Replacing Slab over Clearwells	$ 500,000
E.	Control Room Floor Repair and Tile Replacement	$ 100,000
F.	Equipment Abandonment Plan	$ 250,000

	Total	**$19,670,000**

Exhibits



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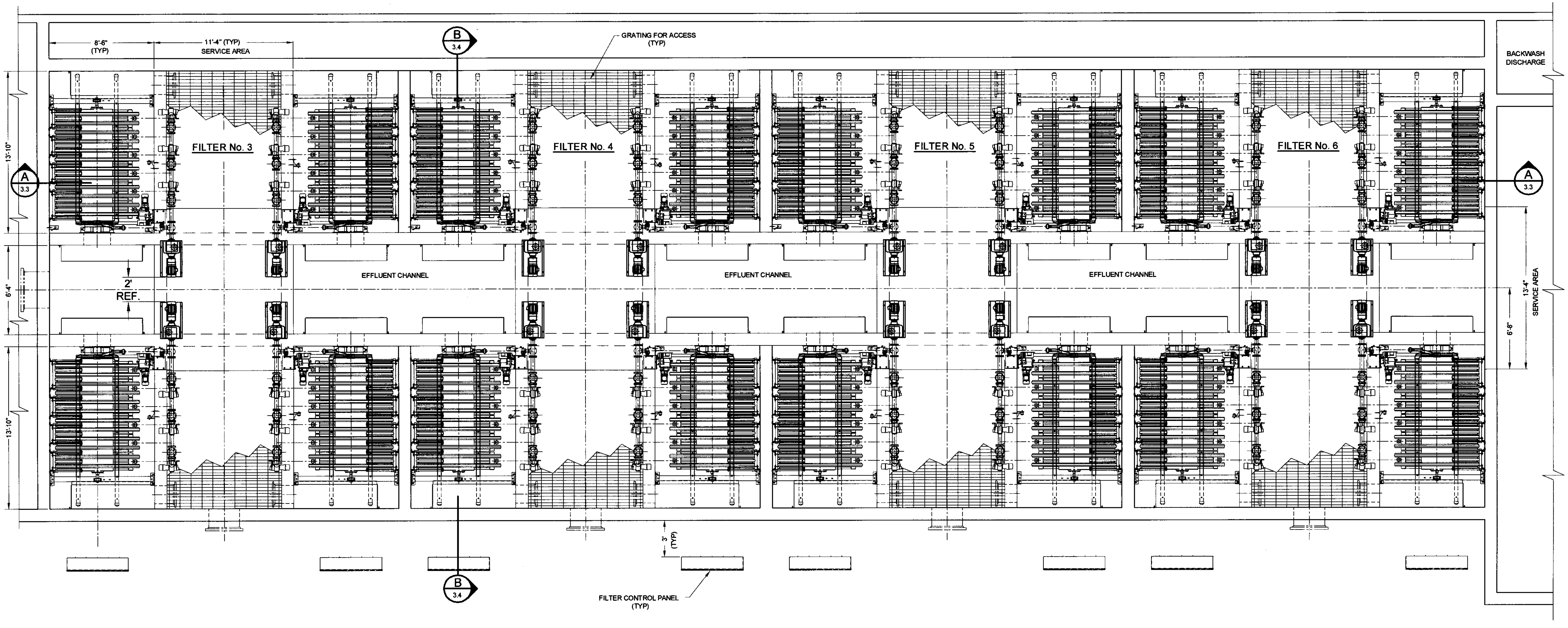
CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

DISC FILTER SYSTEM SCHEMATIC
INFLUENT, EFFLUENT & BACKWASH PIPING

AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

Exhibit No. 3.1	JOB No. 60213591	DATE: JANUARY 2012



PLAN VIEW 1 -
NTS

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

RETRO-FITTING OF DISC FILTERS
PLAN VIEW

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Exhibit No. 3.2 | JOB No. 60213591 | DATE: JANUARY 2012

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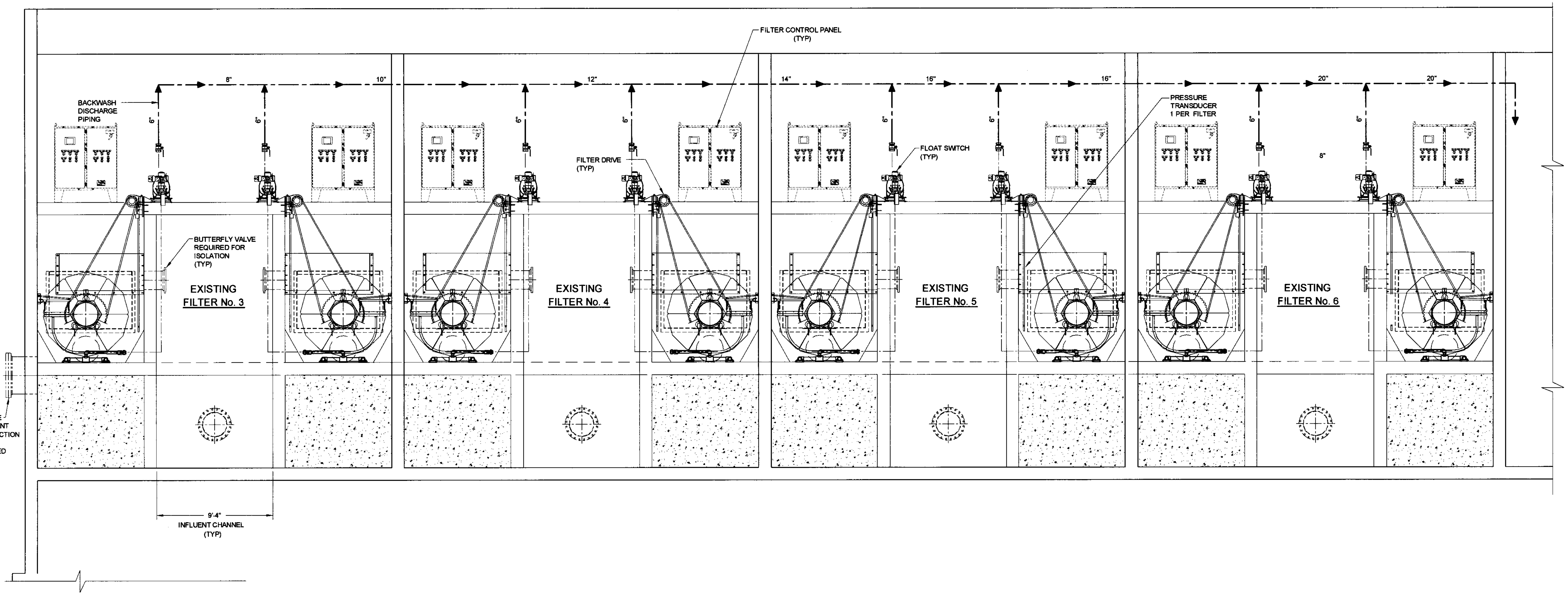

SECTION A
NTS 3.2

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CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

RETRO-FITTING OF DISC FILTERS
SECTION A

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400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
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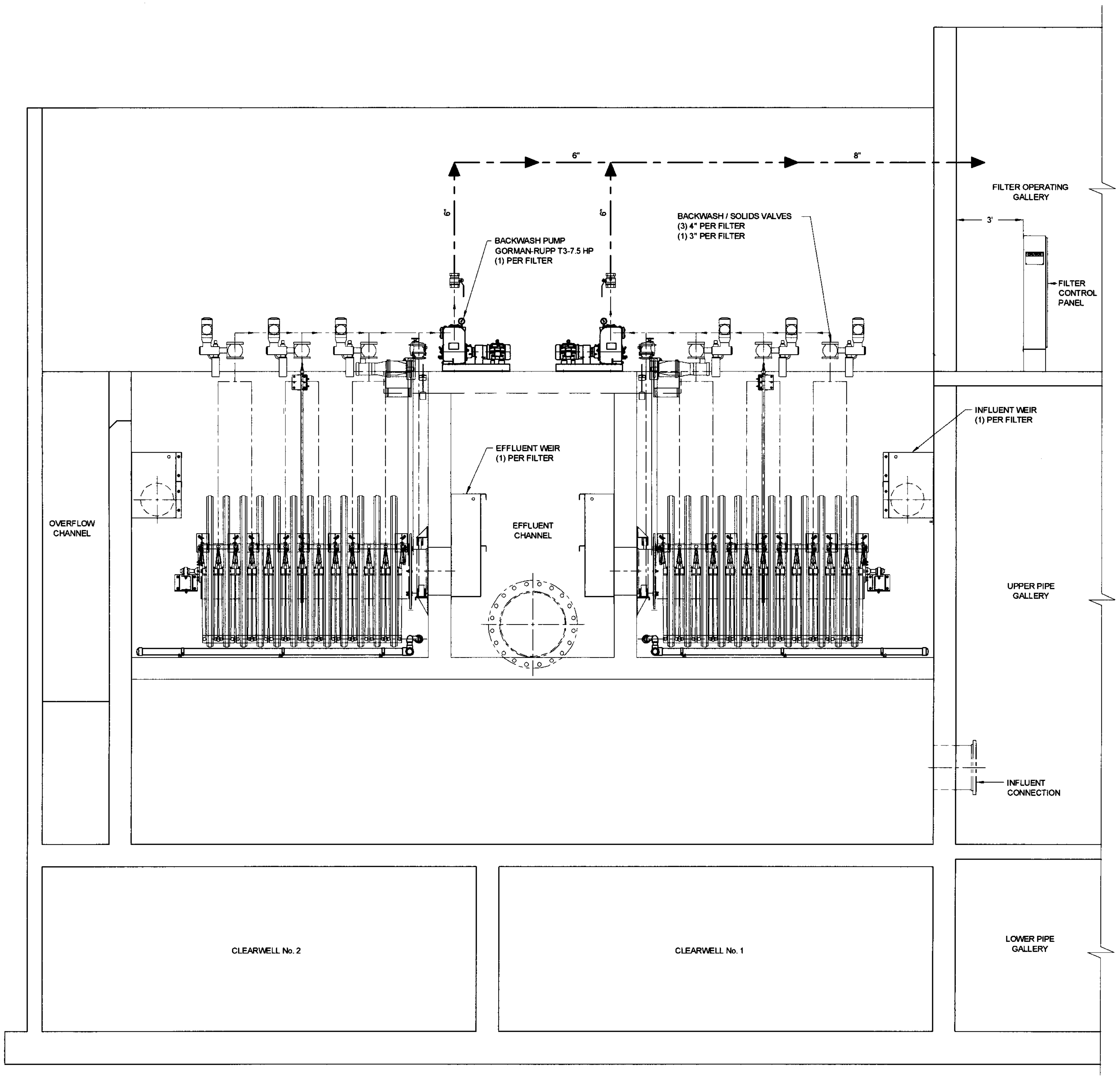
Exhibit No. 3.3	JOB No. 60213591	DATE: JANUARY 2012



SECTION (B / 3.2)
NTS

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

RETRO-FITTING OF DISC FILTERS
SECTION B

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Exhibit No. 3.4	JOB No. 60213591	DATE: JANUARY 2012

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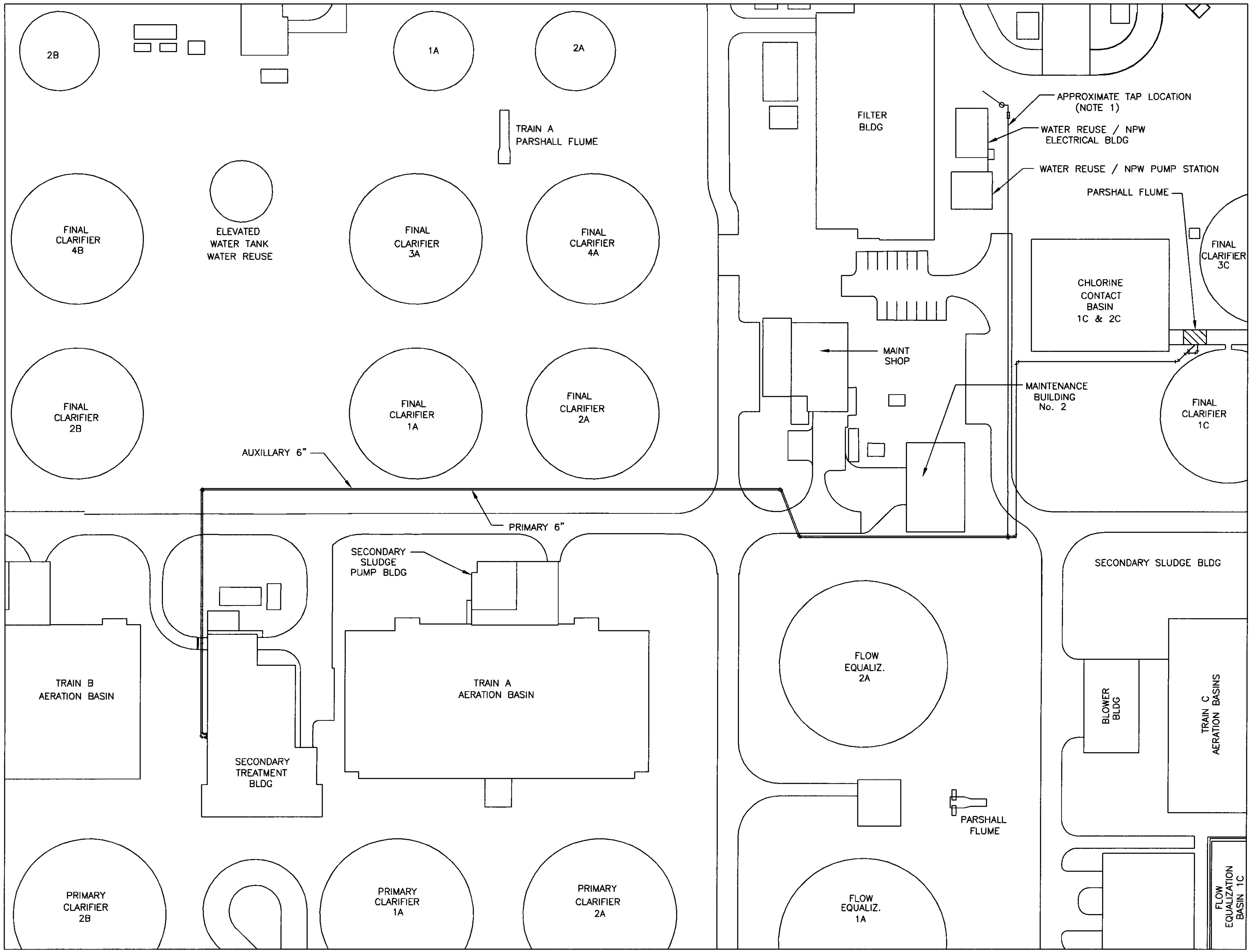

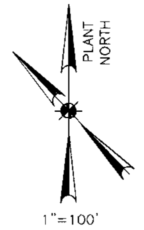

NOTE:

1. SECONDARY FILTER BUILDING CHLORINE SOLUTION FEED LINE TAP PRIOR TO VALVE Y-DV-1. PIPE ROUTING DEPENDENT ON FILTRATION TECHNOLOGY CHOSEN.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER BUILDING
CHLORINE SOLUTION LINE

AECOM
AECOM
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AUSTIN, TEXAS 78701
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EXHIBIT No. 4.1 | JOB No. 60213591 | DATE: DECEMBER 2011

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Appendix 1:

Filter Backwash System Modifications

State of Texas
Registered Firm
No. F-3572

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Civil Engineering, Program Management & Construction Management
Austin • Dallas • Houston • San Antonio

3-23-2012

AMY LYNN MIDDLETON
107560

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT FILTER IMPROVEMENTS

INTRODUCTION

The South Austin Regional Wastewater Treatment Plant (SARWWTP) is one of the two wastewater treatment plants in the City of Austin (COA). SARWWTP treats an average flow of 75 million gallons per day (MGD).

This phase of the project will consist of the project team identifying and evaluating potential design alternatives for filter improvements at SARWWTP. The project team will evaluate hydraulic, process, mechanical, electrical and instrumentation/control systems as part of the overall project. As part of this evaluation routes for the Filter Backwash Handling System to allow the backwash water to be distributed to Train A, B, or C were investigated. The project team has examined four potential route alternatives while considering the minimization of interference with existing structures and utilities.

PROJECT HISTORY

According to records, the SARWWTP Filter Building flooded in the early 1990's and many of the pipes, valves and control devices in the lower levels were submerged. A subsequent electrical improvement project modified the electrical duct bank entrance into the Filter Building and replaced some of the at-grade incoming power equipment. During the SARWWTP Train C Expansion project, additional exterior pipe modifications were made to address hydraulic issues with the Filter Building. However, no engineering evaluation and/or rehabilitation of the entire Filter Building and filter cells have been performed. The SARWWTP staff has performed overall operation and maintenance of these filters, and in doing so, has very likely replaced some of the damaged and inoperable equipment within the building. Additionally, events within the SARWWTP have impacted the operation of the filters. All of these events have resulted in operational problems that require rehabilitation in order to provide an acceptable level of service from the filters.

Backwash water from the filters is pumped from the existing mudwell to a splitter box for diversion to Train A and B. However, Train B is not currently operational because a segment of pipe delivering backwash water is missing. As a result only Train A is receiving filter backwash water and conveyance to Train B needs to be repaired. Ultimately, the objective is to deliver filter backwash water to Trains A, B, and C.

Austin Office
7908 Cameron Road
Austin, Texas 78754
(512) 836-2388
Fax (512) 836-4515

Dallas Office
1820 Regal Row, Ste 200
Dallas, TX 75235
(214) 589-6942
Fax (214) 638-3723

Houston Office
10497 Town & Country Way Ste 220
Houston, TX 77024
(512) 836-2388
Fax (512) 836-4515

San Antonio Office
700 E. Sonterra Blvd., Ste 1206
San Antonio, Texas 78258
(210) 248-9083
Fax (210) 248-9155

www.casengineers.com

DATA COLLECTION

The following documents were provided to the project team for reference purposed in order to complete this analysis:

- SARWWTP Operations Manual - Section V - Description, Operation, and Control of the Filter Building.
- Select Turner Collie & Braden, Inc. South Austin Regional Wastewater Treatment Plant Record Drawings dated June 1986, January 2002, and July 2002.

The project team made the assumption that the documents provided used the same datum for elevations and that the equipment shown in the record drawings provided are still in service.

EXISTING CONDITIONS

The Filter Building is located in the northeast corner of the plant site. The Filter Building was constructed in 1988 as part of the Train B expansion. In the early 2000's, the plant was expanded to include Train C. The SARWWTP operation staff indicated a general satisfaction with the performance of these filters. However, these filters are over 20 years old and have not had major rehabilitation since they were constructed. The SARWWTP maintenance staff performed routine maintenance and some repair but these were inadequate to maintain an acceptable level of performance.

The SARWWTP filtration facilities consist of deep bed sand filters, backwash pumps, blowers, mudwell pumps, clearwell and a mudwell. There are two filter bays, each having six filter cells. Each filter cell has two filter beds separated by a center collection trough. There is a 72-inch filter influent line that branches into two (2) 42-inch filter influent headers. Each of the influent headers feeds one of the filter bays via the center collection trough.

The filters are used as a tertiary treatment to improve the effluent quality before discharging into the Colorado River. The filters remove suspended solids which are deposited on the filter media and/or trapped in the pores between the media particles. As the use of the filter continues, the solids accumulate and clog the pores in the filter media. This increases the resistance to the passing of effluent through the filter, causing increased headloss through the filter. Filter cleaning is a necessary part of the filter and this is accomplished by periodically backwashing the filter with a combination of air and water. The filter media used at the SARWWTP is a single media deep bed unstratified filter and consists of a four foot deep course sand media.

The dirty water generated during the filter backwash cycle is collected and temporarily stored in a mudwell located in the lower level of the Filter Building. The mudwell acts as an equalization basin, allowing the wash water to return to the treatment plant at a low flow rate to prevent hydraulic and organic surge loadings into the treatment process. The wash water in the mudwell is pumped by one of the three non-clog vertical centrifugal pumps to a flow splitter box. The incoming backwash water is normally delivered to the flow equalization diversion structures of treatment Trains A and B for additional treatment. The existing line to Train B has a segment of the line missing. As a result the Train B line is not currently functional. All backwash water is now delivered to Train A. Currently the Train C Aeration Basin is not designed to receive any of the mudwell flows.

PROPOSED ALTERNATIVES

The goal of this project is to make improvements to the Filter Backwash Handling System to allow the delivery of backwash water to Train A, B, and C. Four alternatives were examined to provide flow to the three trains. Please refer to the related exhibits (Exhibit 1, 2, 3, & 4).

- Alternative 1 (See Exhibit 1) – In this Alternative the existing mudwell pumps will deliver the backwash water from the mudwell to a proposed flow splitter box located at south east corner of Train A Aeration Basin. All flows from the proposed splitter box would flow in gravity lines to the three Trains for treatment. One line would be provided to deliver the backwash water to the Aeration Basins in Train A and B and another line would deliver flow to Train C. The proposed splitter box weirs would be designed to have a 66/34 split between Trains A/B and Train C respectively. The backwash water flow for Trains A and B would be diverted to the existing flow splitter box located between the two trains. The gravity line between the splitter boxes would be under surcharged condition. Half of the flow would be delivered to Train A and the other half would be delivered to Train B. Existing overflow weirs would be modified to assume this 50/50 split of the incoming backwash water. Existing lines would be used to deliver the backwash water. The missing segment of line to Train B would need to be installed to have this functioning again. Backwash flows to Train C would flow by gravity to the Aeration Basin and the gravity line to Train C would be under surcharged conditions.

  For this alternative the pumped portion would encounter three (3) utility crossings and two (2) culvert crossings, and the gravity portion would encounter twenty-three (23) utility crossings, and two (2) roadway conflicts, as noted on Table 1 below. The tree (just northwest of the filter building) would not be impacted by Alternative 1.

- Alternative 2 (See Exhibit 2) – The existing pumps would deliver the backwash water flow from the mudwell to two flow splitter boxes. One splitter box is the existing splitter box and the proposed splitter box would be located to the east of the Train A Final Clarifier No.4. The existing filter box would serve Train A and B using existing gravity lines, but a new segment would need to be installed to have the line for Train B functioning again. Train C would be served by the proposed splitter box near Final Clarifier 4A. The backwash water would gravity flow by to the equalization basins for Train C.

  This alternative limits excavation, since the existing line and splitter box will be in use as part of this alternative. The gravity portion leading to Train C would encounter at least eighteen (18) utility crossings, one (1) roadway conflict, two (2) storm culvert crossings, and an intersection, as noted on Table 1 below. The tree (just northwest of the filter building) would not be impacted by Alternative 2.

- Alternative 3 (See Exhibit 3) - The existing pumps would deliver the flow from the mudwell to two flow splitter boxes. One splitter box is the existing splitter box and the proposed flow splitter box would be located northwest of the Filter Building, near the Power Center. The existing splitter box would serve Train A and B by gravity using the existing piping, but a new segment would need to be installed to have the line for Train B functioning again. Train C would be served by the proposed splitter box northwest of the Filter Building. The backwash water would then flow by gravity to the Flow Equalization Basins for Train C.

This alternative limits excavation, since the existing line and splitter box will be in use as part of this alternative. The gravity portion leading to Train C would encounter at least seventeen (17) crossings, two (2) roadways, a parking lot, and a tree root zone, as noted on Table 1 below. The tree (just northwest of the filter building) would need to be removed for this alternative.

- Alternative 4 (See Exhibit 4) - The existing pumps would deliver the flow from the mudwell via two forcemains with valves located at the mudwell to either direct the flow to the existing piping leading to Train A and B or to a new forcemain which leads to Train C. Train A and B would be serviced by existing infrastructure, but a new segment would need to be installed to have the line for Train B functional again.

  This alternative limits excavation, since the existing line and splitter box will be in use as part of this alternative. Train C would be served by a new forcemain that comes from the mudwell to the Flow Equalization Basins of Train C. This forcemain would come out of the Filter Building just east of the Power Center. The forcemain would cross the roadway and would follow to the east of Final Clarifier 4A and 2A. Then the main would cross the roadway and make a 90 degree turn to the south and cross the roadway again, avoiding the intersection. The forcemain would then follow the lines of Flow Equalization 2A and 1A avoiding the parshall flume and then to the Flow Equalization Basins for Train C. This new forcemain would encounter twenty-four (24) utility crossings, with four (4) roadway crossings and two (2) culvert crossings, as noted on Table 1 below. The tree (just northwest of the filter building) would not be impacted by Alternative 4.

Items impacted by the Alternatives are summarized in Table 1- Impacts of the Alternatives.

Table 1 - Impacts of the Alternatives

	Alt 1	Alt 2	Alt 3	Alt 4
Proposed Forcemain Utility/Piping Crossings	3	0	0	24
Proposed Gravity Utility/Piping Crossings	23	17	19	1
Roadway Crossings	2	1	2	4
Intersection Crossings	0	1	0	0
Culvert Crossings	2	2	0	2
Parking Lot	0	0	1	0
Trees	0	0	1	0
New Splitter Box Required	1	1	1	0
Limits excavation by utilizing existing piping to Train A/B	No	Yes	Yes	Yes

UTILITY CONFLICTS

In the discussion of each Alternatives, utility conflicts were noted; refer to Table 1 - Impacts of Alternatives for an overview. After examining the pump ratings and site and equipment elevations, utility conflicts will be the driving force behind making the recommendation. Alternative 1 has a total of twenty-three (23) utility crossings that affect the gravity portion of the line. Alternative 2 has seventeen (17) crossings which affect the gravity portion of the line. Alternative 3 has nineteen (19) crossings which affect the gravity portion of the line. Alternative 4 has one (1) crossing which affects the gravity portion of the line which is in the segment leading to Train B that was at one time in service.

ENVIRONMENTAL CONFLICTS

There is a large tree (of unidentified size and type) just northwest of the filter building that could be impacted by the Filter Backwash Handling System improvements. The severity of damage done to the tree depends on the Alternative chosen to upgrade the backwash distribution system and how the critical root zone is affected. The critical root zone (CRZ) of a tree is defined by the City of Austin as "the area of undisturbed natural soil around a tree defined by a concentric circle with a diameter in feet equal to twice the number of inches of trunk diameter". Alternatives 1, 2, and 4 would cause least disturbance to the tree, while Alternative 3 would require removal of the tree in its entirety. It appears that the tree is over 24 inches in diameter which would classify it as a heritage tree and if it were to be removed, a variance and council approval would be required. (The size and type of this tree would need to be field verified.)

Alternatives 1 and 2 both show proposed piping to slightly encroach on the CRZ of the existing tree. Alternative 4 shows the proposed piping to be close to the CRZ, but not infringing upon the CRZ. During construction, proper tree protection for Alternatives 1, 2, and 4 would need to be implemented, including but not limited to tree protection fencing and boarding. Also, this tree would likely need remedial tree care as outlined in Appendix P-6 of the *COA Environmental Criteria Manual.* This would include aeration and providing nutrients to the soil/tree prior to any construction. It is likely that the City Arborist will need to observe the tree and evaluate potential construction methods regarding the tree or in close proximity to the tree prior to commencement of work.

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST (EOPPC)

A preliminary EOPPC was determined for the recommended option (Alternative 1) and can be found attached. The probable construction cost including a 25% contingency for Alternative 1 is $902,879.00.

An EOPPC for the remaining three alternatives was not determined because Alternatives 2-4 are not feasible options. Alternative 2 has 1,350 LF of gravity piping with 17 crossings and the hydraulics of the line with all of the crossings make this alignment not feasible. Alternative 3 has 1,350 LF of gravity piping with 19 crossings and hydraulic issues are prevalent for this option as well. Alternative 3 would also require removal of the large tree (just northwest of the filter building) and this option would likely require a variance from the City and Council approval. Alternative 4 is feasible, but requires two forced lines. The intent of the City was to keep the lines gravity as much as possible. This alignment would also require significant electrical, building, and mechanical modifications which make this alternative not feasible under the goals of this project.

RECOMMENDATION

Alternative 1 is the only feasible alternative for connecting Train C and giving plant staff the flexibility of sending the mudwell backwash water to each of the three trains for treatment, while maintaining the goals of the project by keeping the amount of forcemain to a minimum. This would include a proposed forcemain, proposed gravity sewer lines, abandonment of most of the existing forcemain, valving at the mudwell, updating the programmable logic controller (PLC), and replacing the missing line to Train B. This solution will require construction of a new splitter box, but will also utilize the existing splitter box. Alternative 1 requires the shortest linear footage of force main to be in operation, does not disturb the existing 48" tree, and would cross the road perpendicularly so as not to disturb an intersection or significantly impact existing drainage culverts.

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SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT
FILTER BACKWASH
ALTERNATIVE 1 - FILTER BACKWASH
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST - PRELIMINARY ENGINEERING REPORT

9/20/11

ITEM NO	QTY	UNIT	ITEM DESCRIPTION	UNIT PRICE	AMOUNT
210	2,000	LF	FLEXIBLE BASE FOR TRENCH REPAIR	$ 50.00	$ 100,000.00
210	12	CY	FLEXIBLE BASE ROADWAY REPAIR	$ 95.00	$ 1,172.84
340S	56	SY	HOT MIX ASPHALTIC CCONCRETE PAVEMENT 2 INCHES TYPE D	$ 15.00	$ 833.33
401S-A	24	CY	UNCLASSIFIED STRUCTURAL EXCAVATION (Splitter box)	$ 60.00	$ 1,440.00
432SR-4	80	SF	RECONSTRUCT CONCRETE SIDEWALKS TO 4 INCH THICKNESS,INCLUDING REMOVAL OF EXISTING SIDEWALK	$ 10.00	$ 800.00
403S	80	CY	CONCRETE FOR STRUCTURES (Splitter Box)	$ 600.00	$ 48,000.00
509S	2,010	LF	TRENCH EXCAVATION SAFETY PROTECTIVE SYSTEMS(all depths)	$ 1.00	$ 2,010.00
510-AWWRJ	650	LF	PIPE 24" DIA. DUCTILE IRON FACTORY RESTRAINED (ALL DEPTH),INCLUDING EXCAVATION AND BACKFILL	$ 150.00	$ 97,500.00
510-AWW	110	LF	PIPE 12" DIA. PVC(ALL DEPTH),INCLUDING EXCAVATION AND BACKFILL	$ 120.00	$ 13,200.00
510-AWWRJ	900	LF	PIPE, 12" DIA. RESTRAINED JOINT DUCTILE IRON CLASS 350 (ALL DEPTH), INCLUDING EXCAVATION AND BACKFILL	$ 120.00	$ 108,000.00
510-AWWRJ	340	LF	PIPE, 16" DIA. RESTRAINED JOINT DUCTILE IRON CLASS 350 (ALL DEPTH), INCLUDING EXCAVATION AND BACKFILL	$ 140.00	$ 47,600.00
510-ASD	10	LF	PIPE UNKNOWN DIA. CULVERT PIPE(ALL DEPTH),INCLUDING EXCAVATION AND BACKFILL	$ 120.00	$ 1,200.00
510-KWW	4	TON	DUCTILE IRON FITTINGS	$ 8,750.00	$ 35,000.00
510-JWW	4	EA	TIE INS	$ 5,100.00	$ 20,400.00
511S-A	3	EA	VALVES, GATE, 12-INCH	$ 3,000.00	$ 9,000.00
511S-B	1	EA	VALVES, CHECK, 12-INCH	$ 3,000.00	$ 3,000.00
600 Series	1	LS	EROSION AND SEDIMENTATION CONTROL AND TREE PROTECTION	$ 15,000.00	$ 15,000.00
Speical	1	LS	EXISTING SPLITTER BOX RECONFIGURATION	$ 5,000.00	$ 5,000.00
700S-TM	1	LS	TOTAL MOBILIZATION PAYMENT	$ 20,367.00	$ 20,367.00
				Sub Total	$ 529,523.17
			Contingency 25%		$ 132,381.00
			TOTAL		**$ 661,904.00**
	1,418	LF	ASSUMING 75% BORE W/O SS CASING OF PROPOSED LINES ADD	$ 170.00	$ 240,975.00
			TOTAL INCLUDING BORING		**$ 902,879.00**

NOTE: Cost estimate does not include any utility relocations

Notes Regarding the Opinion of Probable Construction Cost:

1. This cost estimate is released as an interim review document to facilitate completion of design review.

2. This cost estimate is prepared by Amy Lynn Middleton, P.E. No. 107560, State of Texas and reviewed by Chelsea Solomon, P.E. No. 97246, State of Texas.

3. This cost estimate is released under the authority of CAS Consulting and Services, Inc., TBPE Registration No. E-003572

4. A Class "D" opinion of construction cost of $902,879.00 with a margin of error of 25% was prepared for the project. This opinion was based on materials and labor process prevailing at the time of preparation without consideration of inflationary increases in costs. This opinion is linked to the July 2011 Engineering News Record (ENR) Construction Cost Index value of 9080.15. Unit prices for bid items were determined from the best source of information available for a particular bid item. The following list provides the priority given to the various sources of unit prices:

1 Review of recent COA average bid tabulations
2 Information provided by vendors and contractors
3 CostWork's RSMeans
4 TxDOT Average Low Bid Unit Price for the Austin District

Austin Office
7908 Cameron Road
Austin, Texas 78754
(512) 836-2388
Fax (512) 836-4515

Dallas Office
1820 Regal Row, Ste 200
Dallas, TX 75235
(214) 589-6942
Fax (214) 638-3723

Houston Office
10497 Town & Country Way Ste 220
Houston, TX 77024
(512) 836-2388
Fax (512) 836-4515

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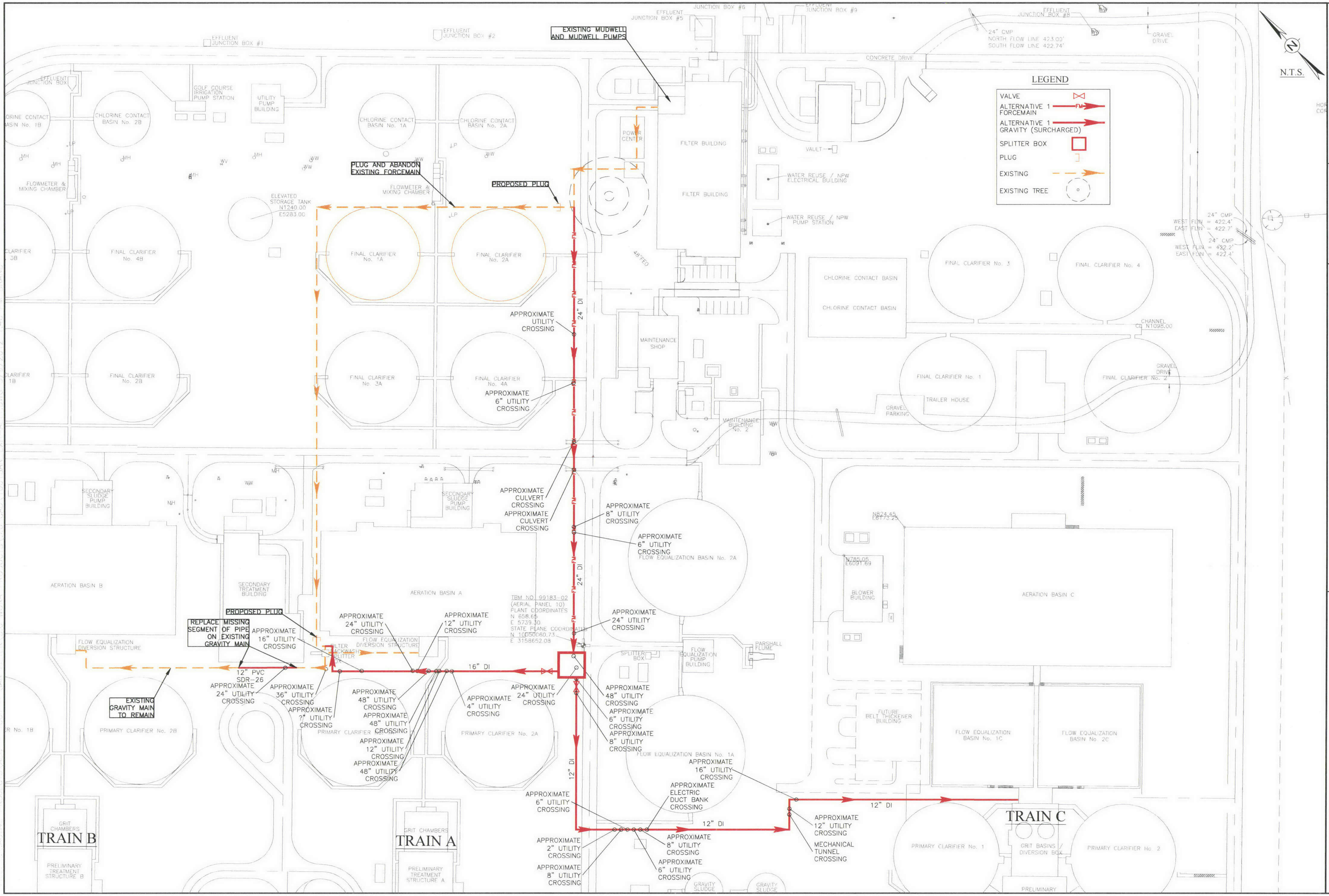

ALTERNATIVE 1

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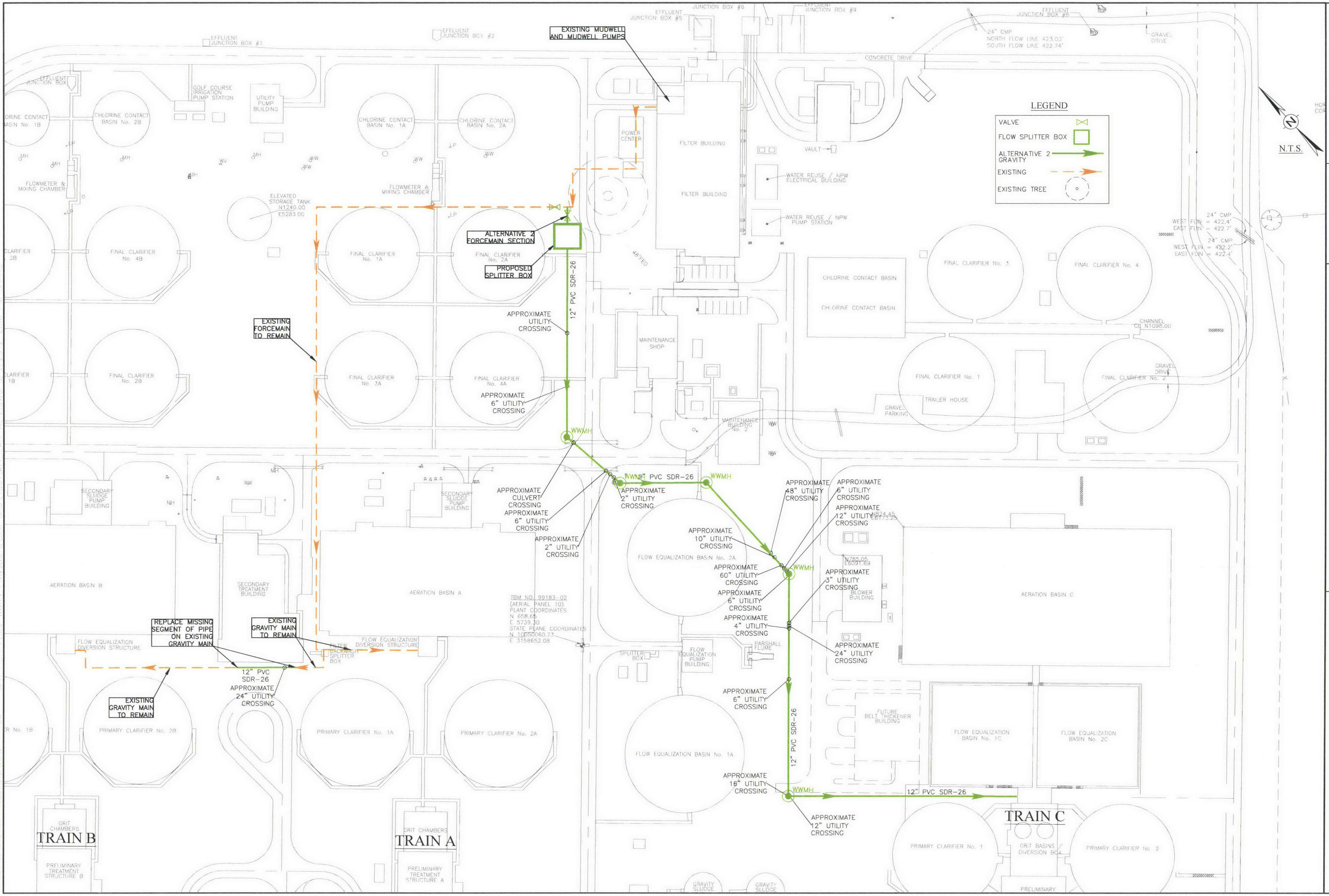
CITY OF AUSTIN

SOUTH AUSTIN REGIONAL
FILTER BACKWASH UPGRADES



ALTERNATIVE 2

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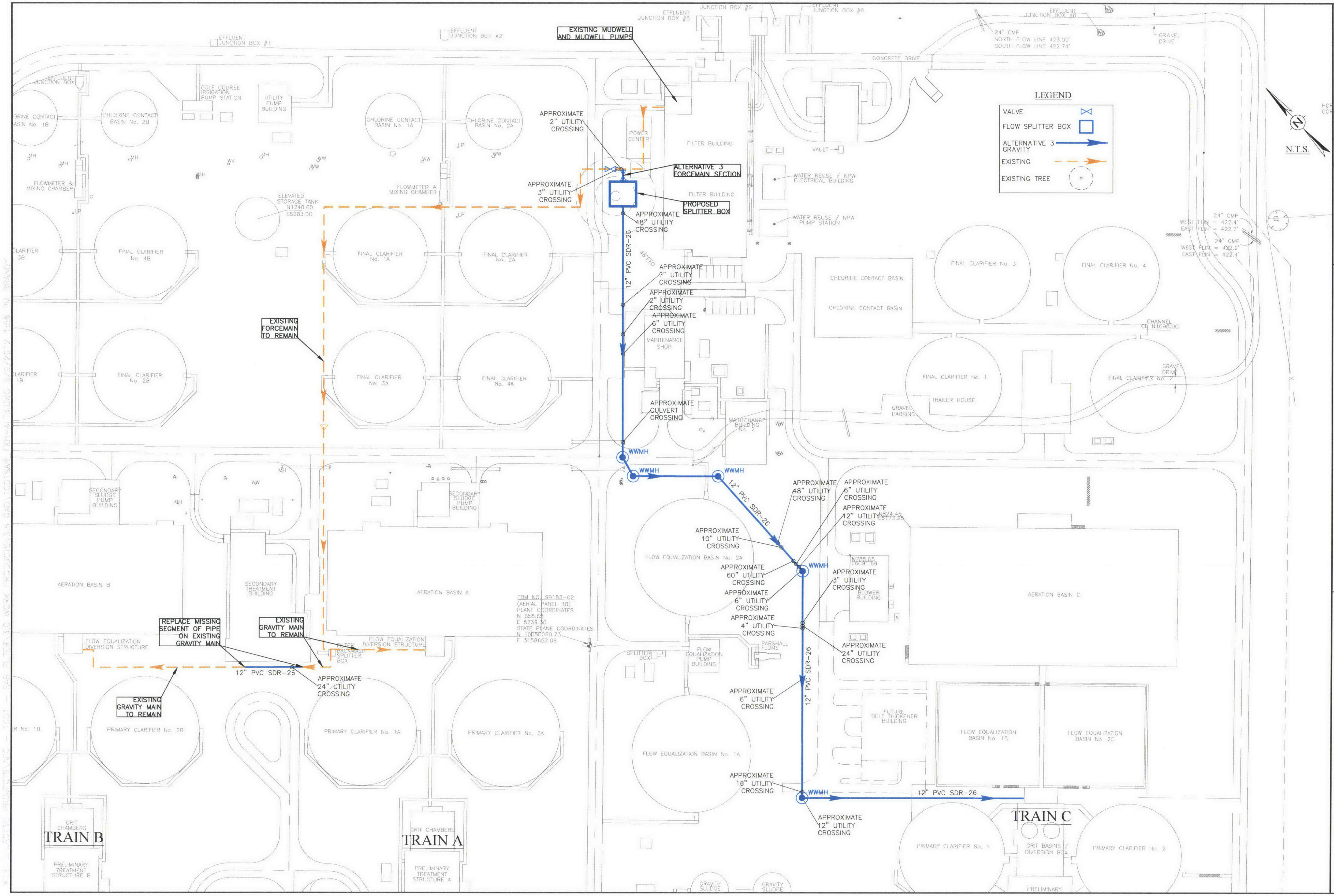
CITY OF AUSTIN

SOUTH AUSTIN REGIONAL
FILTER BACKWASH UPGRADES



ALTERNATIVE 3

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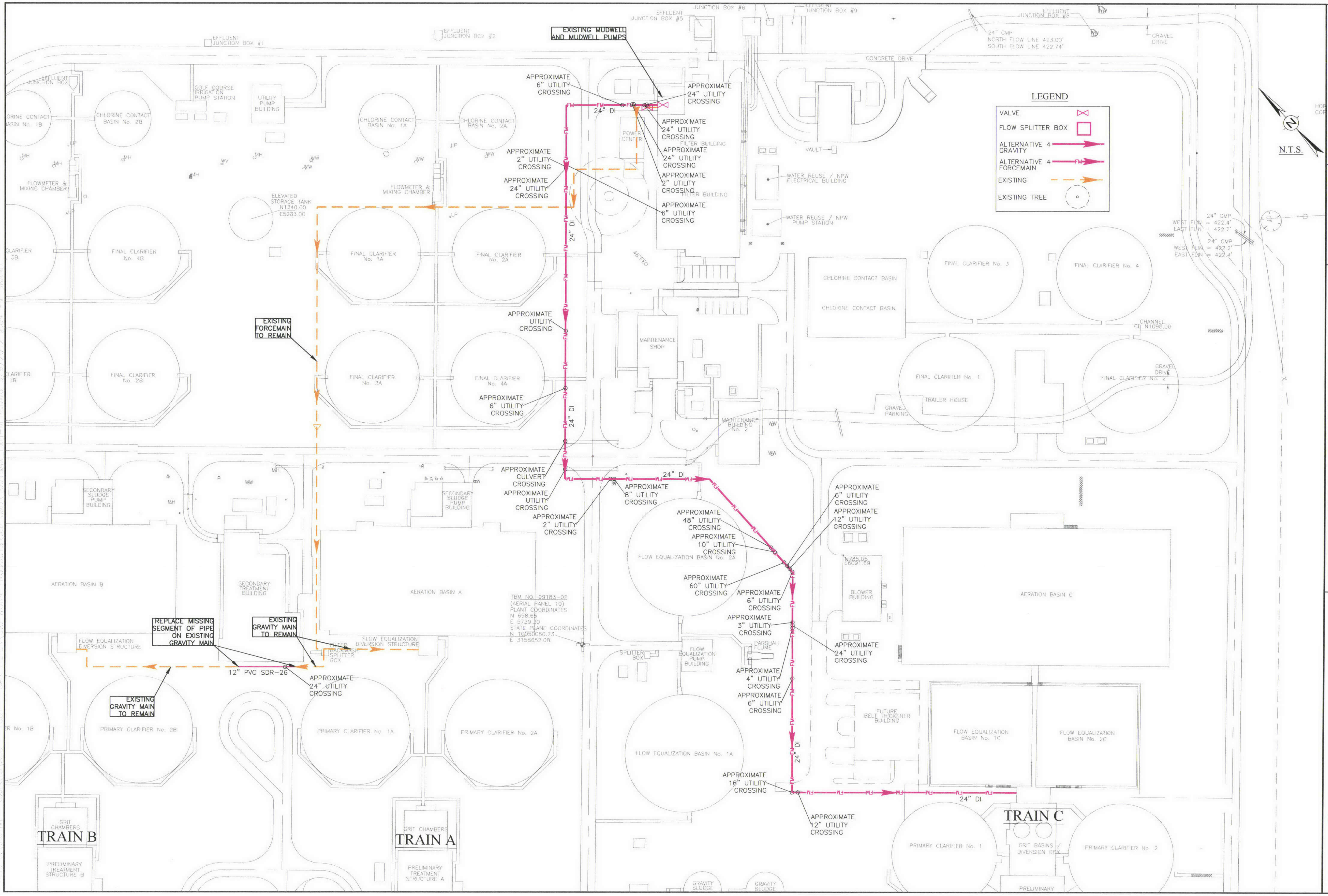
CITY OF AUSTIN

SOUTH AUSTIN REGIONAL
FILTER BACKWASH UPGRADES



ALTERNATIVE 4

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& SERVICES INC
6633 HWY 290 EAST, SUITE 104
AUSTIN, TEXAS 78723
REG. No. F-003572

CITY OF AUSTIN

SOUTH AUSTIN REGIONAL FILTER BACKWASH UPGRADES

Appendix 2:

SARWWTP Filters - Structural

STATE OF TEXAS
LARRY M. SWAYZE
38354
REGISTERED
PROFESSIONAL ENGINEER

03/26/12

City of Austin

South Austin Regional Wastewater Treatment Plant

FILTER BUILDING IMPROVEMENTS PROJECT STRUCTURAL MODIFICATIONS: PRELIMINARY STRUCTURAL INVESTIGATIONS AND ANALYSIS

March, 2012

CITY OF AUSTIN

SOUTH AUSTIN REGIONAL WASTEATER TREATMENT PLANT
TECHNICAL MEMORANDUM
FILTER BUILDING STRUCTURAL MODIFICATIONS PRELIMINARY STRUCTURAL INVESTIGATIONS AND ANALYSIS

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1.0 INTRODUCTION AND OBJECTIVES

Jose I. Guerra, Inc. (JIG) performed preliminary structural investigations and analysis for the improvements being considered for the South Austin Regional Wastewater Treatment Plant (SARWWTP) filter building complex. The goal of these tasks was to identify issues of concern and preliminary costs regarding the required structural modifications.

The objective of this Technical Memo is to present the findings from the investigations and analysis for the:

2.1 Splitter box size and structural requirements;
2.2 Expansion joint repair;
2.3 Clearwell Hydraulic modifications; and
2.4 Control room floor tile replacement

Each of these items are summarized herein, followed by a list of exhibits containing proposed drawings and cost estimates.

2.0 FILTER COMPLEX STRUCTURAL MODIFICATIONS

2.1 SPLITTER BOX SIZING AND STRUCTURAL REQUIREMENTS

Based on the recommended alternative filter backwash system improvements layout, the proposed splitter box was initially sized to accommodate the incoming force main, the outgoing gravity sewers to Trains A, B, and C and the 12" gravity sewer to Train C. On this basis, the geometry of the splitter box is estimated to be approximately 15-feet long, 10 feet wide and 22 feet deep (interior dimensions).

A preliminary structural analysis of the concrete 15' X 10' X 22' (interior dimensions) splitter box indicates that the walls will be 24" thick founded on a concrete mat base that is 48" thick extending 2 feet past the exterior face of the splitter box walls (19' X 14'). Pressure relief valves will be required for the installation due to buoyancy issues caused by the depth of the box and the proximity to the water table.

A proposed splitter box isometric drawing is shown in Exhibit 1.

2.2 EXPANSION JOINT REPAIR

Record drawings indicate an existing expansion joint that "separates" the northern and southern halves of the building horizontally, passing vertically from the control room floor (El. 419) down to the floor slabs of the lower pipe gallery, mudwells, and clearwells (El. 389). Visual inspection of the expansion joint of the Filter building indicates expansion and separation in some locations. An inspection of both Clearwells No. 1 and No. 2 was performed by plant staff shortly before the onset of this project. The investigation indicated various levels of sediment in both Clearwells, significant leaking along the expansion joint in Clearwell No. 1, and some minor leaking of the expansion joint in Clearwell No. 2.

JIG investigated the expansion joint based on both record drawings and a site visit to the filter building in order to develop a repair approach that will include a sealing system for the expansion joint consisting a high movement capacity joint sealant system for waste water treatment plants such as Sikaflex PRO 3WF manufactured by Sika Corporation. The cost of the expansion joint repair is estimated to be $250,000. The cost estimate is shown in Exhibit 2.

An asbestos survey of the existing expansion joint components was not performed as part of this project scope of work.

2.3 CLEARWELL HYDRAULIC MODIFICATIONS

Through the process of evaluating the filter system hydraulics, identifying hydraulic limitations, controlling elevations and other "bottlenecks" in the piping and building systems, a potential improvement option developed in the vicinity of the Clearwells. TM No. 1 for the Hydraulic Evaluation defined that maintaining 18-inches of freeboard at the Clearwells is a limiting criteria. Currently the Clearwell roof is shown at El. 408 with stairs to an intermediate level at El. 412 in the backwash pump room. By removing a 17'-8" by 30'-8" section of the backwash pump room floor / Clearwell roof at El. 408 and reconstructing it at a higher El. 412, significant hydraulic capacity can be gained for the filter building by allowing more elevation head in the Clearwells, and reducing the frequency of potential building flooding from the Colorado River or other events. (A 10'-0" by 16'-8" slab at elevation 412' now exists in the area; the newly raised slab would be constructed to match that elevation.) Revision of the stairs into the backwash pump room from El. 404 to the new floor at El.412 would be required, as well as the addition of new stairs from the raised floor at El. 412, back down to the backwash pump level at El. 408.

JIG investigated the structural modification required to accomplish this change and propose the following approach: remove existing slab & reinforcing, walls and slabs suspended from the slab at El. 408, and stairs; pour new wall beams above the existing beams B-1 and B-2 on GL 2 along with a new 18" slab at El. 412; repour the suspended walls and slabs currently in place below El. 408 and replace the concrete stairs from El. 412 to El. 408 and from El. 412 to El. 404. A preliminary layout of the improvements can be seen in Exhibit 3. The cost of the Clearwell structural modifications is estimated to be $500,000 due to the degree of difficulty of material removal and replacement.

2.4 CONTROL ROOM FLOOR TILE REPLACEMENT

The upper level control room at El. 419 of the Filter Building is a large open room, approximately 26'-8" wide by 185'-9" long with walls of window to view the filters and with four (4) exterior door access to the filters. The existing flooring system consists of 12"x12" vinyl tiles as indicated by the original filter building project specifications and confirmed by site visit. In general, the tiles are in poor condition with a good portion of the tiles being cracked, peeling, and/or missing. As such, the filter building improvements need to be considering removal of the original tiles and replacement as part of the overall project for safety and other practical purposes. It is speculated that the cause of the current condition of the tile is either improper or degraded sealing of the floor slab beneath the tiles/ upper gallery ceiling. Because of the level of moisture potential in this facility, the sealant system used during construction has likely broken down over time. Another potential cause of the tile degradation is the UV exposure/sunlight from the windows along the control room gallery.

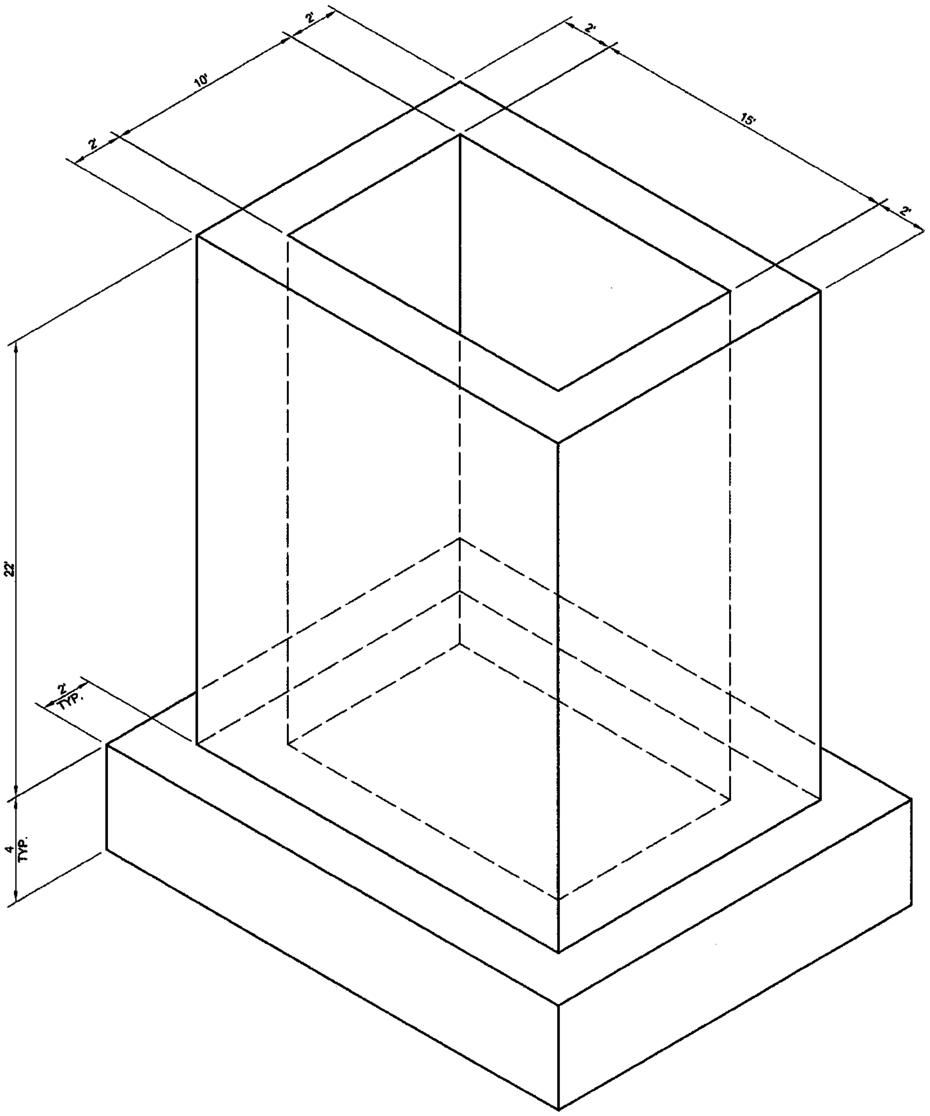
JIG's recommended improvement option is to remove the existing tiles, re-seal the floor with an epoxy system and place new vinyl tiles to be selected by the plant staff. The cost of the control room tile repairs and replacement is estimated to be $100,000 as shown in Exhibit 4.

An asbestos survey of the existing floor tile, mastic, and sealant (if any) has not been performed as part of this project scope of work.

EXHIBITS

EXHIBIT 1

Proposed Splitter Box



SPLITTER BOX ISOMETRIC
NO SCALE

EXHIBIT 2

Expansion Joint Replacement

The expansion joint in question that divides the facility is approximately 114' in length. It is between a double concrete wall that separates two of the filter bays and is exposed from the top side, at the ceiling and the floor of the clearwell and at the walls of the facility, the total linear footage needing repair is computed as follows:

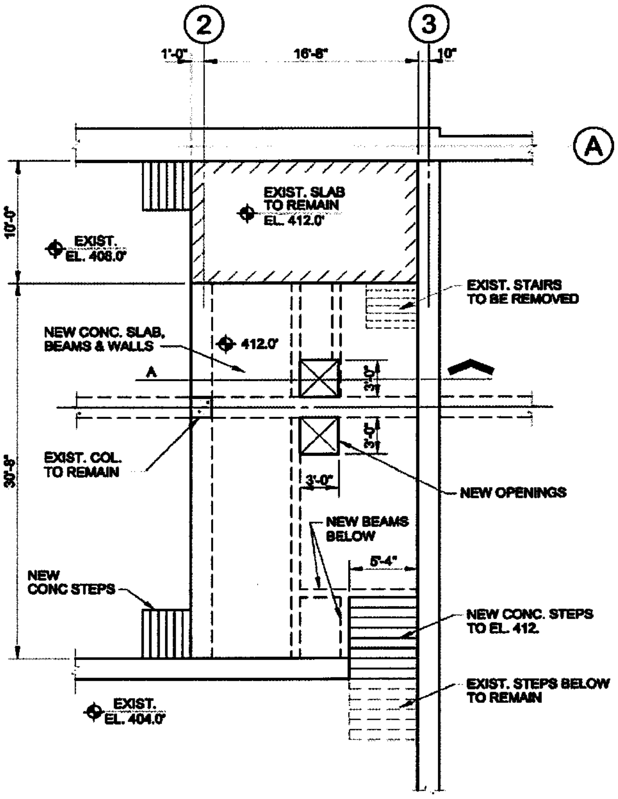
Expansion Joint Replacement

Repair Item	Linear Ft. (LF)
Top side joint	114
Ceiling and floor of clearwell	228
Each side of clearwell (4 total)	70
Total Linear Footage	412
Estimated Total Cost ($600+/- per LF)	$250,000

The total estimated cost of $250,000 is based on an estimated cost of $600+/- per LF of expansion joint installation, and includes existing material removal, joint preparation, installation of the new sealant, and installation of a new joint cover.

EXHIBIT 3

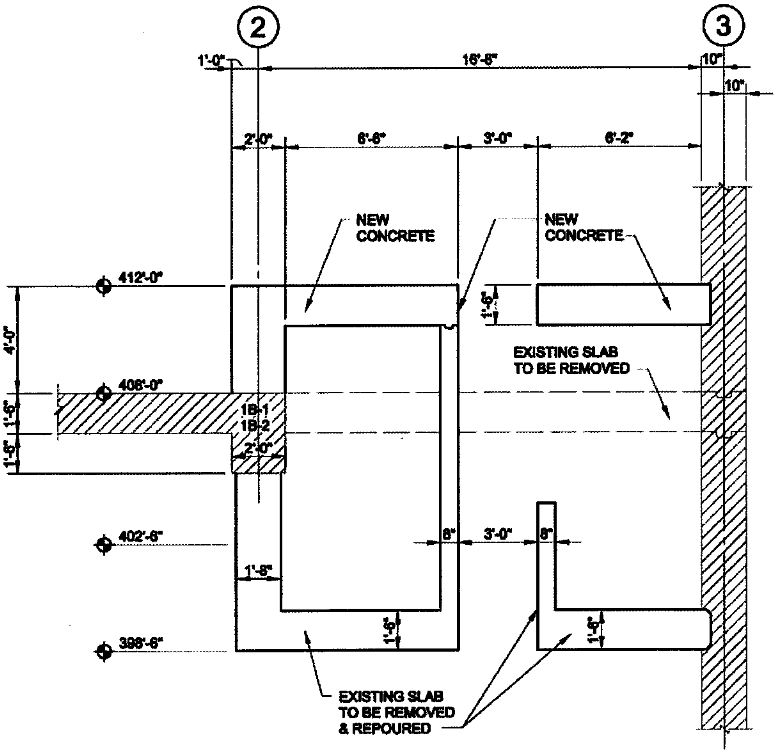
Partial Structural Plan



① PARTIAL STRUCTURAL PLAN
NO SCALE

EXHIBIT 3 Cont.

Partial Section



Ⓐ PARTIAL SECTION
NO SCALE

EXHIBIT 3 Cont.

Clearwell Hydraulic Modifications

The following figures represent an approximate cost estimate for the structural modifications required to accomplish the proposed clearwell modifications. Refer to the partial structural plan and section of the proposed modifications.

Clearwell Hydraulic Modifications

Demolition Item	Cost ($)
Remove 16'-8" X 30'-8" section of 18" th. slab	160,000
Remove 2 sets of concrete steps	20,000
Remove 8" concrete walls and 18" th. slabs below	112,000
Sub-Total #1	**$292,000**
Reconstruction Item (Elevation 412' Structure)	
Repour 8" concrete walls and 18" th. slabs below	80,000
Cut keyway into exist. walls and dowel into walls	15,000
Repour slab and beam (atop GL 2)	90,000
Repour 2 sets of steps	20,000
Sub-Total #2	**$205,000**
Total	**$497,000**

EXHIBIT 4

Control Room Floor Tile Replacement

The area of the control room floor covers approximately 5,000 square feet and the estimated tile removal and replacement cost may be itemized as shown below.

Control Room Floor Tile Replacement

Repair Item	Cost ($)
Mobilization of subcontractor	10,000
Tile removal: 5,000 sf @ 1.50 per sf	7,500
Removal of vinyl base	2,000
Floor cleaning: 5,000 sf @ $200 per sf	10,000
Sealing of exposed floor (epoxy system): 5,000 sf @ $1.50 per sf	12,500
New tile installation (solid color, 1/8" th., M & L): 5,000 sf @ $8.00 per sf	40,000
Replacement of vinyl base @ $6.00 plf	4,000
Removal of debris, clean-up, demobilization	12,000
Total	**$98,000**

Appendix 3:

SARWWTP Filter Abandonment Plan Cost Estimate

SARWWTP Filter Improvements
CONSTRUCTION COST ESTIMATE

Project:	**SAR WWTP Filter Improvements**	AECOM
AECOM Job No.:	**60213591**	400 West 15th Street, Suite 500
Date:	**1/11/2012**	Austin, Texas 78701
Prepared By:	**Nathan Fitzhugh**	Phone: (512) 472-4519
File Name:	**Cost Estimate for SAR Filter Abandonment Plan**	Fax: (512) 472-7519
Design Stage:		

Objective: **Cost estimate Summary for SAR Filter Abandonment Plan**

SAR Filter Abandonment Plan

Division No.	Title	Material Cost	Labor Cost	Subtotal
01000	General (mobile/demobile, 3.5%)	$ -	$ -	$ 4,869
02000	Sitework	$ 29,120	$ 10,270	$ 39,390
03000	Concrete	$ -	$ -	$ -
04000	Masonry	$ -	$ -	$ -
05000	Metals	$ -	$ -	$ -
06000	Wood and Plastics	$ -	$ -	$ -
07000	Thermal and Moisture Protection	$ -	$ -	$ -
08000	Doors and Windows	$ -	$ -	$ -
09000	Finishes	$ -	$ -	$ -
10000	Specialties	$ -	$ -	$ -
11000	Equipment	$ -	$ -	$ -
12000	Furnishings	$ -	$ -	$ -
13000	Special Construction	$ -	$ -	$ -
14000	Conveying Systems	$ -	$ -	$ -
15000	Mechanical	$ 21,823	$ 10,416	$ 32,238
16000	Electrical	$ 50,000	$ 17,500	$ 67,500
			Subtotal:	**$ 143,998**
			Contractor's Overhead & Profit (20%):	$ 28,800
			Bonds & Insurance (2%):	$ 2,880
			Subtotal:	**$ 175,677**
			Contingency (40% @ PER):	$ 70,271
			Total Estimated Cost:	***$ 245,948***

SARWWTP Filter Improvements
CONSTRUCTION COST ESTIMATE

Project: **SAR WWTP Filter Improvements**
AECOM Job No.: **60213591**
Date: **1/11/2012**
Prepared By: **Nathan Fitzhugh**
File Name: **Cost Estimate for SAR Filter Abandonment Plan**
Design Stage:

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

SAR WWTP Filter Abandonment Plan Cost Estimation

Division	Item No.	Description	Source	Unit	Qty.	Unit Material Cost	Material Cost	Labor Multiplier	Unit Labor Cost	Labor Cost	Subtotal
2-Sitework											
	1	Removal of Existing Media		CY	1000	$ 20	$ 20,000	35%	$ 7	$ 7,000	$ 27,000
	2	Dewater all West Side Pipes		LS	12	$ 10	$ 120	100%	$ 10	$ 120	$ 240
	3	Operate/Close all West Side Valves		EA	60	$ 150	$ 9,000	35%	$ 53	$ 3,150	$ 12,150
	Subtotal Division 2						**$ 29,120**			**$ 10,270**	**$ 39,390**
3-Concrete											
	Subtotal Division 3						**$ -**			**$ -**	**$ -**
5-Metals											
	Subtotal Division 5						**$ -**			**$ -**	**$ -**
8-Architecture											
	Subtotal Division 8						**$ -**			**$ -**	**$ -**
9-Finishes											
	Subtotal Division 9						**$ -**			**$ -**	**$ -**
11-Equipment											
	Subtotal Division 11						**$ -**			**$ -**	**$ -**
15-Mechanical		**Miscellaneous**									
	4	6" Blind Flange		EA	8	$ 63	$ 500	100%	$ 63	$ 500	$ 1,000
	5	12" Blind Flange		EA	8	$ 200	$ 1,600	100%	$ 200	$ 1,600	$ 3,200
	6	20" Blind Flange		EA	8	$ 563	$ 4,500	50%	$ 281	$ 2,250	$ 6,750
	7	24" Blind Flange		EA	6	$ 820	$ 4,920	50%	$ 410	$ 2,460	$ 7,380
	8	36" Blind Flange		EA	2	$ 3,080	$ 6,160	35%	$ 1,078	$ 2,156	$ 8,316
	9	48" Blind Flange		EA	1	$ 4,143	$ 4,143	35%	$ 1,450	$ 1,450	$ 5,592
	Subtotal Division 15						**$ 21,823**			**$ 10,416**	**$ 32,238**

16-Electrical											
	10	Cut/Pull/Cap Existing Conduits to be Abandoned		LS	1	$ 50,000	**$ 50,000**	35%	$ 17,500	$ 17,500	$ 67,500
	Subtotal Division 16						**$ 50,000**			**$ 17,500**	**$ 67,500**
SUBTOTAL (Filter Backwash Return System):							**$ 100,943**			**$ 38,186**	**$ 139,128**

Appendix 4:

Hydraulic Measurements and Hydraulic Calculation Verification

CITY OF AUSTIN
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

Filter System Hydraulic Evaluation
Hydraulic Measurements and Hydraulic Calculation Verification

Introduction:

On March 27, 2012, City of Austin and AECOM staff performed a hydraulic test and took hydraulic measurements at the South Austin Regional Wastewater Treatment Plant (SAR WWTP). The purpose of the work was to confirm the hydraulic calculations performed for the Filter Improvements project using actual field data.

Data Collection:

To perform the test, SAR WWTP staff turned off the plant influent pumps and allowed the influent wetwell level to rise. The wetwell was filled to a level which would allow a flow of approximately 80 to 90 mgd to be pumped through the plant for a duration of about 1 hour. Flows were monitored and recorded at 5-minute intervals in the OIU room on the control level of the filter building. Levels were monitored and recorded at 5 to 10-minute intervals at the clearwell effluent weirs, the clearwell effluent drop box, Junction Box No. 6 (JB6), and Junction Box No. 9 (JB9).

In the field, it was observed that there was approximately a 3-inch difference between the top of concrete handrail at JB6 and JB9. Record drawings show handrail elevations of 431.0 for both JB6 and JB9. It was assumed that top of handrail elevation at JB9 is 431.0 and top of handrail elevation at JB6 is 430.75. Water levels in JB6 and JB9 were measured relative to the top of handrail elevations.

Attachment 1 contains a description of the various parameters that were measured for this test, and Attachment 2 contains the data that was collected.

Data Analysis:

The flow data used in this analysis was the sum total of the flows measured at the Parshall Flumes of Train A and Train C. The measured tabulated data did not contain a distinct peak, but a range of peak flows was observed between 11:45 and 12:00. Additionally, the flow values were fluctuating in the OIU display. For these reasons, an average value of the 4 flow values between 11:45 and 12:00 was used as the basis of comparison to the hydraulic model.

The level data used in this analysis were the maximum water levels measured at the clearwell effluent weirs, the clearwell effluent drop box, and Junction Box No. 6. The peak levels used for each of these 3 locations were an average of the two highest measured level values. These were assumed to correspond to the peak flow.

The summary of the measured data used in this analysis is as follows:

Maximum flow measured at Parshall Flume of Train A and Train C
- Time: 11:45 to 12:00
- Average Value: 88.25 MGD

Maximum water level measured in the Filter Building Clearwell and Effluent Drop Box:
- Time: 12:10 to 12:15
- Water Level upstream of CW1 Effluent Weir (L1): 404.79
- Water Level upstream CW2 Effluent Weir (L2): 404.73
- Water Level in Effluent Drop Box (L5): 404.35

Maximum water level measured in JB6 (L6):
- Time: 12:10
- Water Level: 403.96

The measured average flow value and water level in JB6 were used as input data in the hydraulic model developed as part of TM1 and the following results were obtained:

Input data (from measured data):
- Flow through filter building: 88.25 MGD
- Water Level in JB6: 403.96

Calculated data:
Water Level upstream of CW2 Effluent Weir (L1): 404.76
Water Level upstream CW1 Effluent Weir (L2): 404.80
Water Level in Effluent Drop Box (L5): 404.40

Conclusions:
The calculated data matches very closely with the data measured in the field. Consequently, the hydraulic model used in TM 1 is confirmed.

ATTACHMENT 1

SOUTH AUSTIN REGIONAL WWTP
FILTER IMPROVEMENTS

Following is the list of level and flow measurements required in order to verify the theoretical calculation conducted as part of the Filter System Hydraulic Evaluation. The measurements shall be conducted by a group of at least 2 persons, such as flow data can be monitored during the level measurements.

A. LEVEL MEASUREMENTS:

The following levels/distances shall be measured:

L1. Water level in the CW1 before the effluent weir.

Open hatch above CW1 effluent trough

Measure distance between: a) water surface upstream of CW1 weir, and
b) top of concrete slab (Elev. 408.0-ft from record drawings).

L2. Water level in the CW2 before the effluent weir.

Open hatch above CW2 effluent trough

Measure distance between: a) water surface upstream of CW2 weir, and
b) top of concrete slab (Elev. 408.0-ft from record drawings).

L5. Water level in effluent drop box.

Open hatch on top of effluent drop box.

Measure distance between: a) water surface in drop box, and
b) top of concrete slab (Elev. 412.0-ft from record drawings).

L6. Water level in JB6 – South Compartment:

Measure distance between: a) water surface in JB6, in the vicinity of South 60" pipe to JB9
b) top of concrete handrail (Elev. 431.0-ft from record drawings).

L8. Water level in JB9

Measure distance between: a) water surface in JB9, in the vicinity of East wall
b) top of concrete handrail (Elev. 431.0-ft from record drawings).

B. FLOW DATA

Record the following flow data shown on the OIU installed in the filter building. Record data at 5 minutes intervals, starting 20 minutes before the first level measurement.

F1. Water Flow at Train A effluent Parshall flume
F3. Water Flow at Train C effluent Parshall flume
F4. WR/NPW pump station flow (FIT-NPW-02A1)

C. OBSERVE SLUICE GATES POSITION:

Observe and record the position of the sluice gates at JB5, JB6, JB9 and Filter Building Effluent Troughs:

JB5: Sluice gate on 72" to Filter Building

Filter Building - Effluent Sluice gates at downstream end of CW effluent troughs

JB6
Sluice gate at the end of 60" Filter Effluent Pipe
Sluice gate between North and South Compartment
North effluent sluice gate (to JB9)
South effluent sluice Gate (to JB9)

JB9:
North effluent gate (to outlet)
Middle effluent gate (to outlet)
South effluent gate (to outlet)
Gate between North and South compartment

ATTACHMENT 2

CITY OF AUSTIN
SOUTH AUSTIN REGIONAL WWTP FILTER IMPROVEMENTS
60213591

FILTER SYSTEM HYDRAULIC EVALUATION
FIELD MEASUREMENTS, 03/27/12

Measured data shown in blue
Calculated data shown in black

Elevations:

408.00	Top of concrete slab above clearwell
412.00	Top of concrete slab above effluent drop box
430.75	Top of concrete handrail at JB6
431.00	Top of concrete handrail at JB9

Level Data:

Time:		L1:			L2:			L5:			L6:		L8:	
(time)	(minutes)	(inches)	(ft)	(elevation, ft)	(inches)	(ft)	(elevation, ft)	(inches)	(ft)	(elevation, ft)	(ft)	(elevation, ft)	(ft)	(elevation, ft)
10:50	0										30.292	400.46	30.917	400.08
10:55	5													
11:00	10	60.25	5.02	402.98	61	5.08	402.92				30.292	400.46	31.042	399.96
11:05	15													
11:10	20	58.6	4.88	403.12	59	4.92	403.08	136.5	11.38	400.63	30.042	400.71	30.917	400.08
11:15	25													
11:20	30	55	4.58	403.42	55	4.58	403.42	118.5	9.88	402.13	28.667	402.08	29.917	401.08
11:25	35	53	4.42	403.58	53.75	4.48	403.52	110	9.17	402.83				
11:30	40	49.75	4.15	403.85	50.5	4.21	403.79	109.5	9.13	402.88	27.5	403.25	29.313	401.69
11:35	45	46.5	3.88	404.13	47.5	3.96	404.04	101	8.42	403.58				
11:40	50	45.5	3.79	404.21	46.5	3.88	404.13	98.5	8.21	403.79	27.208	403.54	29.042	401.96
11:45	55	44.5	3.71	404.29	45.25	3.77	404.23	97.5	8.13	403.88				
11:50	60	43.25	3.60	404.40	44	3.67	404.33	96	8.00	404.00	27	403.75	29	402.00
11:55	65	41.5	3.46	404.54	42.5	3.54	404.46	94	7.83	404.17				
12:00	70	40	3.33	404.67	41	3.42	404.58	93	7.75	404.25	26.875	403.88	28.75	402.25
12:05	75	39.5	3.29	404.71	40.5	3.38	404.63	92	7.67	404.33				
12:10	80	38.5	3.21	404.79	39.5	3.29	404.71	91.5	7.63	404.38	26.792	403.96	28.75	402.25
12:15	85	38.5	3.21	404.79	39	3.25	404.75	92	7.67	404.33				
12:20	90	39.25	3.27	404.73	40	3.33	404.67	92.5	7.71	404.29	26.833	403.92	28.854	402.15
12:25	95	41.5	3.46	404.54	42.25	3.52	404.48	95.5	7.96	404.04				
12:30	100										27.167	403.58	28.958	402.04
			AVG	404.79		AVG	404.73		AVG	404.35				

Flow Data:

Time: (time)	(minutes)	LS1 Flow: (mgd)	LS2 Flow: (mgd)	LS1+LS2: (mgd)	F1: (mgd)	F3: (mgd)	F1+F3: (mgd)	F4: (mgd)	Outfall: (mgd)
10:50	0				2.02	1.92	3.94	0	4.1
10:55	5								
11:00	10				1.93	1.92	3.85	0	3.66
11:05	15								
11:10	20				7.28	24.66	31.94	0	32.47
11:15	25								
11:20	30				19.16	45.72	64.88	0	65.62
11:25	35								
11:30	40	36.2	49.7	85.9	27.77	52.9	80.67	0	80.67
11:35	45	35.5	41.6	77.1	28.3	53.24	81.54	0	81.54
11:40	50	45.1	47.5	92.6	27.38	53.98	81.36	0	81.36
11:45	55	42.47	54.7	97.17	30.68	59.49	90.17	0	90.17
11:50	60	45.63	49.2	94.83	28.68	59.06	87.74	0	87.74
11:55	65	39.35	52.7	92.05	29.13	56.23	85.36	0	85.36
12:00	70	40.26	49.6	89.86	32.63	57.12	89.75	0	89.75
12:05	75	20.23	42	62.23	29.13	55.94	85.07	0	85.07
12:10	80	10.91	24	34.91	30.97	51.25	82.22	0	82.22
12:15	85	16.17	25.3	41.47	25.32	33.51	58.83	0	58.83
12:20	90	16.18	30.4	46.58	22.1	33.36	55.46	0	55.46
12:25	95	16.7	29.6	46.3	20.52	31.17	51.69	0	51.69
12:30	100								

AVG 88.255

AECOM
400 West 15th Street, Suite 500, Austin, Texas 78701
T 512.472.4519 F 512.472.7519 www.aecom.com

City of Austin
South Austin Regional Waste Water Treatment Plant Filter Improvements

Technical Memorandum No. 1
Filter System Hydraulic Evaluation

To: Chris Graf, P.E., Austin Water Utility

From: Shelby Eckols, P.E. (AECOM)

Prepared By: Ioan Chilarescu, P.E., Ph.D. (AECOM)
Abu Alam, Sc.D. (AECOM)
Christopher Perkins, P.E. (AECOM)

Date: March 28, 2012

IOAN C. CHILARESCU
89173
Ioan Chilarescu
3/29/12

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1.1 Introduction

The Filter Building facilities at the South Austin Regional Wastewater Treatment Plant (SARWWTP) were constructed in 1988 as part of the Train B Expansion with a design capacity of 40 MGD and a peak capacity of 80 MGD. The Filter Building is located at the Northeast side of the plant between Trains A and C, and the filtration facility consists of 12 single-media, intermittently backwashed, deep-bed filters with associated piping, valving, and electrical facilities. There have been multiple modifications to the Filter Building throughout its life span including modifications to the electrical duct banks entering the building, and additional exterior pipe modifications made during the Train C expansion to address hydraulic issues reported in the filter system. Other known conditions of the hydraulic system of the filter building include:

- The existing filters at the SARWWTP can be operated successfully at hydraulic loading rates in excess of 3 gallons per minute per square foot of filter area[1]
- Historically, flood levels in the Colorado River impact the hydraulics/ability of the filters to treat the plant effluent.
- Backwash water from the filters is pumped to a splitter box intended for diversion to Train A and B. Currently only the diversion to Train A is operational. Ultimately, fully operational diversions to Trains A, B, and C are intended.

1.2 Scope of Work and Objectives

The scope of services covered in this Technical Memo includes:

- Meeting with SARWWTP operational and maintenance personnel to discuss hydraulic issues, goals and observations

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[1] "Capacity Assessment and Rerating Recommendations for South Austin Regional Wastewater Treatment Plant", CH2MHill, May 1995

- Reviewing and evaluating the hydraulic profile of the plant effluent and the Filter Building, including field survey as required by the survey sub-consultant. The Evaluation is to consider and report on each of the following:
    A. The Filter Building hydraulic capacity
    B. Definition of the Colorado River water level that impacts Filter Building discharge
    C. Identification of alternatives to eliminate the impact of the Colorado River water level on the Filter Building discharge
    D. Evaluation of the hydraulic impact of alternative filtration processes and determination of the hydraulic restraints that may impact Filter Building capacity

- Consolidation of the hydraulic evaluation into this Technical Memo, followed by a workshop with the COA to review the results of the evaluation and discuss recommendations

1.3 Existing Conditions and Issues of Concern

1.3.1 Existing Filter Building and Effluent Water Systems

Filters are used at the SARWWTP as a tertiary treatment to improve the effluent quality before discharging into the Colorado River. The Filter Building contains two bays, each having six filter units. Each filter unit contains two filter cells separated by a center collection trough. Each filter cell contains a four-foot-deep sand bed.

The SARWWTP Junction Box No. 5 is used to direct the effluent of Trains A and B to the Filter Building or to bypass the filters, depending on the water elevation in the Colorado River. Water is supplied to the Filter Building by closing the interior gate from Junction Box No. 5 (JB5) to Junction Box No. 6 (JB6) and opening the 72-inch gate to the filters. A schematic representation of the filter system is shown in **Exhibit 1.1**. The effluent enters the Filter Building through a 72-inch filter influent line from JB5. The 72-inch filter influent line branches into two 60-inch lines. Each 60-inch branch then reduces down to 42-inch filter influent headers. Each header feeds one filter bay, feeding each filter unit's center inflow distribution trough. The center inflow distribution troughs are provided with weirs to ensure that the water is introduced uniformly across the length of the filters.

The filter water level at design flow conditions will be below the trough weir elevation when the filter bed is clean, and the flow will pass through the filter bed by gravity. The effluent weir at the outlet of the clearwells is set at elevation 403.00. The water level in all operating filters varies depending on the time of the last filter backwash and the volume of solids accumulation in that filter bed from filtration of the effluent. After filtration, the filtered effluent flows into an underdrain plenum located below each bed into a center collection trough, which is routed into the filter effluent pipe. Filtered effluent from each filter is collected in one of two effluent headers. Flow is routed from the headers to a clearwell flow splitter box.

From the clearwell flow splitter box, the filtered effluent is either pumped into the Water Reuse/Non-Potable Water (WR/NPW) system or is routed to the two clearwells below filters No. 1-6. From the clearwells, filter effluent flows over weirs into two effluent troughs. Two slide gates, one at the end of each effluent trough, are installed to control water level in the troughs and in the clearwells. During AECOM's field inspection, both of these gates were found to be in the fully open position.

Filtered effluent flow from the two troughs flow into a 4' wide x 15.83' long drop box and then into a pipeline which routes the flow into JB6. From JB6, two parallel 60-inch plant outfall lines carry the effluent to Junction Box No. 9 (JB9). From JB9, the plant effluent enters three lines (one 84-inch and two 60-inch). These three lines discharge into the cascade outfall structure into the Colorado River for ultimate disposal.

When the level in the Colorado River is at flood stage, no water can flow by gravity out of the Filter Building. Under this high river stage condition, the filter system is required to switch from normal filtration mode to partial filtration mode. For the partial filtration mode, the Filter Building is limited to a flow value equal to or less than the amount of water that can be pumped out by the WR/NPW system. During the high river stage condition, the filters are required to treat at least the flow needed to meet the WR/NPW demand.

1.3.2 Existing Backwash Water System

When the headloss in a filter cell increases beyond a predetermined setpoint, the filter needs to be taken out of operation and cleaned by backwashing. Since filter headloss is not measured for each individual filter unit, filters are backwashed when the filter run-time exceeds a predetermined time to prevent solids breakthrough, deterioration of the filter media due to filter clogging and mudball formation, and permit limit violations. When an operating filter needs cleaning, it is taken offline for backwashing. Backwash water is pumped by one of two vertical turbine pumps from the clearwells to the filter being backwashed. Air for scouring the filter media and for combined air and water backwash is supplied by one of two multistage centrifugal blowers.

AECOM observed backwash operations at two filters. It was observed that the filters are currently backwashed manually. A filter is selected manually for backwash using a selector switch. Backwash is initiated for the selected filter by closing the influent valve to the filter. First air scour of the filter bed is initiated with air supplied to the filter for 10 to 12 minutes at a rate of about 4,500 scfm. After completion of the air scour, the filter is backwashed by using a combined air and water backwash for about 10 minutes to 15 minutes. During this combined air and water backwash, water is supplied by the Backwash Pump at rates varying from about 7,600 gpm to about 8,000 gpm corresponding to a unit rate of 8.8 to 9.3 gpm/ft^2. Once the combined air and water backwash is complete, the air to the filter is turned off. The water backwash is continued for an additional 10 to 15 minutes to complete the backwash cycle. After the backwash cycle is completed, the filter is returned to normal operation.

1.3.3 Existing Mudwell Water System

The dirty washwater generated during a filter backwash is collected and temporarily stored in the mudwell which is located in the filter building below filters No. 7 though 12. The mudwell acts as an equalization basin, enabling the washwater to return to the treatment plant at a low flow rate to prevent hydraulic and organic surge loadings to the treatment process. The mudwell is 184-feet long, 40.6-feet wide and 7.0-feet high, with a total volume of 391,000 gallons. The bottom slab elevation is 389.0-ft and according to the original O&M Manual, lead pump off elevation is 390.25-feet and high level alarm elevation is 395.0-ft, resulting in a maximum working volume of 265,400 gallons.

The washwater in the mudwell is pumped by one of three non-clog vertical centrifugal pumps to a backwash flow splitter box through a header pipe (which varies in diameter from 24-inch to 14-inch). From the Splitter Box the backwash water is currently diverted to the headworks of Train A only for treatment. The PER for this project will address improvements to provide diversion to Trains A, B and C.

1.3.4 Filter Building Hydraulic Issues of Concern

The following lists some of the issues associated with hydraulics through the Filter Building which are of concern with operational and maintenance personnel:

- Water levels in the Colorado River impact the hydraulic capacity of the filters to treat the plant effluent.
- High water levels in the clearwells and difficulty discharging effluent have been reported, even when the Colorado River water levels are not high.

1.4 Hydraulic Evaluation

A hydraulic evaluation method was developed for the SARWWTP filter building in order to evaluate hydraulic characteristics of the filter system. The hydraulic evaluation method is covered in this technical memorandum (TM) and starts at Junction Box No. 5 (JB5) ahead of the filter building, and continues to the outfall at the Colorado River.

Calculation Method

The hydraulic evaluation is based on a calculated headloss value, which occurs as a liquid flows through a given section, from JB5 to the outfall. Different forms of headloss were required to be calculated through the hydraulic evaluation. The headlosses calculated are as follows:

- Friction headlosses were calculated for pipe friction. The Hazen-Williams equation was used to estimate the friction headloss. A Hazen-Williams coefficient C=100 was used for the Hazen-Williams equation.
- Local headlosses were calculated for pipe appurtenances along the flow path. The headloss coefficient value used in the equation for various bends and valves were chosen based upon appropriate engineering literature as required.
- Weir headlosses were calculated using the sharp-crested weir equation for flow traveling over weirs in the system.
- Headlosses through the filter media were calculated based on the Carmen-Kozeny equation.
- The flow regime in the outfall pipes is dependent of the level in the Colorado River. Accordingly, the outfall pipes were modeled in SewerCAD and analyzed for pressure or free surface flow conditions.

The hydraulic calculations were conducted for the two main components of the system:

- Filter building: hydraulic calculations started from JB6 and ended at JB5 in order to determine the capacity of the filters for various levels in JB6. A detailed description of these calculations is shown in section 1.4.1.2 below. The calculations were used to define the maximum allowed water surface elevation in JB6, for different flow conditions, so that the Filter Building will not be flooded and a pre-established freeboard will be maintained in the clearwells.
- Outfall lines: calculations started from the river to JB6 and the results were used to define the water surface elevation in JB6 for various river levels and flow conditions, when filter effluent could be discharged to the Colorado River by gravity. A detailed description of these calculations is presented in section 1.4.4 below.

From the downstream starting point, represented by the outfall structure or JB6, as mentioned above, the gradually varying water surface profile upstream is calculated using determined headlosses for various flow conditions. These headlosses cause a rise in the energy grade line (EGL) through the upstream hydraulic profile. This calculated EGL at each point in the system is used to determine the estimated water surface elevation at that point.

1.4.1 Filter Building and Effluent Water Systems

1.4.1.1 Flow Conditions

The main purpose of this TM is to determine the maximum hydraulic capacity of the filter building and current limiting factors of the hydraulic capacity. In order to achieve this, various flow conditions and River levels were used to evaluate the system's reaction. The filter building designed flow rate of 40 MGD was used as the minimum flow rate for the evaluation. The second flow condition evaluated is the filter building peak flow rate of 80 MGD. A higher flow rate (100 MGD) was evaluated in order to determine if 100 MGD could be passed through the existing system. The evaluated flow conditions are shown in **Table 1.1**.

Table 1.1 – Flow Conditions

Flow Conditions	**Design**	**Peak**	**Maximum**
Total Flow through Filters (MGD)	**40**	**80**	**100**
Total Flow through Filters (CFS)	61.89	123.78	154.73

1.4.1.2 Junction Box No. 5 to Junction Box No. 6

The hydraulic profile for the flow from JB5 through the existing filter building to JB6 was evaluated at various flow conditions in order to determine the water surface elevation in JB6 required for maintaining a minimum freeboard of 18-inches in the Clearwells. The evaluation required the flow path from JB5 to JB6 be separated into four (4) segments starting downstream at JB6 and proceeding through the filter building upstream to JB5. The four segments are as follows:

- JB6 to Filtered Water Splitter Box
- Filtered Water Splitter Box to Filter Unit Effluent Piping
- Filter Unit

- Filter Unit Influent Piping to JB5

JB6 to Filtered Water Splitter Box

The first segment evaluated starts at JB6 and ends at the Filter Water Splitter Box. Starting at the South compartment of JB6, the friction and local headlosses through the 84-inch pipe to the Filter Effluent Box were calculated for each flow condition. These headlosses are summarized in **Table 1.2**.

Table 1.2 – Headloss from Clearwells to JB6

Flow Conditions	40 MGD	80 MGD	100 MGD
Flow (cfs)	61.89	123.78	154.73
Velocity in pipe (ft/s)	1.61	3.22	4.02
Friction losses (ft)	0.02	0.06	0.10
Minor losses (ft)	0.07	0.30	0.47
Total losses (ft)	0.09	0.36	0.56

From the filter effluent box, calculations were conducted upstream to the filtered water splitter box situated upstream of the Clearwells. Headlosses were considered for the filter effluent box, filter effluent troughs, head over the sharp crest effluent weirs, loss through the vertical opening between the troughs, and loss through the sluice gates between the clearwells and the filtered water splitter box. Due to the different effluent weir lengths for Clearwell no. 1 (CW1) and Clearwell no. 2 (CW2), several different flow iterations were required in order to accurately balance the flow between the two clearwells. A summary of the headlosses from the filter effluent box to the filtered water splitter box, calculated for various water surface elevations in JB6, is shown in **Table 1.3**.

Table 1.3 – Headloss from Filter Effluent Box to Clearwells

Flow Conditions	40 MGD	80 MGD	100 MGD
Flow (cfs)	61.89	154.73	185.68
Transition from trough to effluent box	Submerged	Submerged	Submerged
Water depth in effluent trough - CW1 (ft)	4.98	4.86	4.72
Water depth in effluent trough - CW2 (ft)	4.98	4.89	4.77
Weir condition	Submerged	Submerged	Submerged
CW1 - Weir Head for CW1 - H1 CW1 (ft)	2.00	2.01	2.01
CW1 - Flow from CW1 - Q CW1 (cfs)	28.74	57.02	71.13
CW1 - Headloss through opening between troughs	0.01	0.03	0.05
CW1 - Headloss through Sluice Gate (at Splitter Box)	0.04	0.16	0.24
CW2 - Weir Head for CW2 - H1 CW2 (ft)	2.00	1.99	1.96
CW2 - Flow from CW2 - Q CW2 (cfs)	33.16	66.76	83.60
CW2 - Headloss through Sluice Gate (at Splitter Box)	0.05	0.21	0.33

Note: The effluent weirs of CW1 and CW2 are submerged because the calculations are conducted for worse conditions in order to determine the maximum allowed water surface elevation in JB6.

Filtered Water Splitter Box to Filter Unit Effluent Piping

The friction and local headlosses were calculated from the underdrain system of Filter No. 7 to the filtered water splitter box (longest distance for furthest Filter). To be conservative, constant flow in the 42" diameter Filter Effluent Pipe was assumed. Actual flow through the 42" Effluent Pipe would be smaller than presented in the table if calculated considering gradually increasing flow through the Effluent Header pipe due to feed from each filter. Filter effluent travels from the filter underdrain system through a 24-inch filter effluent pipe into one of two common 42-inch filter effluent header pipes. The 42-inch effluent header carries the filter effluent to the filtered water splitter box. Filter No. 7 was selected to insure the highest headlosses due to the increased length in pipe and additional fittings for this filter. The headlosses through the 24-inch and 42-inch filter effluent pipes are shown below in **Table 1.4**.

Table 1.4 – Headloss from Filter Underdrain to Filter Effluent Box

Flow Conditions	40 MGD	80 MGD	100 MGD
Flow for the 42-inch header (half of total flow) (CFS)	30.95	61.89	77.37
Velocity in pipe (ft/s)	3.22	6.43	8.04
Friction losses (ft)	0.21	0.75	1.13
Minor losses (ft)	0.58	2.34	3.65
Total losses - 42-inch piping (ft)	0.79	3.09	4.79
Flow for the 24-inch effluent pipe (cfs) (11 Filters ON)	5.16	10.32	12.89
Velocity in pipe (ft/s)	1.64	3.28	4.10
Friction losses (ft)	0.01	0.03	0.04
Minor losses (ft)	0.15	0.61	0.95
Total losses - 24-inch piping (ft)	0.16	0.64	0.99
Total losses 42-inch and 24-inch piping (ft)	0.95	3.72	5.78

Filter Unit

The headlosses starting at the filter influent trough, through the filter media and filter underdrain system were calculated. The headloss through the filter media was calculated using Carmen-Kozeny formula for a clean media bed. Using a Kozeny constant of 6, an assumed grain size, porosity and specific surface for the filter media, the headlosses through the media could be evaluated. After flow passes though the filter media, it is collected at the bottom of the filter by the nozzle underdrain system and then passed through 6”x12” openings in a channel under the influent gullet and into the 24-inch filter effluent pipe. The headlosses though the filter media and underdrain system are shown in **Table 1.5**.

Table 1.5 – Headloss from Filter Influent to Filter Effluent

Flow Conditions	40 MGD	80 MGD	100 MGD
Total Flow through Filters (CFS)	61.89	123.78	154.73
No. of Filters ON	11	11	11
Filter Load (gpm/sq.ft.)	2.92	5.85	7.31
Headloss through filter media (ft)	0.49	0.99	1.24
Headloss through nozzle (ft)	0.25	0.99	1.54
Headloss through 6"x12" opening to underdrain (ft)	0.01	0.03	0.03
Total Headloss (Filter media and underdrain) (ft)	0.75	2.00	2.81
Influent trough condition	Free Fall	Submerged	Submerged
Freeboard to Overflow weir	10.24	6.07	3.11

Filter Unit Influent Piping to JB5

The friction and local headlosses were calculated from Junction Box No. 5 to the inlet pipe of Filter No. 6. Filter No. 6 was selected to insure the highest headlosses due to the increased length in pipe and additional fittings for this filter (longest distance for furthest Filter). To be conservative, constant flow in the 42” diameter Filter Influent Pipe was assumed. Actual flow through the 42” Influent pipe would be smaller than presented in the table if calculated considering gradually reducing flow through the Influent Header pipe due to feed into each filter. Flow from JB5 travels though a 72-inch pipe, 60-inch pipe, 42-inch Influent Header pipe, and to the 24-inch Filter Influent pipe to Filter No. 6. The headlosses though each pipe were calculated and are summarized in **Table 1.6**.

Table 1.6 – Headloss from JB5 to Filter Influent

Flow Conditions	40 MGD	80 MGD	100 MGD
24-inch Pipe - Flow (cfs)	5.16	10.32	12.89
24-inch Pipe - Velocity (ft/s)	1.64	3.28	4.10
24-inch Pipe - Total losses (ft) (Friction+Minor)	0.05	0.20	0.31
42-inch Pipe - Flow (half of total flow) (cfs)	30.95	61.89	77.37
42-inch Pipe - Velocity (ft/s)	3.22	6.43	8.04
42-inch Pipe - Total losses (ft) (Friction+Minor)	0.51	1.97	3.04
60-inch Pipe - Flow (half of total flow) (cfs)	30.95	61.89	77.37
60-inch Pipe - Velocity (ft/s)	1.58	3.15	3.94
60-inch Pipe - Total losses (ft) (Friction+Minor)	0.06	0.25	0.39
72-inch Pipe - Flow (cfs)	61.89	123.78	154.73
72-inch Pipe - Velocity (ft/s)	2.19	4.38	5.47
72-inch Pipe - Total losses (ft) (Friction+Minor)	0.09	0.34	0.53
Total losses - Filter 6 to JB5	0.72	2.76	4.27

Water Surface Elevations

Based on the total headloss from JB5 to JB6, the change in water level can be determined through the system for each flow condition. The water surface elevation for the system is based on a minimum 18-inch freeboard in the clearwells. By using the minimum freeboard requirement, the maximum allowed water surface elevation was calculated for JB6 and for the filter system. The water surface elevation from JB5 to JB6 is shown in **Table 1.7**.

Table 1.7 – Water Surface Elevation from JB5 to JB6

Flow Conditions	40 MGD	80 MGD	100 MGD
WS Elevation in JB5 (assuming clean media)	407.47	413.69	418.16
WS in Filter Cells (assuming clean media)	406.76	410.93	413.89
WS at Filter 7 Effluent Pipe connection	406.00	408.93	411.08
Water level over CW1 Weir	405.00	405.01	405.01
Water level over CW2 Weir	405.00	404.99	404.96
Clearance to ceiling (freeboard)	1.50	1.49	1.49
Clearance to ceiling (freeboard)	acceptable	acceptable	acceptable
Water Level in Splitter Box	405.05	405.20	405.30
WS Elevation in Filter Effluent Box (ft)	404.95	404.76	404.56
WS Elevation in JB6 (ft)	**404.86**	**404.40**	**404.00**

The water surface elevation shown for JB6 is the maximum water surface elevation allowed in the junction box for the specific flow conditions.

1.4.1.3 Junction Box No. 6 to Outfall

The water surface elevation of the Colorado River has a direct impact on the water surface elevation in JB6. As the elevation in the Colorado River rises, the elevation in JB6 increases to maintain the head difference that is required to overcome the headloss through the outfall system. The calculations were conducted assuming that the water surface elevation for the Colorado River was equal to the critical depth required in the outfall pipes at the top of the cascade outfall. Any elevation lower than the assumed elevation for the Colorado River at the given flow condition would not have an impact on the water surface elevation in JB6.

There are two 60-inch pipes to carry flow from JB6 to JB9, and one 84-inch and two 60-inch pipes to carry flow from JB9 to the cascade outfalls into the Colorado River. The hydraulic profile for the flow from JB6 to the discharge outfall was evaluated at various flow conditions in order to determine the minimum water level in JB6 such that the water flow can be discharged by gravity into the river.

The flow distribution between the outfall pipes was calculated. The three outfall pipes were modeled in SewerCAD from JB6 to the outfall to determine the partially filled pipe conditions. Using the SewerCAD analysis of the individual pipe flow, the combined energy grade line for the three outfall pipes was determined. The energy grade line for the combined pipe flow through the two 60-inch pipes and the 84-inch pipes shows the water surface elevation in JB9 based on flows ranging from 40 MGD to 200 MGD.

The energy grade line in JB6 and JB9, for river levels below the critical depth at the end of the outfall pipes is shown in **Figure 1.1**. The levels in the river corresponding to the critical depth at the end of the outfall pipes are shown in **Table 1.8.**

Figure 1.1 – Energy Grade Line vs. Flow

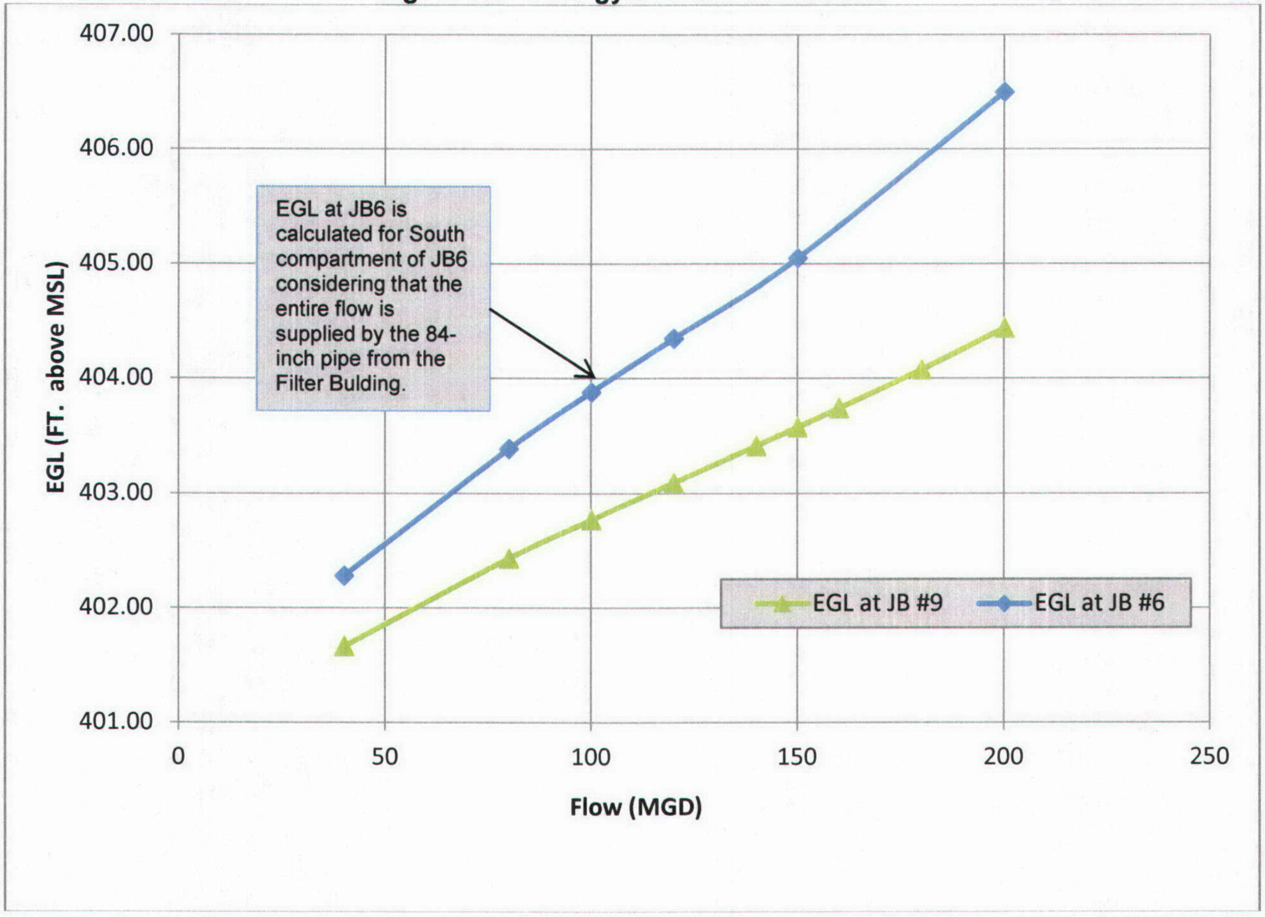


Table 1.8 – Elevation of Colorado River

Water Surface Elevation	Elev. in JB #6 for outfall capacity	Elev. of Colorado River
Design Flow (40 MGD)	402.3	396.7
Peak Flow (80 MGD)	403.4	397.19
Maximum (100 MGD)	403.9	397.39

1.4.1.4 Capacity of existing filter system

The results of the hydraulic calculation described in the previous sections were used to develop the hydraulic profile shown in **Exhibit 1.2**. In order to determine possible bottlenecks for the existing system, the velocities in the existing piping components were calculated as presented in **Table 1.9** below.

Table 1.9 – Pipe Velocity from JB5 to JB6

Location	Pipe Size (in)	Feeding Filters	Velocity (fps)		
			40 MGD	80 MGD	100 MGD
JB No. 5 to Filter Influent	72	12	2.19	4.38	5.47
	60	6	1.58	3.15	3.94
	42	6	3.22	6.43[1]	8.04[1]
	24	1	1.64	3.28	4.10
Filter Effluent to JB No. 6	24	1	1.64	3.28	4.10
	42	6	3.22	6.43[2]	8.04[2]
	84	12	1.61	3.22	4.02

1. These velocities are in the first segment of the pipes feeding the first filters on both sides (Filters No. 1 and 7). In the second segment of the pipes feeding Filters No. 2 and 8, velocities are smaller due to reduction and are 2.68, 5.36, and 6.7 fps respectively for 40 mgd, 80 mgd and 100 mgd total flow. In the third pipe segments feeding Filters No. 3 and 9, velocities are further reduced to 2.15, 4.29 and 5.36 fps respectively for 40 mgd, 80 mgd and 100 mgd total flow due to flows discharged into Filters No. 1, 2, 7, and 8.

2. These velocities are in the last segments of the pipes after the last filters on both bays (Filters No. 6 and 12). In the pipe segments before the feed points from Filters No. 6 and 12, velocities are smaller due to lower flow in these pipe segments and are 2.68, 5.36, and 6.7 fps respectively for 40 mgd, 80 mgd and 100 mgd total flow through the Filters. In the pipe segments before the feed points from Filters No. 5 and 11, velocities are further reduced to 2.15, 4.29 and 5.36 fps respectively due to lower flow in these pipe segments for 40 mgd, 80 mgd and 100 mgd total flow through the filters.

In order to limit the hydraulic headlosses, it is preferable to maintain the velocity in pipes at or below 6 ft/sec. For a total flow of 40 MGD, the velocities in all the pipes are well below 6 ft/sec, resulting in low headlosses through the filter system. At 80 MGD total flow, corresponding to 40 MGD in each header, the velocities in the first segments of the two 42-inch influent headers and in the last segments of the 42-inch effluent headers slightly exceed 6 ft/sec. The lengths of these pipe segments are small (about 15-feet) and as a result, the headlosses are also small and considered acceptable. At a total flow of 100 MGD, the velocities in the first segments of the two 42-inch influent headers and the last two segments of the 42-inch effluent headers increase to about 8 ft/sec, and the overall filter system headlosses may result in a water surface elevation of up to 422 ft MSL in JB5. This high elevation may result in submerging the weir of the contact chlorine basins; however, the existing filter system should be able to hydraulically pass the flow of 100 MGD as long as the sluice gates in JB6 and JB9 are fully open.

The existing capacity of the components of the piping system is summarized in **Table 1.10**.

The elevation of the clearwell effluent weirs is 403.0 ft MSL. The length of the Clearwell No.1 (CW1) weir is 13.84 feet and the length of the Clearwell No. 2 (CW2) weir is 19.5 feet. For un-submerged / freefall discharge and a freeboard of 18-inches over the clearwells, the capacity of the CW1 weir is 72 MGD and the capacity of the CW2 weir is 78 MGD, resulting in a total capacity of 150 MGD. Under existing conditions, gravity flow from JB6 to the River will result in water levels in JB6 that under most flow conditions will submerge the clearwell effluent weirs and reduce the weirs' capacity. The capacity of the submerged weirs for various flow conditions is shown in Table 1.3. To increase the flow over the weir, the water level in JB6 needs to be lowered by pumping the filter effluent to the River, or by modifying the structure of the filter building to allow higher head over the weirs.

Table 1.10 – Capacity of existing filter piping

Pipe Location	Pipe Size	Pipe Capacity	Velocity in Pipe	Comments
	(in)	(MGD)	(fps)	
JB5 to Filter Building	72	110	6.0	
Transition from Filter Bldg. Influent to Influent Header	60	80	6.3	Short pipe segment.
Filter Influent Header	42	40	6.4	Exceeds 6 fps in only a short segment of the pipes
Filter Influent Pipe	24	12	5.9	
Filter Effluent Pipe	24	12	5.9	
Filter Effluent Header	42	40	6.4	Exceeds 6 fps in only a short segment of the pipes
Filter Effluent to JB6	84	150	6.0	

1.4.2 Backwash Water System

To evaluate the backwash water system, system curves were created to represent the minimum and maximum headlosses. The system curves were prepared for the closest filter and for the farthest filters. System curves were developed for Filter No. 1 to represent the minimum headloss for the system. System curves for Filter No. 12 were developed to represent the maximum headloss for the system. The system curves for the other filters in the backwash system will fall in between the two system curves developed. The clearwell water surface elevations are shown in **Table 1.11**.

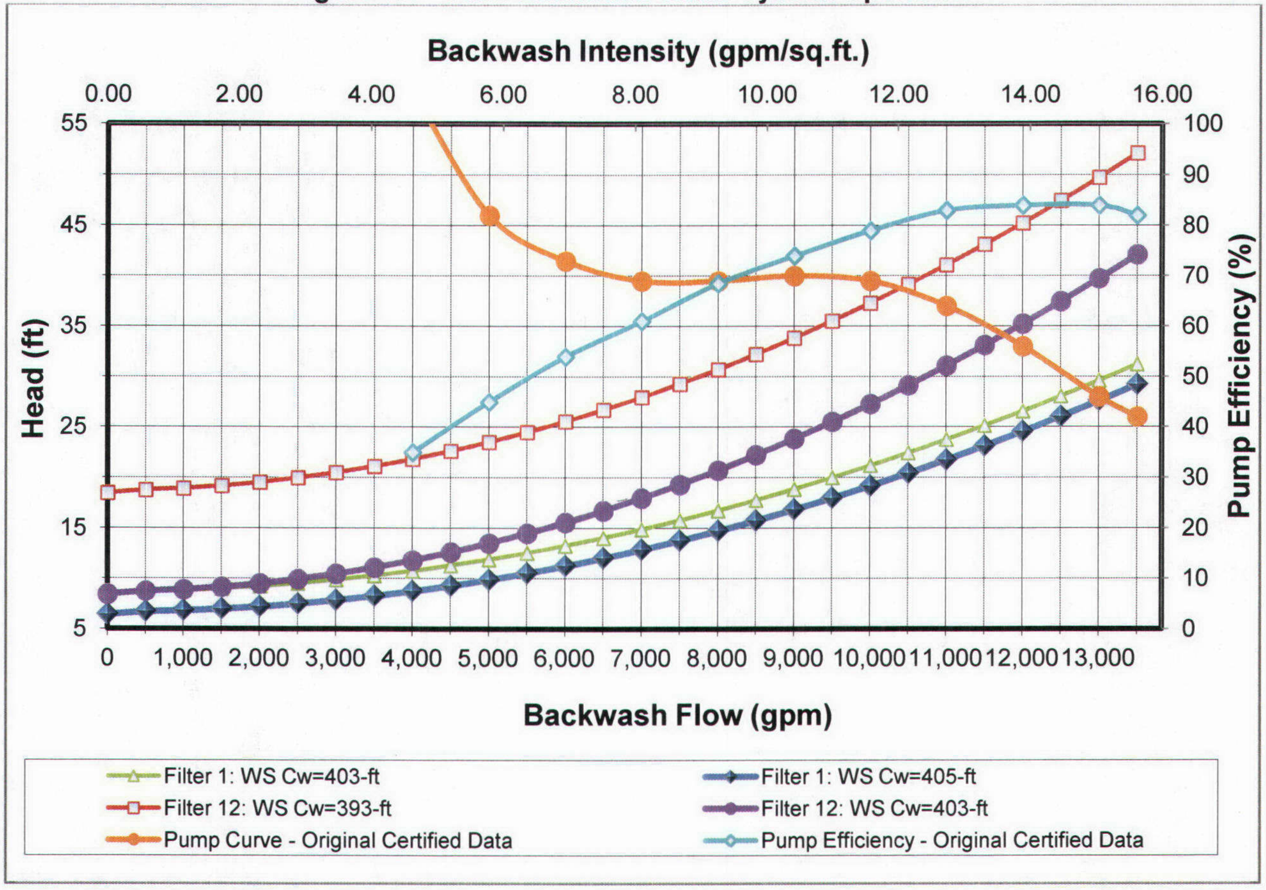
Table 1.11 – Clearwell Water Surface Elevations

Clearwell Water Surface (WS) Elevation	Elevation
Maximum WS Elevation	405 ft above MSL
Average WS Elevation	403 ft above MSL
Minimum WS Elevation (based on min. pump submergence)	393 ft above MSL

The system curves for the backwash water system are based on the headlosses through the system from the discharge piping at the backwash vertical turbine pumps, though the filter underdrain system and filter media. Friction and local headlosses were calculated for the 24-inch and 20-inch backwash pump discharge pipes and associated bends and fittings.

For the filter underdrain system, the headlosses associated with the flow though the existing nozzles were calculated. The headlosses through the nozzles are based on existing O&M data as shown in **Exhibit 1.3**. It was assumed the nozzles are 75% clogged. The headlosses through the media bed was calculated based on the expanded media bed that will be present during the backwash cycle.

Figure 1.2 – Filter Backwash Water System Operation



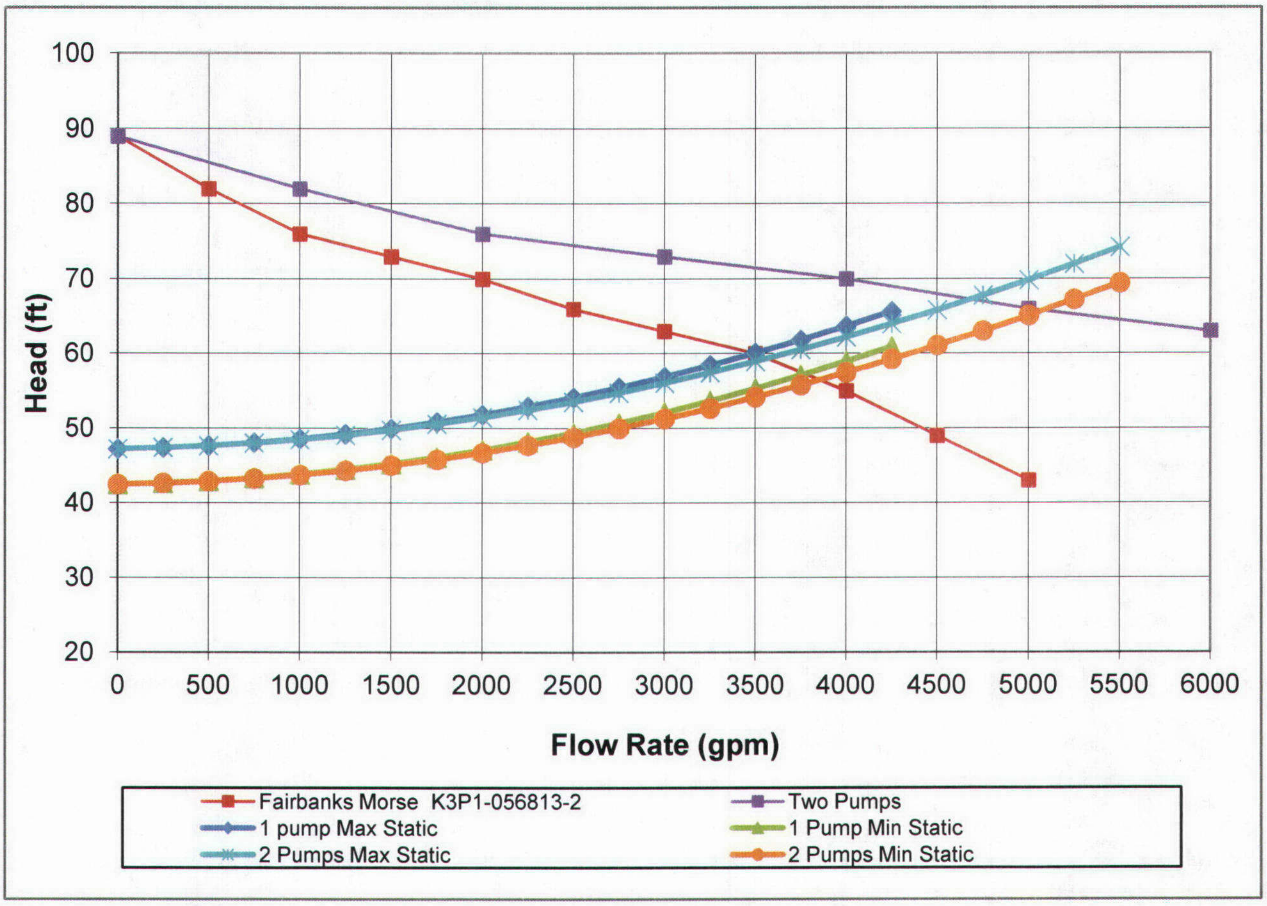
The existing backwash pumps are vertical turbine pumps, and according to the original O&M Manuals are rated at 11,000 gpm and 35-feet total dynamic head. The existing pump curves are shown in **Exhibit 1.4.** The calculated system curves were plotted against the existing pump curves and are shown in **Figure 1.2**.

1.4.3 Mudwell Water System

To evaluate the mudwell system, system curves for one mudwell pump in operation and two mudwell pumps in operation were developed. For each system curve, the headlosses were calculated for the minimum and maximum static head possible in the mudwell. The static head is calculated as the difference between the weir elevation of the splitter box where the backwash water is discharged, and the water level in the mudwell. The weir elevation of the existing splitter box is 437.5-ft MSL. For the maximum static head condition a water level of 390.25 ft MSL was considered in the mudwell, corresponding to the lead pump off elevation. The minimum static head was calculated considering the backwash termination elevation of 395 ft MSL (elevation per O&M Manual).

The system curves for the mudwell system are based on the headlosses through the system from the mudwell pump discharge piping to the discharge at the flow equalization diversion structure for Train A, and eventually Train B. Friction and local headlosses were calculated for the 24-inch to 14-inch discharge pipe and associated bends and fittings. In order to determine the pumping capacity, the mud pumps curves were plotted against the system curves. The mudwell pump curves were developed based on certified pump curves included in the original O&M Manual, and shown for reference in **Exhibit 1.5**. The developed mudwell pump system curves are shown in **Figure 1.3**.

Figure 1.3 – Mudwell Water System Operation



According to the developed mudwell pumping system curves shown in **Figure 1.3**, the existing pumps are capable of pumping a mud flow of 3,500 gpm if one pump is running, and 4,600 gpm if two pumps are running. Considering the capacity of the pumps, calculations were conducted in order to determine if the existing pumping capacity is adequate for displacing the backwash water generated during a filter backwash. Two different scenarios were considered regarding the backwash flow entering the mudwell:

a) backwash flow of 10,360 gpm corresponding to the maximum backwash intensity of 12 gpm/sq.ft. specified as the maximum backwash rate in the original O&M, and;
b) backwash flow of 12,500 gpm corresponding to the maximum capacity of the backwash pumps.

For both scenarios, the O&M Manual elevations were considered for Lead Pump ON (393.25 ft MSL) and Lead Pump OFF (390.25 ft MSL)

For a backwash intensity of 12 gpm/sq.ft. and a backwash time of 20 minutes, one existing mudwell pump has adequate capacity to keep the mudwell from flooding. Before starting the backwash, the mudwell WS elevation shall be 390.25 ft MSL (Lead OFF elevation). The WS elevation in mudwell will be 393.73 ft MSL at the end of the 20 minutes backwash, assuming the mudwell pump will work based on ON/OFF elevations mentioned above.

During normal backwash, the flow of the backwash pump is throttled by opening the discharge/return valve to the clearwell in order to maintain the flow at approximately 9 gpm/sq ft without throttling, the backwash pump is capable of providing a maximum flow of 12,500 gpm. Assuming a 12,500 gpm backwash flow, the WS elevation in the mudwell will be 394.32 ft MSL at the end of the 20 min backwash, if one mudwell pump is used with these ON/OFF elevations.

Given that the water surface elevation in the mudwell does not reach the backwash termination elevation of 395 ft MLS in either of the above described scenarios, it can be concluded that one existing mudwell pump has adequate capacity for removing the backwash water generated during a filter backwash.

1.5 Hydraulic Evaluation Conclusions

1.5.1 Filter Building and Effluent Water Systems

In order to evaluate the hydraulic capacity of the filter system, calculations were conducted from JB5 to the Colorado River (River). The results of the calculations were used to develop the hydraulic profile shown in **Exhibit 1.2**. For hydraulic calculation purposes, the system was divided in two main segments: a) system components from JB5 to JB6 and b) system components from JB6 to the River.

The calculation results for the first segment (JB5 to JB6) shows the maximum water surface elevation in JB6, for various flow conditions, such that an 18-inch freeboard will be maintained in the Clearwells of the Filter Building.

The calculation results for the second segment (JB6 to River) shows the calculated minimum water surface elevation in JB6 that allows filter effluent to be conveyed to the River by gravity.

The water surface elevations calculated for JB6 are shown in **Table 1.10**. The filter system operates via gravity if the JB6 elevation from the first segment calculation is higher than the JB6 elevation from the second segment calculation. If this condition is not satisfied, the 18-inch freeboard condition is not met, and the filter flow must be reduced or pumped to prevent high backwater and flooding of the lower levels of the filter building.

Table 1.10 – Water Surface Elevation in JB6

Flow Conditions	**MAX. allowed WS Elev. in JB6** (required in order to maintain 18" freeboard on top of Clearwells)	**MIN. required WS Elev. in JB6** (required in order to discharge the filter effluent to the River by gravity)	**MAX - MIN (ft)**
Design Flow (40 MGD)	404.8	402.3	2.5
Peak Flow (80 MGD)	404.4	403.4	1.0
Maximum Flow (100 MGD)	404.0	403.9	0.1

The calculations described above were conducted for the existing filter system. The results show that the maximum hydraulic flow that can be passed through the filter building is 100 MGD if the level in the river is below the critical depth of the outfall lines (EL. 397.5-ft above MSL), and all the gates in JB6 are fully open. However, for a flow of 100 MGD through the filter building, the required water surface elevation in JB5 is calculated as 418.2 feet MSL for a clean filter media bed. As the filter media gets dirty, elevation in JB5 would rise up to about 422.0 feet MSL. This high water level in JB5 will submerge the effluent weirs of the existing chlorine contact basins.

The maximum allowed level in the clearwells and the size of the pipes between JB6 and JB9 are hydraulically limiting factors. In order to be able to discharge a flow larger than 100 MGD from the filter building, either the structure of the filter building needs to be modified to allow a higher water surface elevation in the Clearwells, or the filter effluent will have to be pumped.

All of the above calculations and conclusions consider that the water level in the River is below 397.5-ft above MSL, which represents the critical depth in the outfall pipes. When the water level in the River rises above this elevation, the filter effluent shall be pumped to the River or the filter building shall be taken out of service or switched to Partial Filtration Mode for the existing filter system. If alternative filtration processes are selected for the SARWWTP Filter Improvements, the hydraulic limitations reported herein shall be taken into consideration.

1.5.2 Backwash Water System

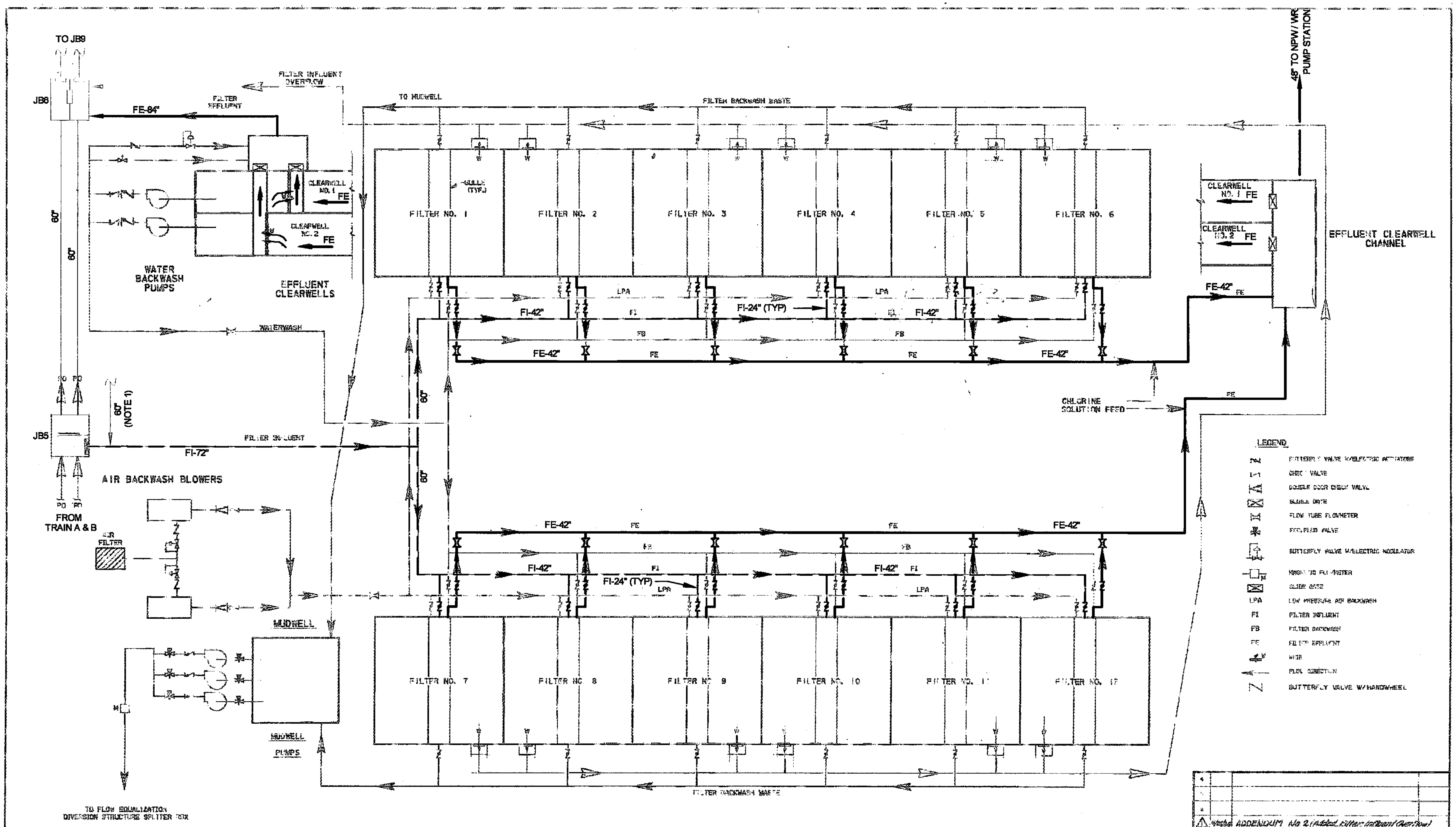
The original design of the backwash system indicates that the system shall deliver a flow corresponding to a backwash intensity of 6 gpm/ft^2 to12 gpm/ft^2. According to the developed filter backwash system curves shown in **Figure 1.2**, the existing pumps are capable of delivering a backwash flow of 12 gpm/ft^2 to 15 gpm/ft^2 depending on the specific filter that is backwashed and the water surface elevation in the clearwell.

The hydraulic evaluation established that the backwash pumps have adequate capacity and can provide a backwash intensity greater than or equal to the maximum designed backwash intensity. To optimize the filter backwash, the backwash intensity can be reduced by circulating a part of the backwash pump discharge flow back into the clearwells. This can be achieved by partially opening the butterfly valves located on the return lines to the clearwell.

1.5.3 Mudwell Water System

According to the developed filter backwash system curves shown in **Figure 1.3**, the existing pumps are capable of pumping a mud flow of 3,500 gpm if one pump is running, and 4,600 gpm if two pumps are running. The hydraulic evaluation established that the mud pumps have adequate capacity for displacing the backwash water generated during a filter backwash.

Exhibits



LEGEND:

FE - FILTER EFFLUENT

FI - FILTER INFLUENT

NOTE:

1. 60" TRAIN C EFFLUENT LINE, FROM JB9.

RECORD DRAWING
PREPARED BY ________
DATE ________

Dwg. No. G-3

4			
3			
2			
1	9/98	ADDENDUM No. 2 (Added Filter Influent Overflow)	
NO.	DATE	REVISION	APPROV.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
PROCESS FLOW SCHEMATIC

Turner Collie & Braden Inc.

P.M. WILLIAMS	Scale Horiz. NONE Vert.	Date JUNE 1998
Designed TPG/TTS	Checked STW	Job No.
Drawn EAD/DRD	Approved TLB	Sheet 9 of 122

ADDENDUM No. 2 Sht. 28 of 68

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM SCHEMATIC
INFLUENT & EFFLUENT PIPING

AECOM
AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

EXHIBIT No.	1.1	JOB No. 60213591	DATE: JUNE 2011

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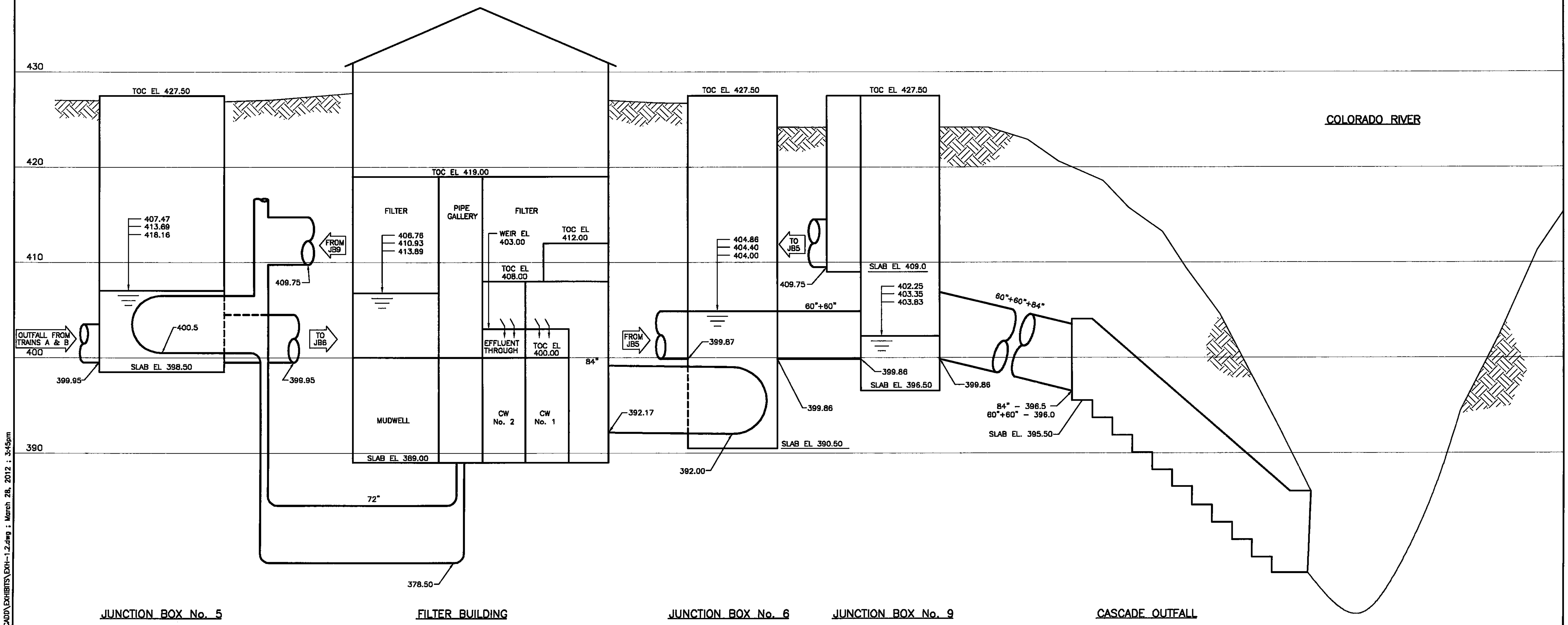

FLOW CONDITIONS

DESIGN FLOW = 40 MGD
PEAK FLOW = 80 MGD
MAXIMUM FLOW = 100 MGD

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER BUILDING AND EFFLUENT WATER SYSTEMS
HYDRAULIC PROFILE

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AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

EXHIBIT No. 1.2	JOB No. 60213591	DATE: JUNE 2011

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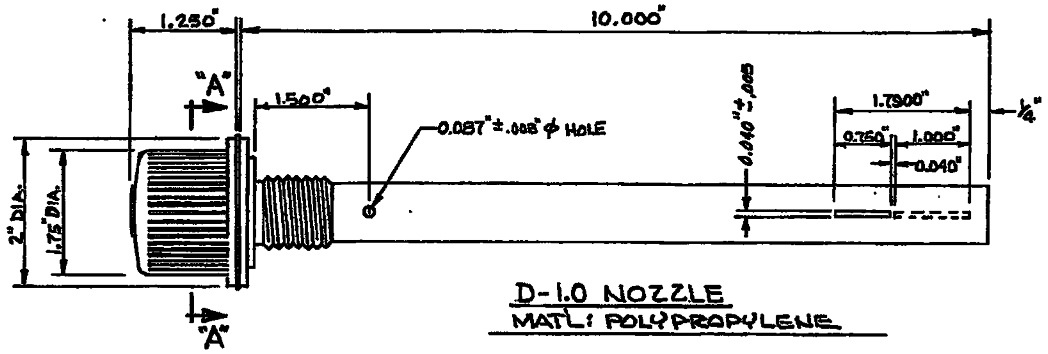
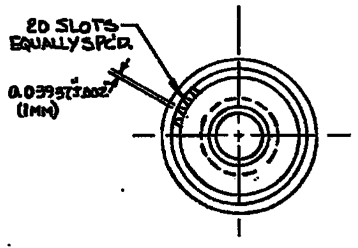
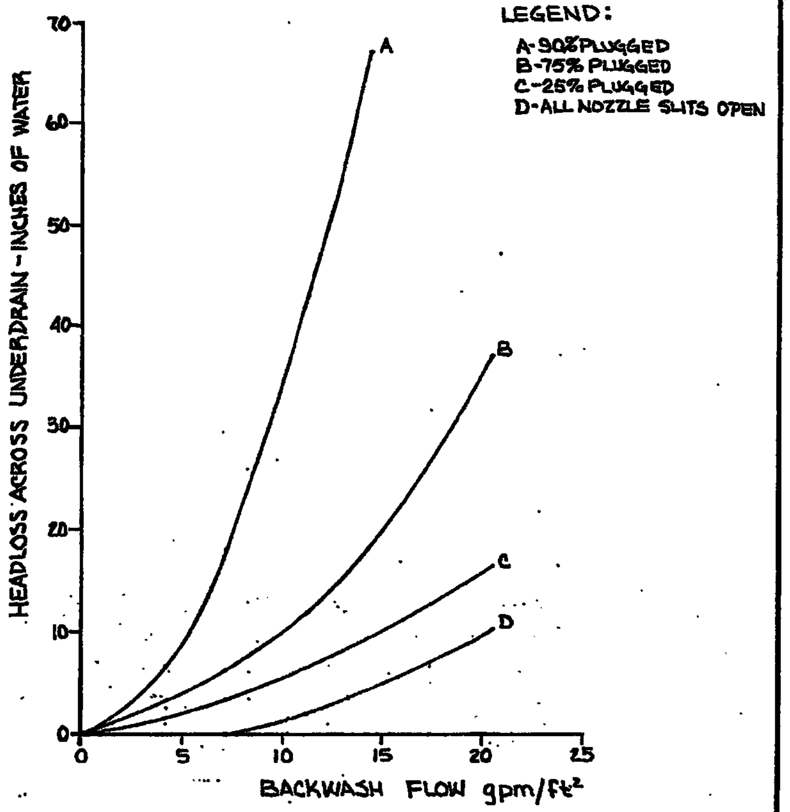


D-1.0 NOZZLE
MAT'L: POLYPROPYLENE



SECTION "A-A"



PRESSURE LOSS THRU NOZZLE DURING BACKWASH

Infilco Degremont Inc.

☒ Information Only - Return not required.
☐ Preliminary - Not to be used for construction.
☐ For Approval } - Requests for changes can add
☐ Certified } to price and delay shipment.

For SOUTH AUSTIN WWTP
AUSTIN, TEXAS

Cust. Ord. No.

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REV. NO.	DR.	CHK.	APP.	APP.	DATE

DR. JENNINGS
CHK. JHM
APP. JHM
APP.
APP.
ASSEMBLY

Infilco Degremont Inc
Box K-7 Richmond, Va. 23288

D-1.0 NOZZLE

SCALE | SIZE | DWG. NO. | REV.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

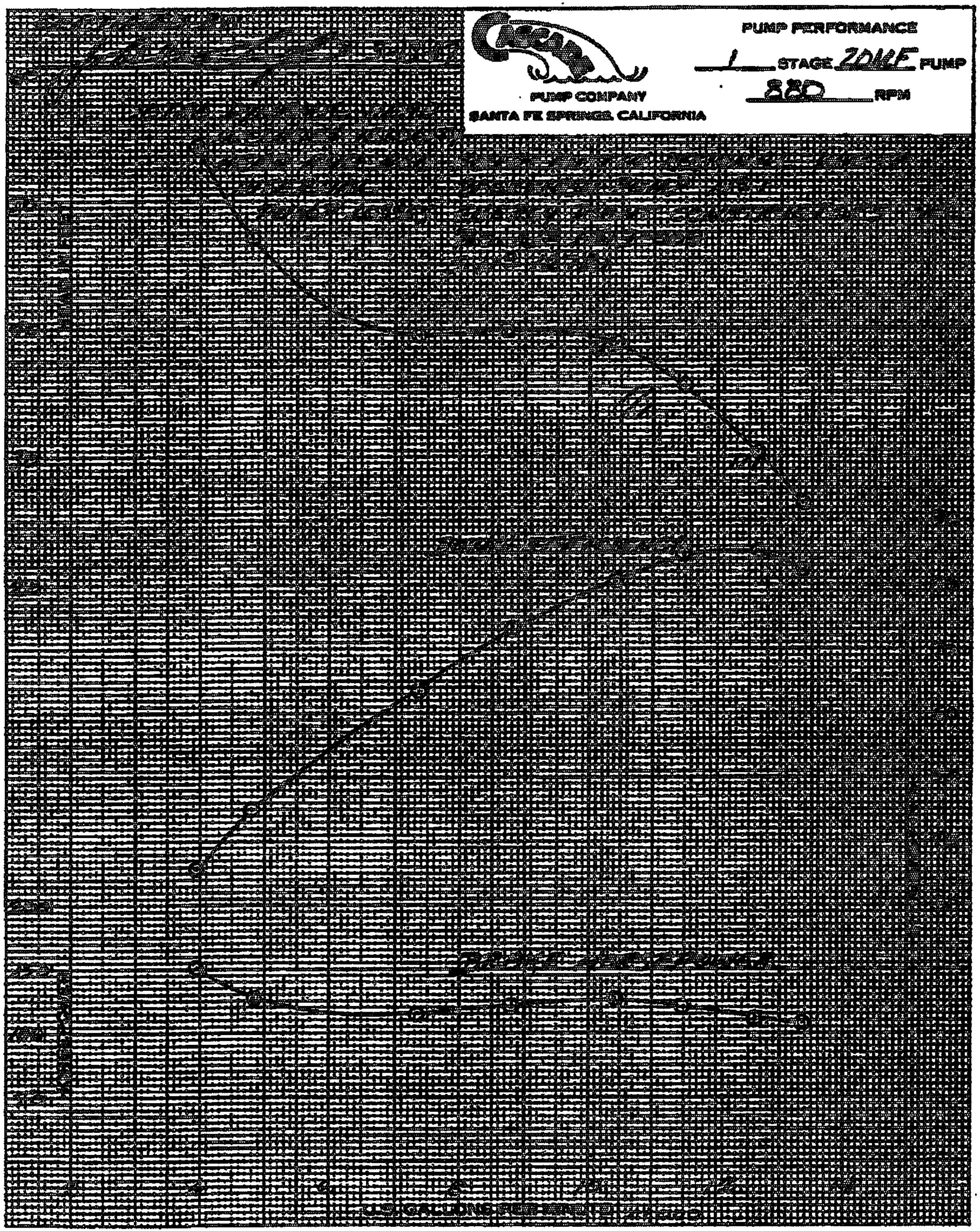
EXISTING FILTER UNDERDRAIN NOZZLE

AECOM
AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

EXHIBIT No. 1.3 | JOB No. 60213591 | DATE: JUNE 2011

E:\60213591 South Austin Regional Filter Improvements\400 Technical Information\410 CADD\EXHIBITS\EXH-1.3.dwg ; March 28, 2012 ; 3:45pm

CURVE NO. 2100



E061 9/84

CURVES SHOW APPROXIMATELY THE CHARACTERISTICS WHEN PUMPING CLEAR NON-AERATED WATER. NO GUARANTEE IS MADE EXCEPT FOR THE RATED POINT.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

BACKWASH WATER SYSTEM PUMP CURVE

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AUSTIN, TEXAS 78701
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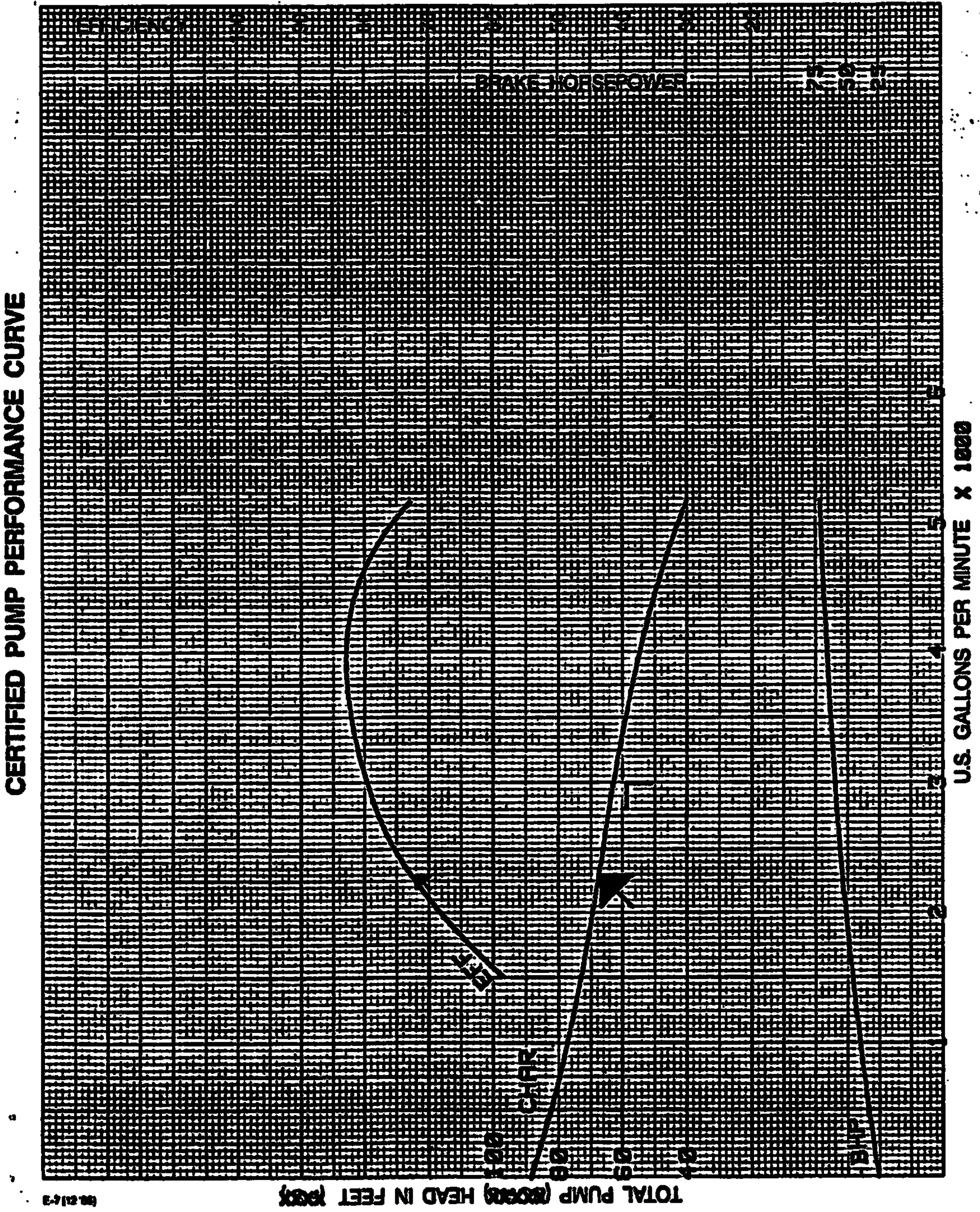
EXHIBIT No. 1.4 | JOB No. 60213591 | DATE: JUNE 2011

Fairbanks Morse
Pump Corporation

CERTIFIED CURVE

SERIAL NO. K3P1-056813-2 NO. STAGES ONE
TEST DATE 1/30/87 DRIVER DYNO-100 MTR
CERTIFIED CORRECT BY 2/87
TEST DEPARTMENT DATE

SIZE-MODEL 10-B5445
IMPELLER TRLESBZ
IMPELLER DIA 10.25"
RPM(S) 885



CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

MUDWELL WATER SYSTEM PUMP CURVE

AECOM
AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
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EXHIBIT No. 1.5 JOB No. 60213591 DATE: MARCH 2012

E:\60213591 South Austin Regional Filter Improvements\400 Technical Information\410 CADD\EXHIBITS\EXH-1.5.dwg : March 29, 2012 : 2:25pm

AECOM
400 West 15th Street, Suite 500, Austin, Texas 78701
T 512.472.4519 F 512.472.7519 www.aecom.com

City of Austin
South Austin Regional Wastewater Treatment Plant Filter Improvements

Technical Memorandum No. 2
Existing Filtration System Evaluation

To: Chris Graf, P.E., Austin Water Utility

From: Shelby Eckols, P.E.

Prepared By: Abu Alam, Sc.D., P.E. (AECOM)
Nathan Fitzhugh, EIT (AECOM)
Neil Higa, P.E. (AECOM)

Date: March 27, 2012

STATE OF TEXAS
SHELBY G. ECKOLS
41485
REGISTERED PROFESSIONAL ENGINEER

Shelby G. Eckols
3/29/12

COA C.I.P. 3333.015
AECOM PROJECT ID. 60213591

2.1 Introduction

The SARWWTP Filter Building was completed in 1988, as a part of the Train B Expansion. The Filters were designed to treat an average influent flow of 40 MGD, and a peak flow of 80 MGD, coming from Trains A, B, and future Train C (2003). The Filter Building is located at the Northeast side of the treatment plant between Trains A and C. The SAR Filter Building consists of the following facilities:

1. A Central Control Room;
2. Twelve (12) Single-Media, Deep-Bed Filters with six (6) Filters on each side of a Central Operations Gallery;
3. A Filter Operations & Control Gallery;
4. Two Clearwells located underneath the Filter Nos. 1 through 6 for storing Filtered Effluent;
5. A Mudwell Located Underneath Filter Nos. 7 through 12 for Storing Filter Backwash water;
6. A Backwash Pump Room for Wash Water Supply;
7. A Blower Room for Air Scour/Backwash Supply;
8. A Mudwell Room for Wastewater Pumping and Disposal;
9. An Upper Pipe Gallery for Influent, Backwash Air and Backwash Water Lines; and
10. A Lower Pipe Gallery for Effluent Discharge.

Over the last 23+ years of service life, some modifications have been made to piping, equipment, and structures outside of the Filter Building, but no evaluations or rehabilitations have ever been performed on either the structure or the equipment. This Technical Memorandum No. 2 addresses the rehabilitation, replacement, remediation, and re-construction issues in this facility and its equipment. The SARWWTP Filters are near the end of their operational life. Many operational changes that have been made over the years modified the filter bed characteristics and their operations. Considerable changes to the facility and its equipment would be required to restore the original design and operational intent of the single-media, deep-bed filters and as well as to bring the SAR Filters up to current standards.

2.2 Objectives and Scope of Work

This TM will outline the work required to return the SAR Filters to their original design and operations, as well as to insure that this facility will provide the City of Austin with reliable and cost-effective filtration services for another 25+ years.

The objective of this Technical Memorandum is to:

1. Consolidate the mechanical, electrical/I&C and structural condition evaluations of this facility; and
2. Identify and define:
   a. The equipment and devices to be modified, upgraded and/or replaced;
   b. Work tasks associated with the rehabilitation and replacement of equipment identified; and
   c. Required automation to accomplish the future operational needs of the COA.

The scope of services covered in this Technical Memorandum, to achieve the above objectives, are included in the following discussions.

2.2.1 Meeting, Field Inspection and Documentation

1. Meeting with SARWWTP Operations and Maintenance personnel to review maintenance history and operational problems with mechanical devices in the process flow stream. Based on this review, AECOM will identify major pieces of equipment to be inspected for current condition, expected remaining life and suitability for future use. It is anticipated that the identified equipment will equal about 5% of the mechanical devices in the process flow stream;
2. A field inspection of the facility and its equipment will be conducted to observe the current condition and operational issues with the equipment of concern, determine rehabilitation and modifications needs of this equipment to provide reliable and trouble free service in the future;
3. Coordinate with plant personnel to operate a selected number of equipment and devices through their normal operations range in order to observe how these performed as compared to new equipment; and
4. Evaluate and document observed operations of equipment and devices to determine and estimate remaining useful life of these devices.

Based on previous flooding of the facility, it is anticipated that corrosion may be a significant factor in reducing the useful life of the existing equipment, devices and piping. As a result, the extent of corrosion and its impact on operability and remaining useful life will be evaluated.

2.2.2 Coordination with Electrical, Instrumentation & Controls Engineer

Coordinate with electrical engineer Harutunian Engineering, Inc (HEI) to perform evaluation of the identified major pieces of equipment from the electrical and I&C perspective, if applicable. It is anticipated this task will consist of the following steps:

1. Review operational and maintenance data on the electrical portion of applicable mechanical/electrical devices;
2. A second field visit will be conducted with the Electrical and I&C Engineer to physically review and evaluate the electrical and I&C portion of the identified equipment;
3. Coordinate with plant personnel to operate the device (if operable) through its range of motion and determine the condition of the electrical components;
4. Evaluate and document the condition of the Electrical and I&C components and quantify remaining useful life of the electrical and I&C components.

Based on previous flooding of the facility mentioned earlier under Section 2.2.1, it is anticipated that corrosion may be a significant contributor to reducing the useful life of the existing electrical and I&C devices. As a result, the extent of corrosion and its impact on operability and remaining useful life will be evaluated.

2.2.3 Coordination with Structural Engineer

AECOM will coordinate with structural engineer Jose I. Guerra (Guerra) for structural evaluations of the existing Filter Building and other appurtenant facilities including modifications and upgrading necessary for a fully functional effluent filtration system. Structural Evaluations of the Filter Building and facilities will be carried out in parallel with the Mechanical, Electrical, and I&C Systems. Included in the Structural evaluations would be the following:

1. Filter Building structural evaluation will review various points of leakage including the existing construction and expansion joints dividing the structure and identify alternatives to correct the leakage;
2. Modifications to the existing, or construction of a new Flow Splitter Box, for distribution of Backwash Water to Treatment Trains A, B, and C (a summary of the flow splitter box will be presented in the Preliminary Engineering Report);
3. Other miscellaneous issues to be identified with plant staff; and
4. Consolidation of Structural Engineering evaluation into this Technical memorandum.

2.2.4 Consolidation of Information

1. Consolidate information and data obtained from personnel and during site visits to define the mechanical, electrical and I&C devices to be replaced and structural modifications to be implemented.
2. Review each item to be replaced to define the procedure to be implemented to accomplish the work. The procedure to be defined shall include each of the following considerations:
   a. Evaluate the work to be done on each device.
   b. Determine if filter cell must be removed from service in order to accomplish the work.
   c. If filter cell must be removed from service, define procedure for removing filter cell from service and confirm the amount of time that it can be out of service.
   d. Evaluate the electrical and instrumentation components of the equipment. Determine if existing wiring is adequate or if new wires and services must be provided.
   e. If new services are needed, then define the route for laying and installing the new services from the power source to the device.

2.2.5 Evaluate Alternatives

1. Evaluate alternatives to isolate the filter cells on the east and west sides of the Filter Building.
2. Define specific work to be done to accomplish the isolation and the amount of time needed to do the work.
3. Determine the impact of this work on the operation of the Filter Building and the amount of time that may be available to make these modifications;
4. Based on definition of hazardous material (lead based paint) locations within the Filter Building, evaluate the impact of this hazardous material on proposed modifications, upgrading and improvements defined in above tasks.
5. Consolidation of the mechanical and electrical/I&C evaluations into this Technical Memo to define devices to be replaced and conduct a workshop with the COA to review recommendations for each device. It is anticipated that this TM and workshop will also define the automation required to accomplish the operational methods preferred by the COA.

2.3 Existing Conditions and Issues of Concern

The wastewater effluent filtration system at the SARWWTP consists of 12 single-media, intermittently backwashed, deep-bed filters and associated piping, mechanical, electrical, and I&C equipment. Over its 23+ years of operational life, much of the equipment has degraded due to: flooding events in the lower levels of the building, lack of rehabilitations, and equipment reaching the end of their useful life. During its operational life, neither the filter media, nor any major piece of equipment and/or controls, have been replaced. As a result, the majority of the existing equipment in the Filter Building is either in need of repair or replacement. Most equipment and controls are now outdated or obsolete and are not fit for continued use in the future.

Several modifications have been made to the facilities in the Filter Building in order to address specific upgrade needs and correct identified problems. The first major modification to the Filter Building was to the electrical duct banks entering the building's north wall. In the early 1990's, the access manholes for this duct bank allowed stormwater build up on the site to enter and flow directly into the Filter Building. This resulted in flooding of the building's lower levels and pipe galleries. The flood event(s) submerged many of the pipes, valves, and control devices.

In order to prevent future flooding, an electrical improvements project was undertaken by the COA. This included modification of the electrical duct bank entrance into the Filter Building and replacement of some of the at-grade power equipment.

During the SARWWTP Train C Expansion project, additional exterior pipe modifications were made to address hydraulic issues with the Filter Building. These modifications included:

1. Addition of pipes and fittings immediately downstream of Junction Box No. 5 for the connection of Train C flow to the Filter Building Influent line; and
2. Addition of two (2) pumps to Junction Box No. 5 to allow "Partial Filtration" during high water levels in the Colorado River and to maintain constant use of the Non-Potable Water system.

Besides these modifications, no other engineering evaluations or rehabilitations of the Filter Building, filters, or their components, have been undertaken. The current operating procedure for the SARWWTP includes the use of the filters to consistently meet the desired effluent quality of the plant, and to meet the permit requirements established by the TCEQ. For this reason, the current concerns and mechanical and electrical issues identified in this TM needs be remedied in order to return the SARWWTP Filters to full operational status.

The Operations and Maintenance staff at the SARWWTP indicate overall satisfaction with the performance of these filters. The maintenance staff report that they have performed routine maintenance and repair at the facility. The flooding event discussed above, has impacted the operation of the mechanical and electrical equipment of the filters, and other events within the SARWWTP have impacted the operation of the filters. Based on review of the operations and maintenance records, and discussions with SARWWTP staff, some operational problems were observed to exist today. These issues require addressing in order to restore the full filtration capacity and provide an acceptable level of service from the filters. The following lists specific items in need of correction:

1. The aeration blowers used in the air scour and combined filter backwash are not performing adequately and require rehabilitation and/or replacement. The existing motors are of lower efficiency, consume excess power and are at the end of their useful life;
2. Modifications to the air piping system and control may be required to prevent surging and water back flow following air scour and combined air and water backwash.
3. The equipment located in the lower level of the Filter Building is difficult to access and remove for repair and to conduct regular and preventive maintenance.
4. Structural (supports for overhead monorail or crane) and mechanical (a new overhead monorail or crane above Mudwell Pumps, valves and fittings) modifications are required to allow removal and transfer of installed equipment for ease of operations and maintenance of this equipment;
5. Due to the restricted access to the equipment and controls in the Upper and Lower Pipe Galleries, special considerations and construction technologies for equipment removal and replacement are needed;
6. One filter (Filter No. 1) has been out of service for an extended period of time. Two other filters (Filter Nos. 2 and 11) are also out of service because they were experiencing operational problems that impact their reliability. Another filter (Filter No. 3) was taken out of service because Plant Operations suspected that it may be leaking through the expansion joint into the clearwell. However, Filter No. 3 can be used if needed;
7. As a result of the previous flooding related damage and age of the equipment, various mechanical, electrical and instrumentation problems exist with the use of motor operated valves; and

8. Currently there are no provisions to isolate and repair filters and equipment on one side of the filter building while keeping the filters and equipment on the other side fully operational. This condition requires either bypassing the filter building entirely to allow repair and maintenance of filters and equipment or full use of the facility with very limited maintenance of equipment.

Since construction of the SARWWTP Filter Building was completed in late 1988, protective coatings on the pipes and valves may contain lead. This was confirmed by the Terracon[1] survey. Besides lead based coatings, there is also the possibility of the presence of asbestos in other areas of the building. The lead-based paint survey report provided by COA is presented in Appendix No. 2.1. The impact of performing rehabilitation in the presence of these hazardous materials needs to be considered in the evaluation of facility upgrades.

2.4 Work Performed

The AECOM team gathered available background data for the SAR Filter Building including: record drawings, the lead based paint study, an asset management study[2], the original O&M Manual, and plant operations data for the past year. Additional information was obtained through a kick-off meeting, several progress meetings, multiple site visits, and interviews of the Operations and Maintenance staff. On-site inspections allowed determination of the current state of the effluent filtration system. Input from the Operations and Maintenance staff on the challenges they are currently facing in maintaining operations to meet current discharge limits allowed AECOM to identify required operational changes needed for reliable operations. More stringent future permit requirements are expected to be implemented by 2014, and increased operations and maintenance needs to provide better effluent quality are also considered.

Site visits were made in order to review the following:

1. Observation of current backwash operations;
2. Inspection of the existing Blower facilities and equipment;
3. Inspection of the Backwash Pumps and their current condition;
4. Inspection of the Mudwell Pumps and their current condition;
5. Inspection of the Upper Gallery housing Influent, Effluent, Backwash Water and Air pipes, flow meters, valves and fittings;
6. Inspection of the Lower Pipe Gallery housing Effluent pipes, valves and fittings and Discharge Control Valves;
7. Inspection of Filter No. 11 which has lost significant (>87%) filter media; and
8. Inspection of the backwash waste valves and stop/weir gates at the Control Level.

The objective of AECOM's multiple site visits to the SARWWTP was to:

1. Survey the condition of Process, Electrical, and Instrumentation & Control equipment;
2. Acquire an understanding of the overall useful life of the individual pieces of equipment and other appurtenances; and
3. Assess the structural condition of the existing Filter Building including the expansion joint.

By conducting field inspections of existing facilities and equipment, the AECOM team was able to determine the work required to restore the SAR Filters and extend the life of these facilities for an additional 25 years. The proposed Scope of Work anticipated that the identified major pieces of equipment requiring evaluation would equal about 5% of the equipment used in the filtration process, while the actual quantity of major pieces of equipment evaluated exceeded 10 percent.

Site visits were scheduled and coordinated with the project manager and plant personnel so that some of the equipment could be physically operated to: observe, review, and evaluate the equipment and their performance. In order to evaluate both the equipment and the operations procedures being used, AECOM engineers observed equipment use by going through the practiced backwash procedure on Filters No. 4 and No. 5. During subsequent site visits, AECOM

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[1] Lead-Based Paint Survey. Terracon Consultants. August, 2010. Reference Appendix 2.1.

[2] South Austin Regional WWTP Condition & Risk Assessment Draft Pilot Summary, February 2011, Malcolm Pirnie, Inc.

also observed partial backwash cycles at other filters as they were conducted as part of everyday filter cleaning operations.

During these filter backwash operations, flow rates of air alone, combined air and water, and water alone were noted. Also recorded were the time intervals of each step and all visible equipment exercised during their operation. The equipment surveyed in these observed operational tests exceeded 10% of the mechanical devices used in the Process Flow. In addition to the backwash operations observed, discussions were conducted with the Plant's Operations and Maintenance staff. O&M staff also identified some of the other pieces of mechanical equipment that are currently inoperable.

To make a thorough assessment AECOM engineers went beyond the proposed 5% evaluation and conducted visual inspection and survey of all mechanical equipment in the upper and lower pipe galleries. By performing this inspection, a more detailed determination of the overall condition of the mechanical equipment was achieved.

The condition assessment of the mechanical equipment and the electrical equipment found in these site visits verified the reports from Operations and Maintenance staff, and data collected from the Plant's SCADA System. The results were comparable to the Asset Management Report.

For reliable cost estimation of needed changes and modifications, the services of an independent construction contractor were obtained. Contractor's construction specialists were brought to the site to assist in the development of alternate construction approaches and associated labor factors and costs due to the constraints existing within the SAR Filter Building, particularly the Upper and Lower Pipe Galleries. Suggestions of Contractor's representatives for removal of lead based coatings on existing pipes, valves and fittings, and cleaning and recoating these were taken into account for determination of Probable Construction Costs estimates. In addition to the mechanical and electrical condition assessment, the AECOM team investigated the additional items contained within the scope during the site visits. These items include the following:

1. Methods for East/West Filter Bay Isolation;
2. Work in confined spaces and improvement of accessibility to the filter building; and
3. Disposal of blasting sand contaminated with lead based paint material.

2.4.1 Filtration System Current Condition Assessment

SAR Filters were designed as Single-Media, Deep-Bed Sand Filters for operation as unstratified filter beds. For optimum performance of Deep-Bed Filters and to assure good effluent quality, it is necessary to backwash the filters appropriately. For deep penetration of solids into the media, Deep Bed Filters need to remain unstratified during operation.

Unstratified filters beds are first scoured with air so that particles can abrade against each other to remove organic solids that get attached to the particles during the filtration process. Good particle abrasion requires that the filter bed is either not expanded or expanded very little. Following air scour, the filter bed is backwashed with combined air and water without fluidizing the filter bed, because fluidization causes stratification (with larger particles settling at the bottom and smaller particles settling at the top) of the filter bed.

To prevent stratification, the filter bed is drained immediately before backwashing. Normally water level on top of the filter bed is lowered to about 6 inches above the bed (as per O&M Manual by TCB, pp V-5) and then combined air and water backwash is initiated. Common practice is to allow 10 percent expansion of the bed. Expansion of 15 percent is the maximum at which point the filter bed starts stratifying.

To assure unstratified condition in the filter bed maximum expansion of filter bed is limited to less than 15 percent. Expansion beyond 15 percent of the bed depth leads to bed fluidization and subsequent stratification at the completion of backwash. (Reference is WEF MOP 8, 2010 Edition, Vol. No. 2, pp 16-33.)

The SAR Filters were originally designed for either 'automatic', 'semi-automatic' or 'manual' backwash. Field observations during filter backwash indicated that the filters are now backwashed mostly in manual mode. Operators reported that the 'automatic' backwash of the filters did not work well even after installation of a PLC based system. Some of the control valves did not work properly in the 'automatic' mode. Other unspecified problems were also encountered. These issues forced Operations and Maintenance staff to keep the operations of the filter backwash in 'Manual Initiation' and 'Manual Control' mode. In this mode, the operators are required to initiate each step in the backwash sequence, as well as to control the elapsed time of operation for each step. Operators pointed out that all but two (2) of the valves associated with the backwash of the filters may be operated from the local control panels in the Filter Operations Gallery. Two Backwash Waste valves (for Filters No. 6 and No. 8), whose operators are located on the filter catwalk, can only be operated locally by hand.

During the multiple filter backwash procedures witnessed by AECOM, it was the 'Manual' filter backwash operation observed. Specifically, it was noted that the filter to be backwashed is first identified and selected for backwash using a hand operated selector switch. Next, O&M personnel must initiate, time, and stop each of the steps in the backwash procedure from the filter's Local Control Panel. AECOM engineers observed the air and water flow rates during each of these steps, and noted that the durations of each step varied by the operator and the time periods for backwash varied between filters.

The operators indicated that durations were based on observations of the clarity of backwash water. Clarity of backwash water varied between filters and to assure good clarity, time of backwash was increased if the backwash water remained turbid.

It was also observed that the filters were not allowed a drain down period to bring the water level to about 6 inches above the sand surface as specified in the design criteria. Air scour was initiated with water standing on top of the media at a level just below the effluent trough weir elevation.

Observed bed expansion during backwash was excessive, with recorded air flow rate during air scour significantly exceeding the maximum allowed in design. Combined air and water backwash rates were also excessive. Filter bed expansion recorded during air scour and combined air-water backwash ranged between 60% and 75%. Expansion was based on observation of top level of media during backwash. Media was observed to flow over the effluent launder weirs. Durations of air scour, air and water backwash, and water alone backwash were significantly higher than design, and have likely caused stratification of the filter bed. Backwash operations are controlled manually and as a result the duration is subject to operator's judgment as to what is required to clean the filter.

Air and water flow through the filter beds appeared to be non-uniform, with areas of the filter bed receiving more air and water while other areas received less. Even following completion of these backwash cycles for longer durations, cloudy water was observed rising through portions of the filter bed during the water alone backwash period. Figure 2.1 illustrates the cloudy backwash water after more than 20 minutes of water backwash.

Due to the excessive bed expansion during manual backwash, as currently practiced, AECOM engineers concluded that the filter beds are now operating as stratified beds with finer sand particles at the top and coarser particles at the bottom.

Samples of the media from Filter No. 12 were taken at levels between 0-12 inches, 12-24 inches, and 24-40 inches. These samples were analyzed independently by HVJ Associates, under the direction of the City of Austin Project Manager. The HVJ analysis and results are presented in Appendix 2.2 of this document and table 2.1 below summarizes the HVJ results.

Review of the HVJ results confirms that the media within Filter No. 12 has become stratified. The SARWWTP Filter Building O&M Manual specifications for the filter media included: an Effective Size (D_{10}) of between 1.9 and 2.1 millimeters; and a maximum Uniformity Coefficient ($U_c = D_{60}/D_{10}$) of 1.6.

Table 2.1 - Filter Media Sample Sieve Analysis

Sample Location	Sample Depth	Effective Size D_{10}	Uniformity Coefficient U_c
Specification	Uniform at all depths	1.9 - 2.1	1.6 (max)
Mixed Sample	mixed	1.9	1.32
12B - Center	0-12"	1.6	1.94
12A - Center	0-12"	1.5	2.07
12A - Far Right	0-12"	2.1	1.57
12A - xBox	0-12"	1.75	1.77
12A - xBox	12-24"	2.1	1.62
12A - xBox	24-36"	2.1	1.57
12A - xBox	36"+	2.1	1.57

The varied Effective Sizes and Uniformity Coefficients in three (3) locations within the top 12-inches of Filter Cell 12A, supports the observation of non-uniform flow conditions in the filter beds. Uniform distribution of backwash water and air scour flows tends to create uniform distribution of filter media particles throughout the filter bed. The data presented in Table 2.1 indicate that the filter media in the SARWWTP Filters may be non-uniform between cells and even within each side of the same filter cell. This is likely due to the non-uniform backwash water and air distribution observed during the site visits. Non-uniform backwash flows create areas in the filter bed where mixing is excessive and stratification is assured, with localized areas of poor mixing. Poor mixing in these localized areas of media filters is often associated with clogged or broken nozzles in the underdrain system, or due to carbonate formation in the filter bed caused inadequate backwash and cleaning.

The following additional information was discovered during the equipment survey, observations of backwash procedures, and based upon discussions with the Operations and Maintenance staff:

1. Operations and Maintenance staff indicated that during investigations within the filter beds, mud balls as well as hard layers of material within the filter media were found which impeded probing of the media column;
2. Personnel indicated that these hard layers could be penetrated, but not without force and effort;
3. Currently four (4) of the filters are not in use (Filters Nos. 1, 2, 3, and 11);
4. According to SAR personnel, Filter No. 1 has not been operated in over 20 years, and is missing several of its electric operators;
5. Filter No. 2 was out of service for several months due to differential filtration rates between the two sides of each of the filter cells possibly due to cementation of filter beds;
6. Filter No. 3 was taken out of service because it was suspected that it may be leaking through the expansion joints into the clearwell but can be used at any time if needed; and
7. Filter No. 11 is out of service due to differential filtration rates between the two filter beds and the occurrence of TSS breakthroughs associated with this filter.

On-site investigations indicated that one bed of Filter No. 11 is missing approximately 87% (40-42 inches) of its filter media. Further investigation of the underdrain system is required in order to determine the cause of this significant media loss. It is concluded (based on similar experience with Infilco Degremont Filters at other plants) that a significant failure of the precast underdrain system and/or the backwash nozzles has occurred. This has created pathways for the media to migrate below the underdrain into the backwash plenum. Field investigations involving complete dewatering of the filter and media removal would be required to confirm this conclusion. Repair of the filter underdrain system and replacement of missing media will be required prior to placing Filter No.11 back into operation.

2.4.2 Equipment Survey

The survey of mechanical equipment including pipes, valves, operators, fittings and other appurtenances within the SAR Filter Building uncovered that the majority of the equipment is in poor condition and has either exceeded or is approaching, the limits of their useful life. The summaries presented below outline the surveyed condition of the mechanical equipment and appurtenances. Appendix 2.3 details the itemized list of the components and survey results, which has been compared and correlated to the Asset Management report

2.4.2.1 Existing Valves

Per the record drawings, there are approximately 139 valves housed within the Filter Complex. All of the valves are reported to be operational, with exception of the valves on Filter No. 1. Several electric operators are missing on this filter and these valves cannot be exercised without the electric operators. Valves on Filter No. 2 are not working and as a result Filter No. 2 is not in service. Though the majority of the valves were found to operate during backwash observations, many valve seats were found to be leaking water while closed. The most significant leaking was present on the 24-inch influent butterfly valves.

Figure No. 2.2 illustrates the leaking valve condition observed at Filter No. 12. Review of available records indicates that none of the valves housed in the Filter Building have ever been replaced or reseated. In discussions with operations staff, the following information was obtained:

1. The 6-inch drain valves in the Lower Pipe Gallery have never been used for filter draining service;
2. The two 42-inch filter effluent valves in the Lower Pipe Gallery, which were installed to control the level within the filters, have lost their automatic operation functions, and are currently set at full open position;
3. These two valves may only be operated manually (open/close) from the electric operator control unit located in the Lower Pipe Gallery; and
4. These two valves and their operators were submerged during the flooding of the Lower Pipe Gallery, which appears to be the likely cause of the loss of automatic controls.

Initially, it was believed that the seats in the existing valves would be replaced with new seats to make these fully functional as this would be a cheaper alternative as compared to complete replacement. To confirm this and to determine the best way to replace the valve seats, AECOM contacted the valve supplier. The manufacturer of these valves stated that the original valves were supplied with fully vulcanized seats. As a result, it would be difficult to replace the existing valve seat and the cost of seat replacement would be high as compared to replacing the entire valve. For this reason, the existing valves require complete replacement with new valves.

2.4.2.2 Existing Valve Operators

All electric operators, with the exception of the two (2) electric operators located on the Backwash Waste Valves of Filters No. 4 and No. 9, are the units originally installed during the construction of the Filter Building. Multiple electric operators are missing from Filter No. 1, including the operators for the Effluent, Backwash Water, and Backwash Waste valves. The electric operators for Backwash Waste valves on Filters No. 6 and No. 8 are not functioning, and these valves require manual operation. The same operators on Filters No. 4 and No. 9 have been replaced with newer units within the last 6 years. During field inspections of the equipment, the gear boxes of most of the valve operators were found to be leaking oil. Patches of oil were also found on the floor underneath each gearbox. The AUMA operators on all but two (2) of the valves were found to be original equipment and are of outdated design. These valve operators are beyond their useful life and are not expected to provide an additional 25+ years of reliable service. In order to insure reliable operation and trouble free service from the existing Deep Bed Filters for an additional 25 years of service life, all but two of the existing valve operators would have to be replaced with new units, based upon the mechanical evaluation. The electrical and I&C evaluation will provide additional information on these operators.

2.4.2.3 Existing Pipes & Fittings

Field observations indicate that the pipes and fittings within the Filter Building are in good physical condition; however, the protective coatings on the Influent, Effluent, and Air Supply lines were found to be cracking, peeling, and allowing surface rust formation in some locations on the exterior of the pipes and fittings. Figure 2.3 illustrates cracking and peeling paint, and rusting of the pipe underneath the coating. As a result of this condition, sand blasting and recoating of the pipes and fittings would be required to keep these pipes in service and to extend the service life of the facility.

It is possible to coat over the existing coating. However, areas where existing coating is cracked and pealing, existing deteriorated coating needs to be removed by sand blasting. Otherwise new coating would not be effective because it would not adhere to the cracked surfaces and as a result coating life would be short. Also, lead-based paint will remain on these pipes.

The original coating applied included lead based paints as confirmed by the independent testing provided by Terracon in its Lead Based Paint Survey (see Appendix 2.1). Measurable levels of lead within the protective coatings inside the Filter Building are reported with ranges from less than 50 ppm in 18 of 27 samples, to 46,000 ppm in 1 of the 27 samples taken during this survey. Out of the 27 total samples taken, only a single sample was found to contain a lead concentration greater than 200 ppm, while all other samples registered at or below 200 ppm. To prevent contamination of the building and exposing operating personnel to hazardous material, any sand blasting would require isolation of the area, and the sand blasting would have to be carried out under controlled conditions by personnel with protective gear. The sand blasted material would have to be removed in an environmentally sound and protective manner, the area would have to be cleaned, and the sand blasted material disposed of safely to meet all applicable environmental regulations and requirements.

During field inspections of the equipment, the brown Backwash Water piping was found to be in fair condition with only localized peeling of paint on a few sections of pipe. The surface rust and peeling paint need to be remedied in a similar manner as stated earlier for the other pipes in order to extend the life of these items. The presence of lead in the pipe coating material would have to be taken into consideration when developing the methods for sand blasting and recoating for these pipes, and in developing the Probable Construction Cost Estimates.

2.4.2.4 Existing Flow Meters

Currently there are fourteen (14) Venturi type flow meters located within the Filter Building. One (1) 16-inch flow meter is located on each of the twelve (12) Filter Effluent lines. These flow meters are currently not functioning and all of the meters have either missing or disconnected instrumentation. Figure 2.4 illustrates this condition for the flow meter used in Filter No. 7. Two (2) other Venturi flow meters are located on the Backwash Water line and the Air Wash line (1 each). The flow meters for the Backwash Water and the Air Wash supply appear to be functioning adequately, and produced consistent readings at both the Control Panel and at the PLC during observations of filter backwash operations.

Accuracy of the flow meters was not checked, as there is no way to check the accuracy of the flow meters by visual observation alone. It is necessary to conduct actual flow measurements with flow meter readings or compare flow meter readings with readings from other calibrated flow meters measuring the same flow. None of these were available at the SAR Filters to determine accuracy of Flow Meter readings.

In addition to the Venturi flow meters listed above, a magnetic flow meter is located on the Mudwell Pump effluent header and appears to be operational. However, according to Operation and Maintenance staff, this magnetic flow meter has never been calibrated over its entire operational life. Normally, magnetic flow meters require calibration once every two to three years to assure that flow measurements are accurate. Since this magnetic flow meter has not been calibrated for a period exceeding 23 years, the flow measurement and indication originating from this meter is unreliable. Rather than use the flow readings of this long un-calibrated magnetic flow meter, the

Operations and Maintenance staff currently relies on the water level elevation in the Mudwell for initiating and terminating pumping.

2.4.2.5 Existing Pumps, Blowers, & Motors

The Backwash and Mudwell pumps and motors are 23+ years old, inefficient, and in poor condition. The pump packing glands are observed to be leaking during operations, while others are desiccated and cracking. Based upon their observed condition, the Mudwell Pumps and motors need replacement. The Backwash Pumps also need to be serviced and repacked, and the motors replaced with modern, high-efficiency units. The motors for the two air blowers are of the same age, out-date and inefficient units. Operators indicated that recently there have been some electrical issues reported on Blower No. 1. During field inspection of the equipment electricians were found to be working on the control system of Blower No. 1. For increased operating efficiency and reliability, the motors for both blowers should be replaced with new energy efficient motors.

2.4.2.6 Existing Filtration Media

The sand media in the twelve (12) SAR Filters is the original media installed during the construction of the Filters. This media is now 24 years old. Sieve analyses presented in Appendix 2.2 and discussed earlier in Section 2.4.1, indicate that the Filter media has become stratified within the individual filter beds and no longer meet the original design specifications. Separate samples from each foot of filter depth showed that the filter media has become stratified during its operations. Stratification of the filter media usually occurs due to poor mixing and/or over-mixing, over expansion and fluidization during the backwash process.

2.4.2.7 Improvements Needed at the Existing SAR Filters

With exception to the structure itself and a few pieces of relatively new equipment, the majority of the components within the Filter Building are in need of some form of rehabilitation, repair, upgrading, and/or replacement for the following purposes:

1. Delivering a reliable, more efficient effluent filtration system with lower operations and maintenance requirements;
2. Providing maximum filtration capacity; and
3. Meeting current and expected future discharge permit requirements.

Exhibits 2.5A through 2.5D, included in the Figures and Exhibits section of this document, outline the work proposed for the existing mechanical equipment within the SARWWTP Filter Building.

The existing filter media needs to be replaced with new sand meeting the original design specifications. Replacing the filter media will require that the existing media be fluidized and pumped out of the structure. Prior to the installation of new media, the underdrain system and nozzles need to be inspected, repaired, and/or replaced, as necessary. Upon completion of inspections, all necessary repairs of the filter underdrain system, and placement of new filter media in the existing filter beds the SARWWTP Filters would be prepared for another 25+ years of service.

2.4.2.8 Condition of Existing Electrical System at the SAR Filters

The Electrical Engineer (HEI) conducted an evaluation of the existing electrical system at the SAR Filter and identified improvement needs. The HEI Report is included in Appendix 2.5 of this document and excerpts of the HEI assessment are presented below.

> 'Most of the distribution equipment in the Filter Building is the original equipment installed circa 1988. This facility has flooded in the past. Additionally, water has entered the MCC in the past through the main service conduits independent of other building flood events. Combined, the past flood events have exacerbated the deterioration of the electrical distribution equipment. With the past six months, one of the air scour blower motor starter sections experienced a substantial fire that required complete refurbishment of all

> interior starter components. Substantial corrosion was observed on the motor control centers and other equipment in the electrical room and this equipment has passed its useful service life.'

2.4.2.9 Future Electrical System for the SAR Filters

The proposed electrical system for the SAR filters is also included in Appendix 2.5 and is summarized as follows:

> 'Based on the power requirements of the air scour blower and pump loads and the available manufactured distribution equipment, the proposed loads will operate at 480V. The total proposed load for the Filter Building is expected to remain relatively unchanged. No changes are anticipated for the dual feed 4160V service from the Filter Power Center to the existing 4160V:480V 1500kVA outdoor located pad mounted transformers.
>
> It is proposed that the 1500kVA transformers serve new 480V 2000A main-tie-main secondary selective indoor located close-coupled switchboard and motor control center lineups (SWBD/MCC). These new SWBD/MCC lineups would replace the existing close-coupled motor control center (MCC). The existing duct bank and feeders routing between the service transformers and the north side of the Filter Building will be reused in the renovation. Additionally, the existing service conduit bank routing along the north wall between the Control Room and the Electrical Room will be reused to feed the proposed close-coupled SWBD/MCCs.'

Additional recommendations for (a) Low Voltage Power Distribution System, (b) Power Quality including Power Factor considerations, and (c) Power Metering and Protection Issues are contained in the Electrical Improvements Report included in the Appendix 2.5.

2.4.2.10 Condition of Existing Instrumentation System at the SAR Filters

HEI conducted an evaluation of the existing Instrumentation and Control System at the SAR Filters and this Report is presented in Appendix 2.6. Excerpts of the assessment of the existing instrumentation system is quoted below:

> 'There is a limited I&C system for the existing Filter Building. The control system architecture for the Filter Building consists of a programmable logic controller (PLC) installed as part of the SAR I&C project circa 1994, used for monitoring selected (minimal) points generated by the legacy hardwired filter control system. AWU I&C personnel have installed one PLC for monitoring and control of the backwash pumps, mudwell pumps, and air scour blowers. The PLCs are located indoors in the air conditioned control room level of the existing Filter Building. The PLCs are linked to the Top-End computer system via a dual channel fiber optic based communication link. Two series of PLCs are used at this facility, the Modicon 984 series installed as part of the SAR I&C project and the Modicon Quantum series installed by AWU I&C personnel for control of the backwash pumps, mudwell pumps, and air scour blowers.
>
> The control logic for each filter is implemented using discrete hardwired control relays located in the filter control consoles. The hardwired control system provides means for manual step-by-step selection of the backwash process by Operations Personnel from the filter control consoles. Filter backwashing is performed manually from the filter consoles by Operations personnel, and Operations personnel must manually select each step of the backwash process to backwash each filter. Additionally, Operations personnel manually verify backwash permissives throughout the backwash process.

> Based upon feedback from Operations personnel, backwashing filters in this manner is a time consuming method of operation. The control equipment located in the filter control consoles appears to be in condition comparable to its age. Main control panel located equipment is further deteriorated due to environmental exposure.'
>
> 'The past flooding has damaged numerous I&C system components located in the electrical room and pipe gallery level and exacerbated the deterioration of the I&C system equipment. Numerous failed components and related wiring appear to have been abandoned in place, further complicating maintenance. The PLC installed by AWU I&C personnel replicates certain hardwired control system functions that were lost when the building flooded in an attempt to restore operation to the Filter Building. An admirable effort has been made by AWU I&C personnel in their attempt to transition from a hardwired control system to a PLC based control system for the mudwell pumps, air scour blowers, and backwash pumps. It is noted that the PLC implementation by the AWU I&C personnel, while functional, is a minimalist type implementation, does not follow the present AWU standards for PLC based control system implementation, and is vulnerable to "single point of failure" type issues.'
>
> 'Numerous valve actuators in the filter gallery level are located such that they are inaccessible. The influent level elements are located near the ceiling of the filter gallery level and are also inaccessible. Various I&C components have been harvested from non-operational elements of other Filters to effect repairs to the filter control system.
>
> There is machine monitoring in the form of winding and bearing temperature RTDs associated with the existing air scour blowers. This data is not telemetered to the Top-End system.
>
> While the Quantum PLC was installed comparatively recently and is still supported by Modicon, the Modicon 984 PLC series is obsolete. The remaining existing hardwired I&C system components date to the initial Filter Building construction (circa 1986) and have passed their useful service life.'

2.4.2.11 Future Instrumentation and Control System for the SAR Filters

The proposed I&C system for the SAR filters are also included in the report presented in Appendix 2.6. The I&C Report states the following:

> 'The majority of control functions shall be performed by PLCs in conjunction with a minimal quantity of hardwired (based upon electromagnetic relays) control functions. Hardwired control functions will be incorporated only for critical hydraulic functions, personnel safety/protection, machine protection, or where it provides the greatest cost effectiveness in the design. The control philosophy is thereby one that is highly reliant upon a functioning PLC network for automatic control. In the event of a PLC failure, provisions are to be available to operate any or all segments of the process, if necessary, with fully attended operation in a hand mode of operation. The control switches located adjacent to each piece of process equipment would enable the operator to run the equipment with close observation of field instrument monitors and would require fully attended operation.
>
> It is proposed that, depending on the application, most individual process equipment would have means to provide the operator the ability to engage or disengage the equipment from operation. Such means, here called a Field Control Station (FCS), would

> be located near the equipment and generally would only be used should a particular PLC become nonfunctional or during maintenance activities for that process equipment. Operation at the FCS level of control will not include automatic coordination with the rest of the process and will require the operator's complete attention in order to operate the facility.
>
> It is proposed to locate the PLC and most I&C equipment (except FCSs and field instruments) inside a centralized Main Control Panel (MCP), which is dedicated to the Filter Building and located indoors in the control room level in an air conditioned environment. The quantity of MCPs will be tailored to the application and is described in further detail below.
>
> Proposed major primary sensing elements to monitor process variables necessary for monitoring and controlling the facility will be made available at the field (at instrument level on the field instrument), at an Operator Interface Unit (OIU), and at the top-end computer in the Administration building. The OIU provides a graphical presentation of the process with a touch-screen interface.'

Additional recommendations and details are contained in the I&C Report is in Appendix 2.6.

2.4.3 Additional Scope Items

2.4.3.1 Isolation of Filter Bays

Through review of the Filter Building Record Drawings and on-site inspections of the facilities, alternative locations and methods for isolation of the filter cells to allow maintenance of major items in the process flow stream were identified. Currently, each of the filter cells can be isolated so that the filter can be drained and maintenance performed within the filter cells; however, in the current set-up, there are no valves with which to isolate the Influent, Effluent, Air, or Backwash Water lines to allow for the removal or maintenance of any of the associated valves, piping, fittings and associated equipment. The only available method to perform maintenance on major items, such as valves, is to shut down the entire Filter Building.

A more localized isolation option is needed to allow for the partial use of filters during the maintenance of others. This will be required for the construction of future improvements and for meeting future maintenance needs. The most straight forward option is to isolate the East and West halves of the Filter Building. Alternatives allowing for the further isolation of individual or smaller clusters of filter cells would require the addition of multiple valves and major modifications to the piping systems, as well as requiring the Filter Building to be shut down entirely for extended periods of time in order to complete the required modifications. This option, although feasible, would be considerably more expensive.

To provide isolation of the East and West Filter Bays, installation of two (2), 42-inch butterfly valves on the two influent lines is required. These valves will be installed in place of the two existing short spool pieces located between the 60-inch to 42-inch, 90-degree reducing elbows and the 42-inch to 24-inch reducer tees leading into Filter No. 1 and Filter No. 7. Exhibits No. 2.6A and No. 2.6B illustrate the proposed locations of these isolation valves. These new valves will be installed with electric operators for operation from the Local Control Panel in the Upper Pipe Gallery, and from the PLC system. In order to accomplish this work, a dresser coupling and a smaller spool piece, together with the 42-inch butterfly valve assemblies, will be installed, replacing the existing spool piece.

In order to accomplish any major work involving the removal of valves or pipe sections on the Backwash Water, Backwash Air, or Effluent lines, temporary isolation will be required to compliment the isolation of the Filter Influent line. Currently the Filter Effluent lines in the East and West filter bays can be isolated using the two (2), 42-inch butterfly valves located in the Lower Pipe

Gallery. Currently these valves can only be operated from the Local Control Panels and changes to the I&C system are required to allow for remote operation and automatic control.

For complete isolation of each half of the Filter Building, additional isolation for the Backwash Water and Air lines will be required. In order to accomplish this isolation, up to two (2) separate locations for each line is required in order to isolate one-half of the Filter Building at a time. Locations of these proposed isolations points are illustrated in Exhibits No. 2.6A and No. 2.6B. The locations illustrate there-in are not the only available locations for temporary isolation, but were found to be the most feasible during site visits to SARWWTP.

2.4.3.2 Impacts of Lead-Based Paint

The existence of the identified lead-based and lead containing protective coatings must be taken into account when considering the methods with which the pipes, fittings, and valves will be rehabilitated, including, but not limited to: removal of existing paint and the application of new protective coatings. Only one of the paints surveyed in the Terracon Report (Appendix 2.1) was found to be lead-based (containing greater than or equal to 0.5 percent of lead by weight). This lead-based paint is the black coating applied to the sanitary sewer line in the Lower Pipe Gallery and this coating is in good condition. However, since most of the paint samples taken contained measurable amounts of lead, protective measures will be required and associated costs considered due to OSHA requirements limiting workers' exposure to air-borne lead particles during removal of lead based paint (Action Level of 30 micrograms/cubic meter). It is anticipated that contractors performing this work will be required to provide isolation of work areas; ample ventilation of these areas; HEPA filtration of air removed; and potentially use of Self Contained Breathing Apparatus (SCBA), depending on the method and materials used for paint removal. Used dust collectors and HEPA filter cartridges may be designated as hazardous waste and will require special disposal measures at designated hazardous waste sites. These considerations will add to the costs and duration of the work involved in blasting/stripping of the existing paint. Similar considerations to ventilation and worker safety will be required for the application of new coatings because the existing Filter Building is an enclosed facility with minimal ventilation.

2.5 Engineer's Opinion of Probable Construction Costs

This section presents the probable construction costs and estimated annual operating costs for upgrading and restoration of the existing Filters at the SARWWTP.

2.5.1 Modifications and Upgrading of Existing Deep Bed Sand Filters

Based upon the conditions assessment of the existing filter building facilities previously discussed the modifications, upgrades and restoration plan of the existing Deep Bed Sand Filtration system shall include:

1. Replacement of all original equipment (pumps, motors, valves, electric operators, etc.);
2. New electrical supply facilities and motor control center;
3. Installing new instrumentation and control system for fully automatic operations;
4. Replacement of the existing filter under drains (includes precast concrete slabs and air/water backwash nozzles):
5. Removal of the original filter media and replacement with new sand media;
6. Backwash system operations to assure maintaining an unstratified filter bed;
7. Sand blasting and recoating of the existing pipes in the Upper and Lower Pipe Galleries;
8. Modification and extension of the existing lifting hoist and monorail system;
9. Enclosure and installation of covers over the filters to prevent algal growth due to sun light.

Estimates of Probable Construction Costs have been developed for the above mentioned tasks for the modifications, upgrading and restoration plan for the Deep-Bed filtration system.

Electrical engineering consultant, HEI, and structural engineering consultant, Jose I. Guerra, have provided their respective initial estimates of Probable Construction Costs. Estimates of Probable

Construction Costs included these initial estimates for the electrical costs and an estimate for structural costs based on volume of reinforced concrete construction.

The highest cost of the three I&C system alternatives described in Appendix 2.6 (Condition of Existing Instrumentation and Control System and Required Improvements for Upgrading Existing Filters) was used in the estimate. This was the most conservative approach from an estimation standpoint. The I&C system alternative selection will be based on owner preference and will be finalized during final design.

The estimates of Probable Construction Costs assume Contractor's Overhead and Profit (20 percent), Bonds and Insurance (2 percent) and Preliminary Design Contingencies (40 percent). Table 2.5.1 presents a summary of the cost estimate for modifications, upgrading and restoration of the existing deep Bed Sand Filters. See Appendix 2.7 for more detailed costs. Total estimated for Option 1 is $17.78 million.

Table 2.5.1 Summary of Cost Estimates for Restoration and Upgrading of Existing Deep Bed Sand Filters

Divisions	Details	Estimated Costs
Division 2 – Site Work	Misc. Site Work	$200,000
Division 3 - Concrete	Filter Underdrains	$156,000
Division 9 - Finishes	Sand Blasting and Re-Coating of All Pipes and Fittings	$308,000
Division 10 Specialties	Filter Media and Underdrain Replacement and New Roof Structures	$2,570,300
Division 11 - Equipment	Pumps & Motors, Valves Operators	$1,362,400
Division 15 - Mechanical	Pipes, Valves and Fittings	$996,300
Division 16 - Electrical	Electrical and I&C Equipment	$4,814,200
Sub-Total 1		**$10,407,100**
Contractor's Overhead & Profit (20%)		$2,081,400
Bonds & Insurance (2%)		$208,100
Sub-Total 2		**$12,696,700**
Contingencies 40% at Preliminary Design		$5,078,700
Total		**$17,780,000**

Estimates of annual Operations and Maintenance (O&M) costs were developed for the Deep Bed Sand Filtration System after these filters are modified, upgraded and restored for operation per design criteria. Operating costs are escalated at 2.5 percent per year to cover inflation. Over a 20-year operating period, the estimated annual O&M costs varied from $216,120 during the first year to $354,140 at the end of the 20-year life cycle with an average annual operations and maintenance cost of $279,760. The present worth of the estimated annual O&M costs is $3,766,700. The combined present worth of Probable Construction Costs and Annual O&M costs using an interest rate of 4.5 percent for a 20-year life cycle is estimated at $21.5 million.

Appendix 2.8 provides details on this present worth life cycle evaluation. This appendix also contains the calculation for the present worth of a 30-year life cycle cost, estimated at $22.9 million.

2.6 Results and Recommendations

The purpose of this Technical Memorandum No. 2 is to determine the existing condition of the mechanical, electrical, and Instrumentation and Control equipment and appurtenances of the SAR Filter Building, and to outline the actions required to rehabilitate and extend the useful life of the existing deep bed filtration system. The estimate of Probable Construction Costs for rehabilitation and upgrading of the existing Deep-Bed Sand Filters was developed and presented in Table 2.5.1 of this Technical Memorandum. Additional estimates of Probable Construction Costs for alternative filtration technology applicable to and suitable for retro-fitting inside the existing filters were prepared and presented in Technical Memorandum No. 3 for the Process Evaluation. The Preliminary Engineering Report (PER) will present consolidation and summary of the results of all investigative efforts contained in TM No. 1, TM No. 2, and TM No. 3 prepared for this Project. The PER will present and compare costs for applicable options and will also present recommendations for future improvements to the existing Filters at the SARWWTP.

Figures
&
Exhibits

Figure 2.1 - Cloudy water observed during backwash to waste operation. After 20 minutes of combined air/water backwash

Figure 2.2 - Filter No. 12 Influent valve seat leaking. This condition is noted as typical during all observed backwash cycles

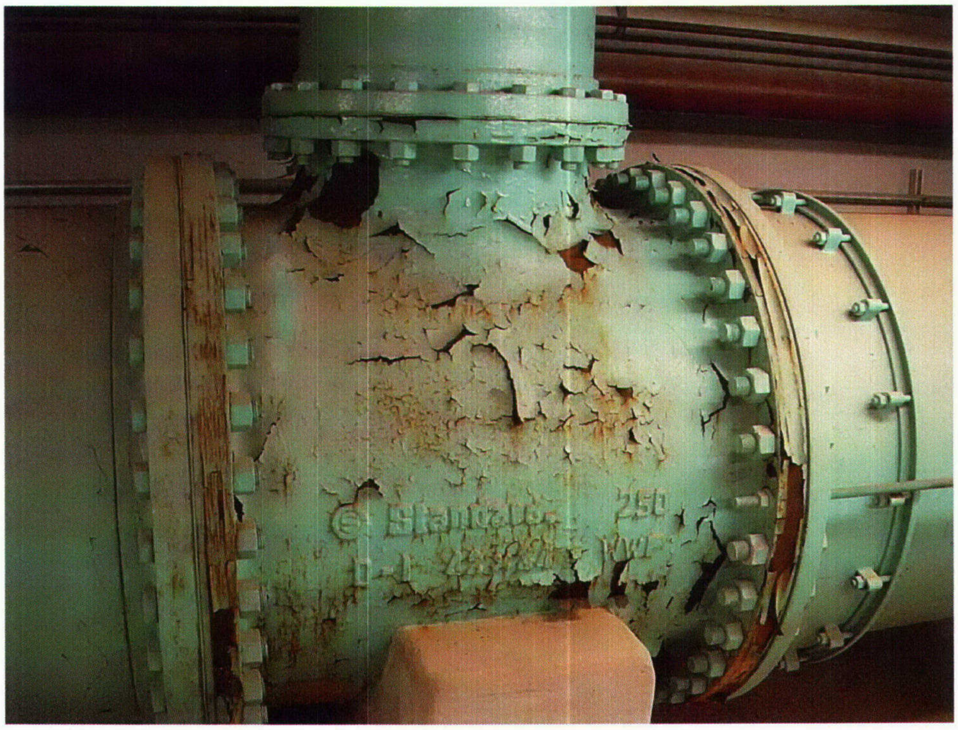
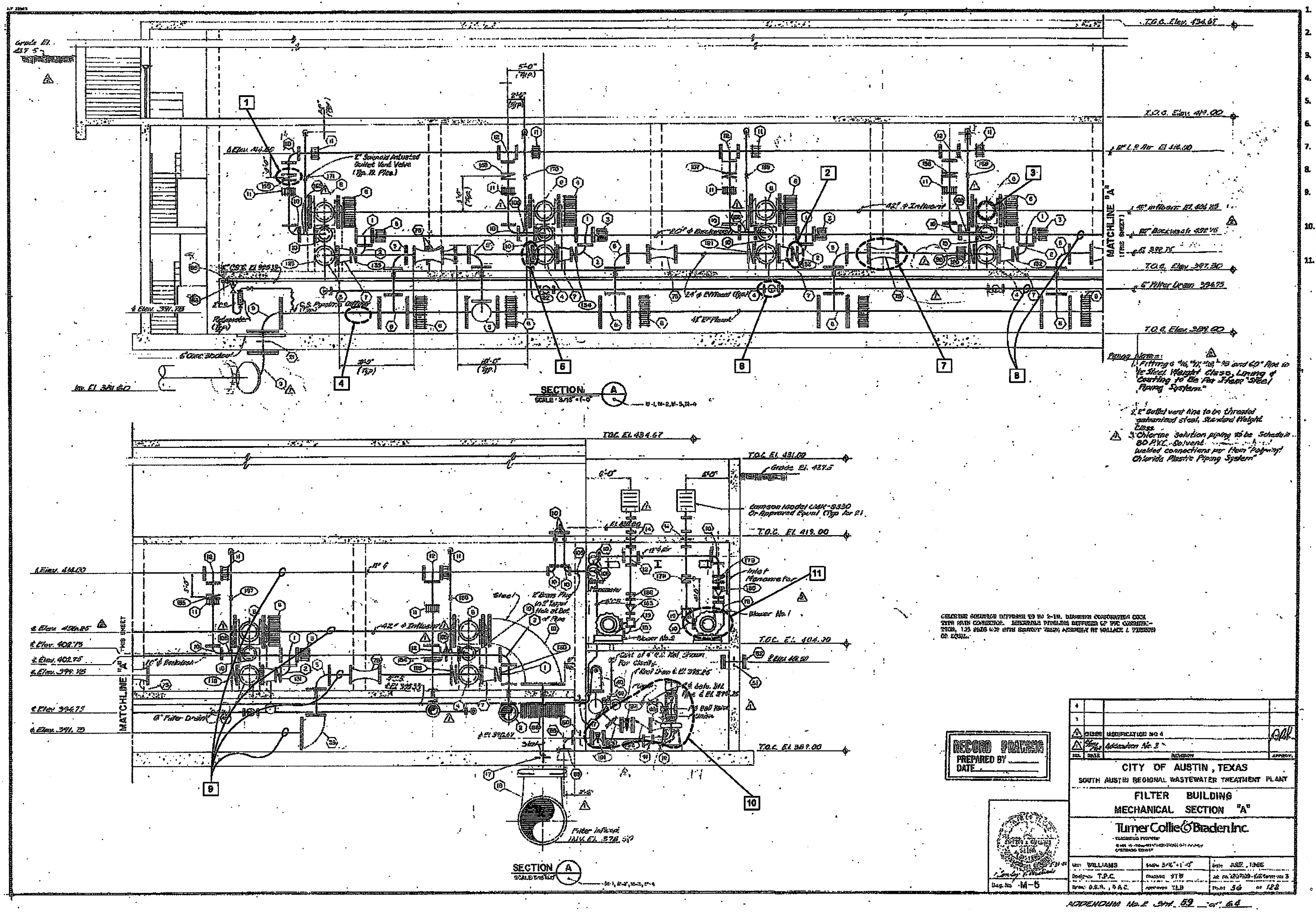


Figure 2.3 - Peeling paint on 42" Effluent pipe and fittings in Lower Gallery

Figure 2.4: Venturi Flow Meter at Filter No. 7, instrumentation not connected (typical)



Piping Notes:
1. Fittings 46, 47, 48, 49 and 60" Pipe to be Steel Weight Class, Lining & Coating to Be Per Item "Steel Piping System."
2. 2" Outlet vent line to be threaded galvanized steel, Standard Weight Class.
3. Chlorine solution piping to be Schedule 80 P.V.C. Solvent welded connections per Item "Polyvinyl Chloride Plastic Piping System"

RECORD DRAWING
PREPARED BY ______
DATE ______

NO.	DATE	REVISION	APPROV.
4			
3			
2	2/3/88	MODIFICATION NO 4	GAV
1		Addendum No. 2	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT
FILTER BUILDING
MECHANICAL SECTION "A"
Turner Collie & Braden Inc.

WILLIAMS	Scale 3/16" = 1'-0"	Date JULY, 1986
Designed T.P.C.	Checked STW	Job No.
Drawn D.S.R., D.A.C.	Approved TLB	Sheet 56 of 128

Dwg. No. M-5

ADDENDUM No. 2 Sht. 59 of 64

NOTES:

1. 10" AIR INLET BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
2. 20" BACKWASH WATER BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
3. 24" FILTER INFLUENT BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
4. 42" FILTER EFFLUENT BFV (TYP. 2) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS. RECORD DRAWING DOES NOT SHOW EXISTING BFV.
5. 24" FILTER EFFLUENT BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
6. 6" FILTER DRAIN ECCENTRIC PLUG VALVE (TYP. 12) TO BE OUTFITTED WITH ELECTRIC ACTUATORS TO ALLOW FOR REMOTE OPERATION.
7. 16" VENTURI FLOW METER (TYP. 12) TO BE REPLACED OR REBUILT AND FITTED WITH NEW INSTRUMENTATION.
8. BACKWASH WATER AND FILTER DRAIN PIPING PROTECTIVE COATINGS TO BE SANDBLASTED AND RECOATED AS NECESSARY (SPOT COATING, <15%).
9. AIR INLET, FILTER INFLUENT, AND FILTER EFFLUENT PIPING PROTECTIVE COATINGS TO BE COMPLETELY SANDBLASTED AND RECOATED WITH APPROPRIATE PROTECTIVE COATING SYSTEMS.
10. MUDWELL PUMPS, MOTORS, SWING CHECK VALVES (TYP. 3), AND 24" EPV (TYP. 6) – PUMPS AND MOTORS TO BE REPLACED WITH NEW UNITS. SWING CHECK VALVES TO BE REPLACED.
11. LAMSON BLOWERS AND BLOWER MOTORS (TYP. 2) – MOTORS TO BE REPLACED WITH NEW, HIGH-EFFICIENCY UNITS.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM
EXHIBIT 2.5A

AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

EXHIBIT No. 2.5A	JOB No. 60213591	DATE: JULY 2011

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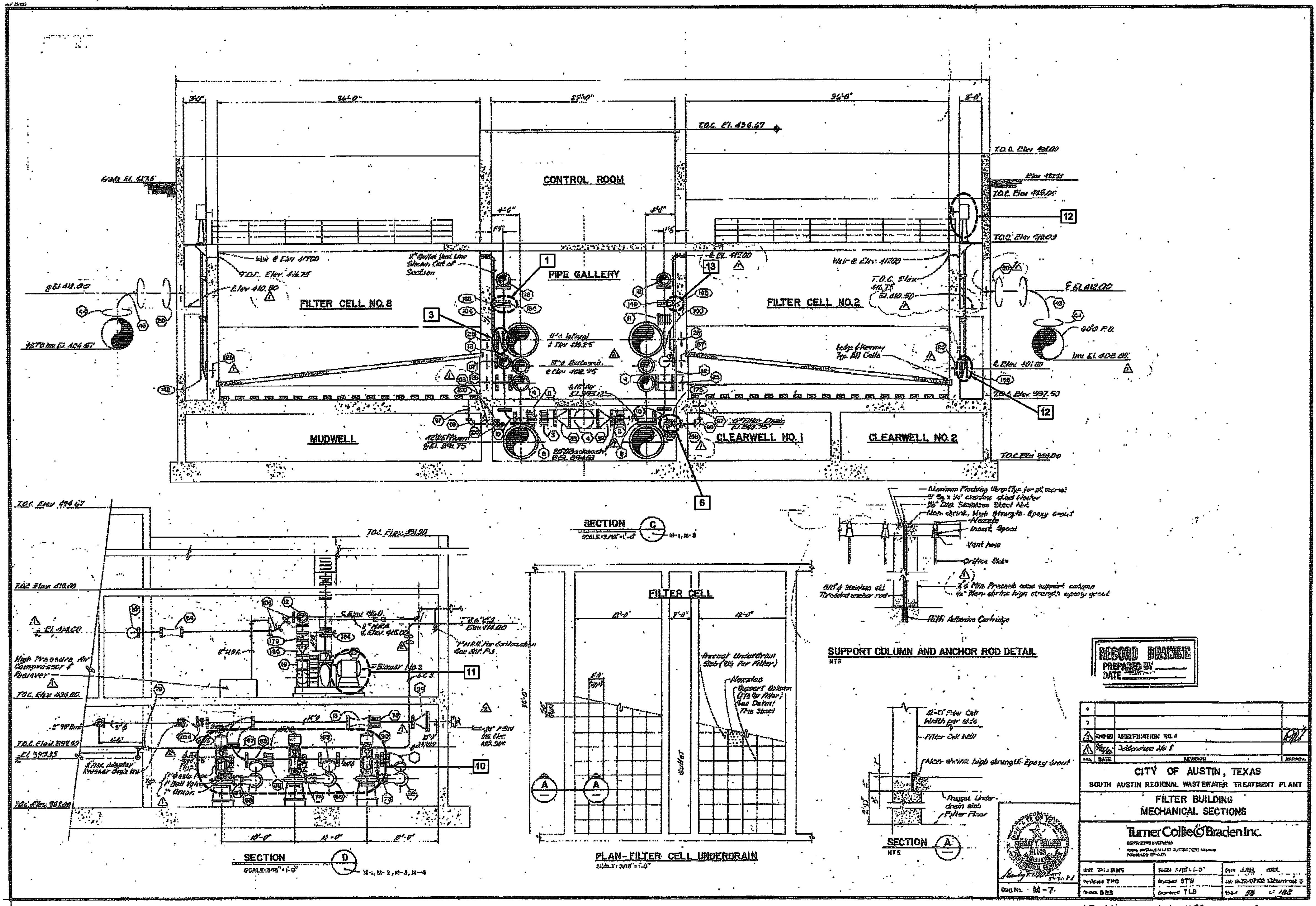

ADDENDUM NO. 2 SHT 61 of 64

NOTES:

1. 10" AIR INLET BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
3. 24" FILTER INFLUENT BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
6. 6" FILTER DRAIN ECCENTRIC PLUG VALVE (TYP. 12) TO BE OUTFITTED WITH ELECTRIC ACTUATORS TO ALLOW FOR REMOTE OPERATION.
10. MUDWELL PUMPS, MOTORS, SWING CHECK VALVES (TYP. 3), AND 24" EPVS (TYP. 6) – PUMPS AND MOTORS TO BE REPLACED WITH NEW UNITS. SWING CHECK VALVES TO BE REPLACED.
11. LAMSON BLOWERS AND BLOWER MOTORS (TYP. 2) – MOTORS TO BE REPLACED WITH NEW, HIGH-EFFICIENCY UNITS.
12. 24" FILTER BACKWASH WASTE BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE UNIT. TEN (10) OF TWELVE (12) ELECTRIC ACTUATORS TO BE REPLACED, TWO (2) NEWER UNITS TO REMAIN AT FILTERS NO. 4 AND NO. 9.
13. 2" AIR VENT SAFETY VALVES (TYP. 12) TO BE REPLACED WITH NEW VALVE UNIT.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM
EXHIBIT 2.5B

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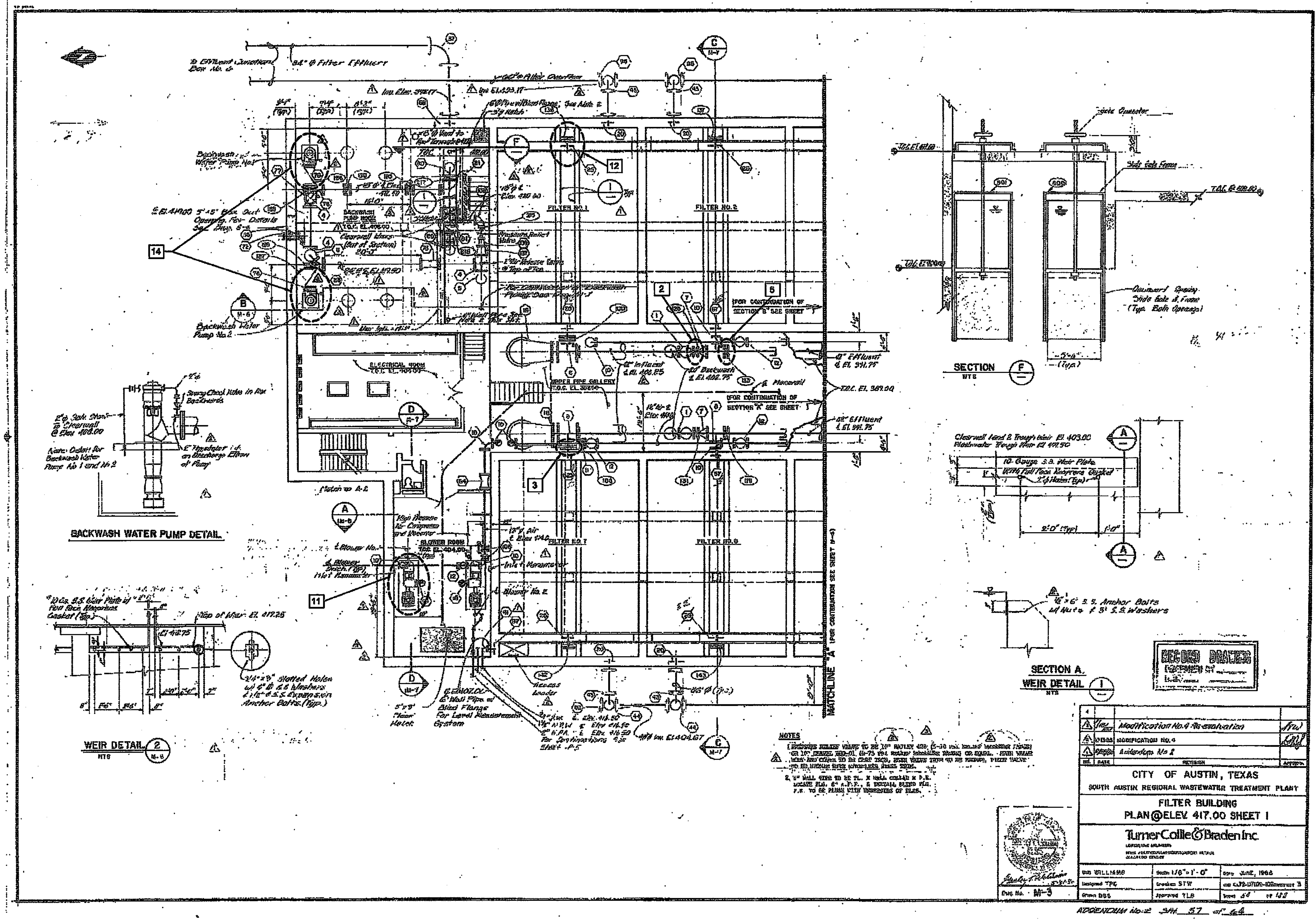
NOTES:

2. 20" BACKWASH WATER BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
3. 24" FILTER INFLUENT BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
5. 24" FILTER EFFLUENT BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE AND ELECTRIC ACTUATOR UNITS.
11. BLOWERS AND BLOWER MOTORS (TYP. 2) – MOTORS TO BE REPLACED WITH NEW, HIGH-EFFICIENCY UNITS.
12. 24" FILTER BACKWASH WASTE BFV (TYP. 12) TO BE REPLACED WITH NEW VALVE UNIT. TEN (10) OF TWELVE (12) ELECTRIC ACTUATORS TO BE REPLACED, TWO (2) NEWER UNITS TO REMAIN AT FILTERS NO. 4 AND NO. 9.
14. BACKWASH PUMPS (TYP. 2) TO BE SERVICED, NEW PACKING GLANDS INSTALLED, AND MOTORS REPLACED. BACKWASH PUMP SWING CHECK VALVES TO BE REBUILT OR REPLACED.



CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM
EXHIBIT 2.5C

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EXHIBIT No. 2.5C	JOB No. 60213591	DATE: JULY 2011

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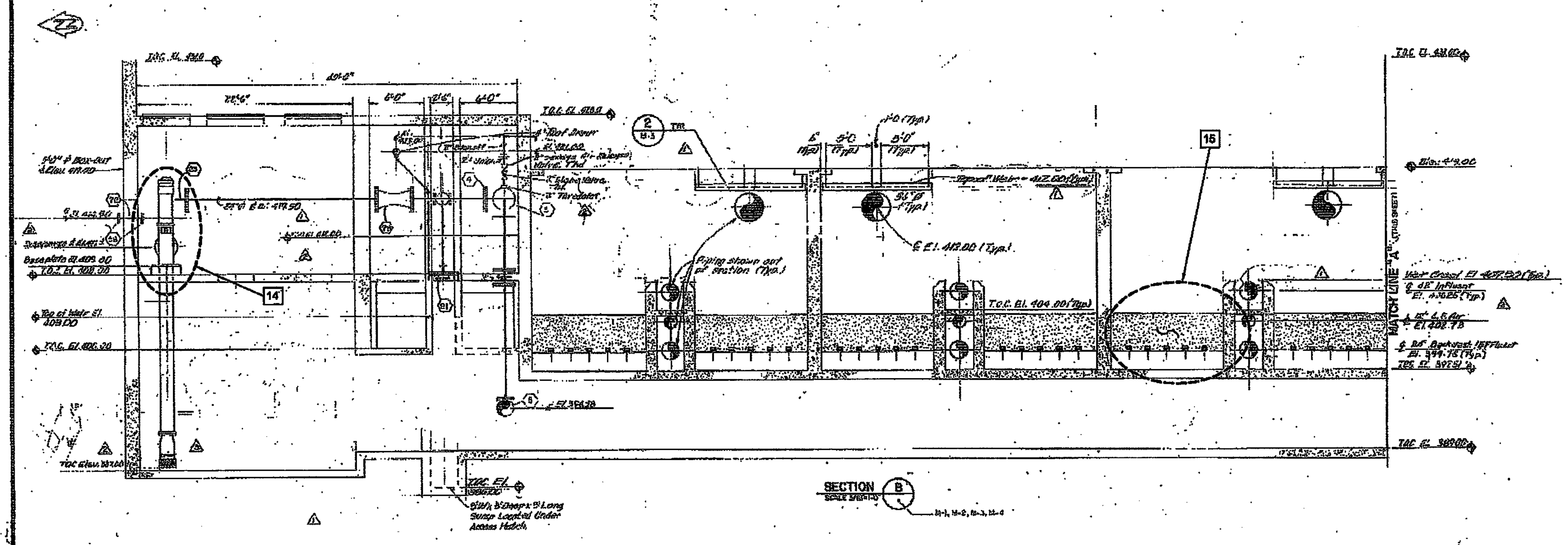
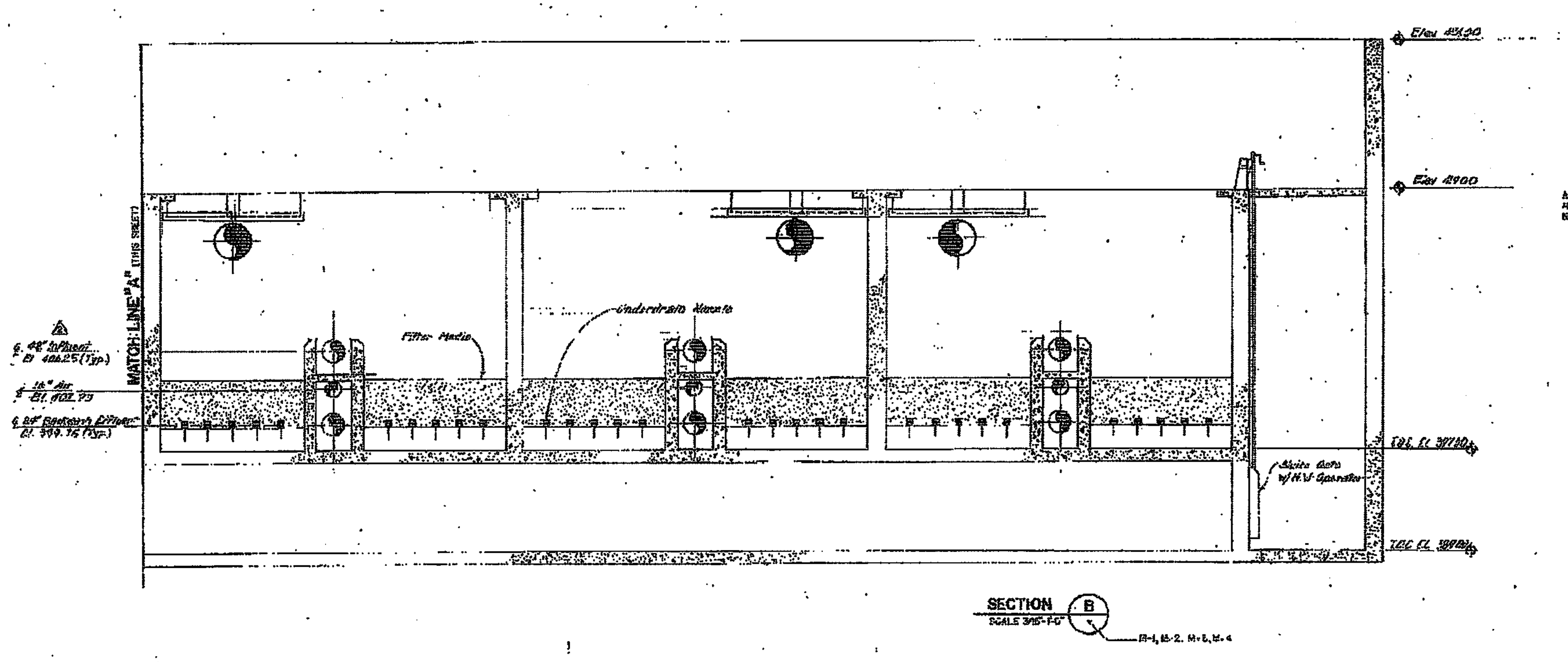
NOTES:

14. BACKWASH PUMPS (TYP. 2) TO BE SERVICED, NEW PACKING GLANDS INSTALLED, AND MOTORS REPLACED. BACKWASH PUMP SWING CHECK VALVES TO BE REBUILT OR REPLACED.
15. REMOVE FILTER MEDIA, INSPECT AND REPAIR UNDERDRAIN SYSTEM/COMPONENTS AS NECESSARY, AND INSTALL NEW FILTER MEDIA SAND (TYP. 12).





AIR RELEASE VALVE TO BE 2-IN. NPT WITH 1/2-IN. ORIFICE, SS INTERNAL MECHANISM, CI BODY, OPERATING PRESSURE 0-25 PSIG, APCO MODEL NO. 400 OR EQUAL.

RECORD DRAWING
REVIEWED BY ____
DATE ____

NO.	DATE	REVISION	APPROV.
4			
3	12 1 88	MODIFICATION NO. 4 RE-EVALUATION	
2	9 12 88	MODIFICATION NO. 4	
1		Addendum No. 2 Elev. of 24" BW Revised	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
MECHANICAL SECTION "B"

Turner Collie & Braden Inc.

Eng. WILLIAMS	Scale 3/16" = 1'-0"	Date JUNE 1986
Designed TPC	Checked STW	Job No. 8-32203-102 Task 3
Drawn W.D.W.H. / R.L.	Approved TLB	Sheet 57 of 122

Dwg No. M-6

ADDENDUM No. 2 Sht 60 of 64

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM
EXHIBIT 2.5D

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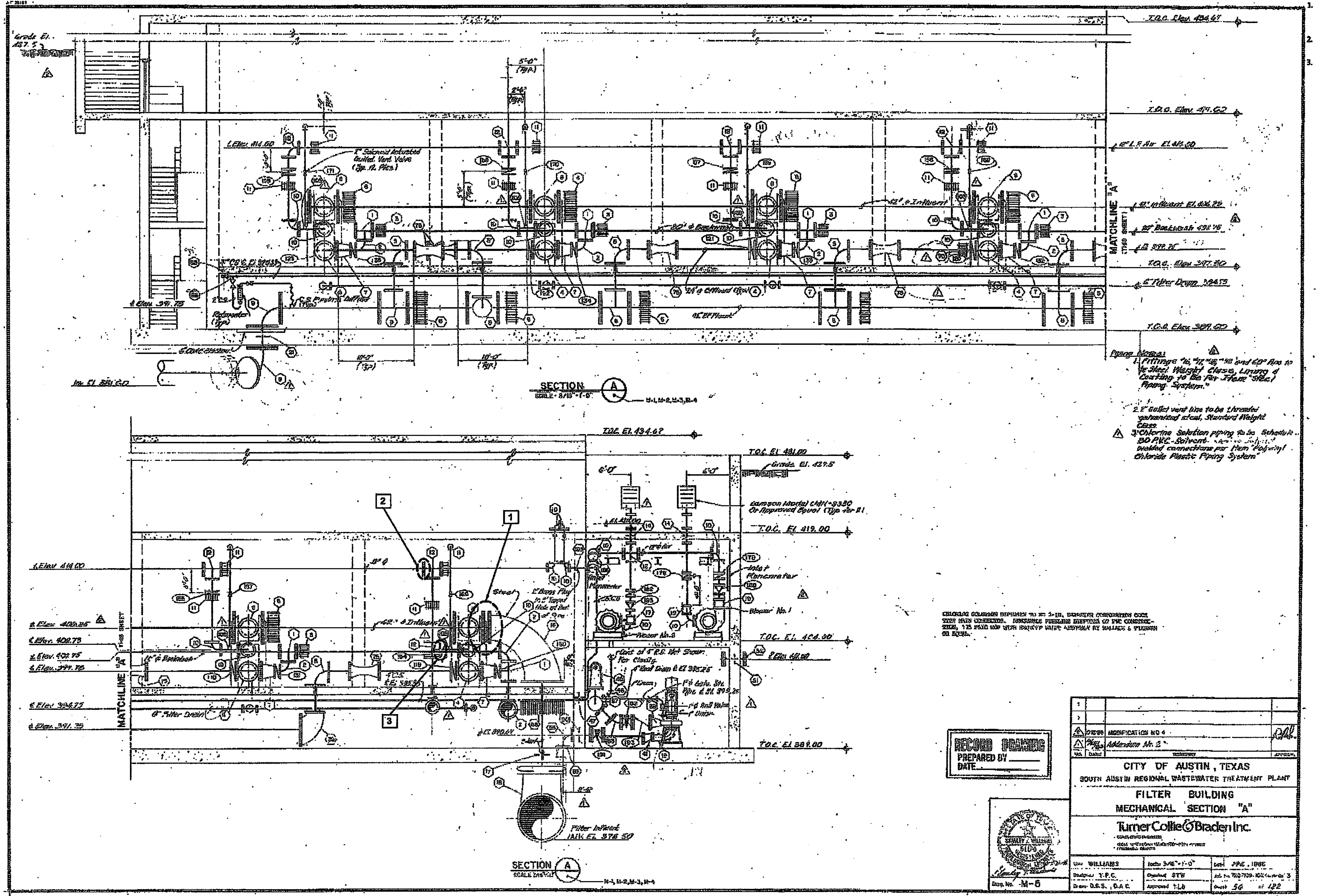
EXHIBIT No.	JOB No.	DATE:
2.5D	60213591	JULY 2011

NOTES:

1. INSTALL 42-INCH BUTTERFLY VALVES (TYP. 2) WITH DRESSER FLANGE ADAPTERS AND SPOOL PIECES IN LIEU OF EXISTING FLANGE-FLANGE SPOOL PIECE, TO ISOLATE FILTER INFLUENT FLOW STREAM FROM THE EAST AND WEST HALVES OF THE FILTER BUILDING.
2. FOR TEMPORARY CONSTRUCTION PURPOSES, INSTALL BLIND FLANGE AT THIS LOCATION TO ISOLATE FILTER NO. 8 THROUGH NO. 12 FROM THE BACKWASH AIR FLOW STREAM.
3. FOR TEMPORARY CONSTRUCTION PURPOSES, REMOVE THE 10-INCH AIR INLET VALVE FOR FILTER NO. 7 AND REPLACE WITH 10-INCH FLANGE CAP TO ISOLATE FILTER NO. 7 FROM THE BACKWASH AIR FLOW STREAM.



Piping Notes:

1. Fittings "16," "17," "18," "19" and "60" Nos. to be Steel Weight Class, Lining & Coating to be Per Item "Steel Piping System."
2. 2" Gullet vent line to be threaded galvanized steel, Standard Weight Class.
3. Chlorine Solution piping to be Schedule 80 PVC-Solvent welded connections per Item "Polyvinyl Chloride Plastic Piping System"

RECORD DRAWING
PREPARED BY ______
DATE ______

No.	Date	Revision	Approv.
4		MODIFICATION NO 4	
1		Addendum No. 2	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT
FILTER BUILDING
MECHANICAL SECTION "A"
Turner Collie & Braden Inc.

STANLEY J. WILLIAMS
51106

WILLIAMS	Scale 3/16" = 1'-0"	Date JUNE, 1986
Designed T.P.C.	Checked STW	Job No. 7807-08-1006 Contract 3
Drawn D.S.S., D.A.C.	Approved T.L.B.	Sheet 56 of 122

Dwg. No. M-6

ADDENDUM No. 2 Sht. 59 of 64

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM
ISOLATION TECHNIQUES

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EXHIBIT No. 2.6A	JOB No. 60213591	DATE: JULY 2011

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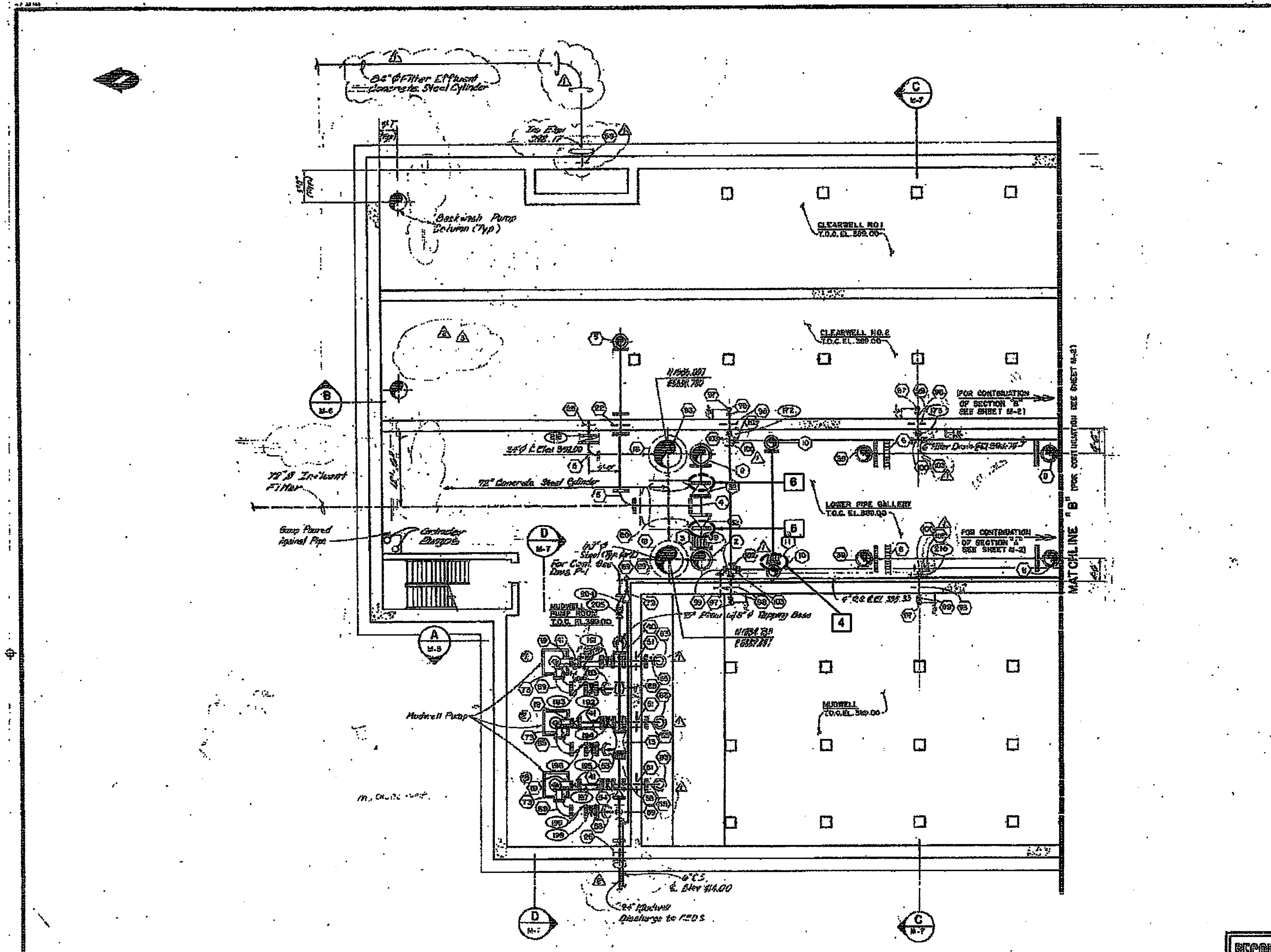

FITTING SCHEDULE

○	FITTINGS
1	20" Tee Fl.
2	20" 90° Ell. Fl.
3	20" Fl. Adaptor, Dresser 128
4	24" Tee Fl.
5	24" 90° Ell. Fl.
6	42" Fl. Adaptor, Dresser 128
7	20"x24" Conc. Red Fl.
8	24"x42" Tee Fl.
9	42" 90° Ell. Fl.
10	12" 90° Ell. Fl.
11	12" Fl. Adaptor, Dresser 128
12	12" Tee Fl.
13	14" Flow Meter
14	12" Wall Pipe Fl.
16	42"x60" 90° Red Ell., Fl
17	60" Wall Pipe Fl. x P.E.
18	60"x72" 90° Red Ell. PE x Fl
19	12" Flexible Connector Fl
20	36" Wall Pipe MJ x PE
21	42" Wall Pipe Fl.
22	24" Wall Pipe Fl.
23	24" 45° Ell., Fl
25	24" Wall Pipe Fl. PE
26	36" 90° Ell. P.C.
31	72" Wall Pipe P.E. x MJ
32	20"x24" Conc. Red. Fl.
33	48" Wall Pipe Fl x PE
35	48" 90° Ell. P.C.
36	48" Wall Pipe P.E. x P.C.
37	84" 90° Ell. P.C.
38	14" Flanged Adapt.
39	24"x42" 90° Red Ell., Fl.
40	24"x14" Red Ell., Fl.
41	12"x16 Ecc. Red Fl
43	36" 90° Ell. P.C. x PE
44	48"x48"x30" Tee P.C.
46	4" 45° Ell., Fl
47	4" Wall Pipe Fl x PE
48	4" 90° Ell., Fl.
50	18" Wall Pipe Fl x PE
51	18" Wall Pipe, Fl.
52	18" Blind Flange
53	18" 45° Ell Fl.
54	24"x15" Conc. Red., Fl.
55	18" 90° Ell., Fl.
56	24" Blind Flange
57	12" Wall Pipe Fl x PE
58	84" Wall Pipe PE x P.C.
59	18"x24" Red Ell., Fl.
60	72" Tee, P.C.
61	6" 90° Ell, Solv Weld
64	12" Flow Meter
67	24" 90° L.R. Ell., Fl
68	24"x16" Red. Tee, Fl
69	16"x10" Red. Ell., Fl
72	24" Wall Pipe, Fl.
73	10" Flex. Connector, Fl.
75	24" Flow Meter
76	24" Fl. Adaptor Dresser 128
77	24"x15" Red. Ell., Fl.
78	15" 45° Ell. Fl.
79	6"x4" Conc. Red S.W.
80	15" 90° Ell., Fl.
81	18" Tee, Fl.
82	48" M.J. Plug
83	16" Flare Coating
84	48"x54" Conc. Red
85	4"x2" Conc. Red., S.W.
86	4"x2" Red. Tee, S.W.
87	48" MJ Plug
88	60" Dresser Coupling, Style 38
89	4" 90° Ell., S.W.
90	20 Fl. Adaptor, Dresser 128
91	16" Wall Pipe, Fl. x P.E.
92	16"x24" 90° Red Ell., Fl.
93	60"x60"x54" Fl x PE x [illegible]
94	72" Tee, P.C.
95	60"x54"x30" Tee, P.C.
96	60" 90° Ell., P.C.
97	6" Wall Pipe Fl x PE
98	6" Wall Pipe, Fl
99	6" 90° Ell. Fl.
100	6" Tee, Fl.
101	42"x60" Ecc. Red, P.C.
102	6" Cross, Fl.
103	6" Fl. Adaptor, Dresser 128
104	60" 45° Ell. P.C.
105	12" Tapping Saddle for 2" Tapping
106	12" 45° Ell., Fl.
107	16"x24" Conc. Red., Fl
108	10"x15" Conc. Red., Fl.
109	10"x16" 90° Red. Ell., Fl.

NOTES:

4. FOR TEMPORARY CONSTRUCTION PURPOSES, INSTALL 12-INCH BLIND FLANGE AT DRESSER FLANGE ADAPTER TO ISOLATE FILTERS NO. 1 THROUGH NO. 6 FROM THE BACKWASH AIR FLOW STREAM.
5. FOR TEMPORARY CONSTRUCTION PURPOSES, INSTALL 20-INCH BLIND FLANGE AT THIS LOCATION TO ISOLATE FILTERS NO. 7 THROUGH NO. 12 FROM THE BACKWASH WATER FLOW STREAM.
6. FOR TEMPORARY CONSTRUCTION PURPOSES, INSTALL 20-INCH BLIND FLANGE AT THIS LOCATION TO ISOLATE FILTERS NO. 1 THROUGH NO. 6 FROM THE BACKWASH WATER FLOW STREAM.

RECORD DRAWING
PREPARED BY ________
DATE ________

NO.	DATE	REVISION	APPROV.
3	1-15-97	MODIFICATION NO. 4 RE-EVALUATION	
2	9-15-96	MODIFICATION NO. 4	
1	[illegible]	Addendum No. 1 Filter Drain Revised	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
PLAN @ ELEV. 396.00 SHEET 1

Turner Collie & Braden Inc.

Dsn WILLIAMS	Scale 1/8" = 1'-0"	Date [illegible], 1996
Designed TPC	Checked LTW	Job No. 72-07109-172
Drawn DSG	Approved TLB	Sheet 52 of 123

Dwg No. M-1

ADDENDUM No. 2 Sht 55 of 64

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

FILTER SYSTEM
EXHIBIT 2.6B

AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

EXHIBIT No. 2.6B	JOB No. 60213591	DATE: JULY 2011

Appendix 2.1:

Lead-Based Paint Survey

Prepared By:

Terracon Consultants, Inc.

August 09, 2010

Lead-Based Paint Survey

SOUTH AUSTIN REGIONAL (SAR) WWTP – FILTER BUILDING

13009 Fallwell Lane
Austin, Texas 78617
City of Austin Request No.: 10052L
Terracon Project No. 96107298
August 09, 2010

Prepared for:
City of Austin
Department of Public Works
505 Barton Springs Road, Suite 900
Austin, Texas 78704

Prepared by:
Terracon Consultants, Inc.
5307 Industrial Oaks Boulevard, Suite 160
Austin, Texas 78735

LEAD-BASED PAINT INPSECTION REPORT
WARNING

WARNING: BEFORE USING THIS REPORT, READ THE FOLLOWING

It is a violation of the Texas Environmental Lead Reduction Rules to perform any of the following, or similar activities, without having the proper certification:

1. Determine what materials are free of lead-based paint (LBP);
2. Determine what materials are LBP or contain lead;
3. Determine what activities can be done that might disturb LBP or lead-containing material; or
4. Determine who can disturb a LBP or lead containing material.

Performing any of these type of activities can be considered a critical violation of the Texas Environmental Lead Reduction Rules and therefore be subject to penalties of up to $5,000 per day per violation. Any person performing a violation is subject to penalty.

THIS REPORT IS PROVIDED FOR INFORMATION PURPOSES ONLY!!

A Management Plan should be provided with this Inspection Report. The Management Plan will explain what activities may be performed, if any, and what materials may be disturbed. If a Management Plan is not provided, any activity that would create or disturb dust from building materials will require the submission of a Lead-Based Paint Work Request or Lead-Based Paint Inspection Request to the Asbestos/Lead Management Group, Architectural and Engineering Services Division, Department of Public Works and Transportation.

August 09, 2010

Mr. Darryl Haba
City of Austin
Asbestos / Lead (Pb) Management Group
Project Management Division
Public Works Department
505 Barton Springs Road, Suite 900
Austin, Texas 78704

Telephone: (512) 974-7205
Telefax: (512) 974-7203
Mobile: (512) 293-8052
Email: darryl.haba@ci.austin.tx.us

Re: Lead-Based Paint Inspection
South Austin Regional (SAR) WWTP – Filter Building
13009 Fallwell Lane
Austin, Texas 78617
CoA Request No.: 10052L
Terracon Project No.: 96107298

Mr. Haba:

On July 27, 2010, Terracon Consultants, Inc. (Terracon) conducted a lead-based paint survey to establish lead levels present in paint coatings applied to the Filter Building at the South Austin Regional (SAR) WWTP located at 13009 Fallwell Lane, in Austin, Texas. The survey was conducted and bulk material samples were obtained by Mr. Glenn Shrode, a Texas Department of State Health Services (TDSHS) Certified Lead Risk Assessor, and Mr. Kenneth Williamson, a TDSHS Certified Lead Inspector, both employed by Terracon. The survey was conducted in accordance with Texas Lead Reduction Act Rules and in general accordance with HUD guidelines and was intended to identify and assess suspect paint materials which may contain lead. **Twenty-seven (27) bulk samples of suspect paint materials were obtained in this study.**

The location and type of samples collected were at the discretion of the Certified Lead Inspectors; with general direction provided by discussions with the Client. Materials not sampled include wood, rubber and hidden or inaccessible components (i.e., materials within walls, unsafe areas, beyond reach from available ladders, etc.).

1.0 LEAD ANALYSIS AND RESULTS

All bulk samples of suspect lead-based paint materials collected during the survey were analyzed by Environmental Hazards Services, L.L.C., an American Industrial Hygiene Association (AIHA) Accredited laboratory utilizing Atomic Absorption Spectrometry (AAS Flame) Methodology. Reports of laboratory analyses of all samples collected, sample chain-of-custody documentation and sampling location photographs are included herein. Note: Primer paint utilized on structural steel within the facility was not sampled as part of this survey and was assumed to be lead-containing.

Eighteen (18) of the suspect paint materials sampled and analyzed as part of this survey were found to contain lead in concentrations below the detection limit for the analysis performed:

- Area L04 – The medium gray on reddish brown paint applied to the metal large piping at the north end of the Lower Pipe Gallery was found to contain <38 ppm lead. Where observed, this material was found to be in good condition.

- Area L05 – The medium gray on white on black paint applied to the metal large piping fittings at the north end of the Lower Pipe Gallery was found to contain <41 ppm lead. Where observed, this material was found to be in good condition.

- Area L07 – The light green on black paint applied to the metal piping at the north end of the Lower Pipe Gallery was found to contain <47 ppm lead. Where observed, this material was found to be in fair to poor condition, with chipping and peeling observed.

- Area L08 – The light green on black paint applied to the metal piping fittings at the north end of the Lower Pipe Gallery was found to contain <38 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed.

- Area L09 – The turquoise on white on black paint applied to the metal piping in the Lower Pipe Gallery was found to contain <44 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed.

- Area L10 – The turquoise on white on black paint applied to the metal piping fittings in the Lower Pipe Gallery was found to contain <43 ppm lead. Where observed, this material was found to be in fair to poor condition, with chipping and peeling observed.

- Area L12 – The bright yellow paint applied to the metal stair tread edges throughout the Filter Building was found to contain <42 ppm lead. Where observed, this material was found to be in good to fair condition, with weathering observed.

- Area L14 – The brown on white on black paint applied to the metal Backwash piping fittings in the Upper Pipe Gallery was found to contain <40 ppm lead. Where observed, this material was found to be in good condition.

- Area L15 – The medium gray on white on black paint applied to the metal Influent piping in the Upper Pipe Gallery was found to contain <46 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed.

- Area L16 – The medium gray on white on black paint applied to the metal Influent piping fittings in the Upper Pipe Gallery was found to contain <39 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed.

- Area L17 – The black paint applied to the metal Sanitary Sewer piping and fittings in the Upper Pipe Gallery was found to contain <35 ppm lead. Where observed, this material was found to be in good condition.

- Area L19 – The light green on white on black paint applied to the metal Process Air piping fittings in the Upper Pipe Gallery and the 180° piping fittings southwest of the Control Room on the Control Room Level was found to contain <44 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed.

- Area L20 – The turquoise on white on black paint applied to the metal piping in the Upper Pipe Gallery was found to contain <42 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed.

- Area L21 – The turquoise on white on black paint applied to the metal piping fittings in the Upper Pipe Gallery was found to contain <49 ppm lead. Where observed, this material was found to be in fair to poor condition, with chipping and peeling observed.

- Area L24 – The light green on white paint applied to CMU and concrete in the Upper Pipe Gallery, Electrical Room south and west interior and exterior walls, Blower Room interior walls and east exterior wall and Restroom interior and exterior walls was found to contain <40 ppm lead. Where observed, this material was found to be in good condition.

- Area L25 – The light gray on tan on black paint applied to the metal exterior valve stem shafts at the Filter Cells on the Control Room Level was found to contain <43 ppm lead. Where observed, this material was found to be in good condition.

- Area L26 – The light green on white paint applied to CMU on walls outside the Control Room, Control Room exterior walls, Control Room interior south wall and partial interior east and west walls on the Control Room Level was found to contain <44 ppm lead. Where observed, this material was found to be in good condition.

- Area L27 – The light green on white paint applied to concrete on columns, Control Room interior north wall and partial interior east and west walls on the Control Room Level was found to contain <48 ppm lead. Where observed, this material was found to be in good condition.

Eight (8) of the suspect paint materials sampled and analyzed as part of this survey were found to contain lead in concentrations exceeding the analytical detection limit, but less than 5,000 ppm:

- Area L01 – The dark gray on medium blue on reddish brown paint applied to the metal mudwell pump motors and driveshaft covers in the Mudwell Pump Room in the Lower Pipe Gallery and the blower motors in the Blower Room in the Upper Pipe Gallery was found to contain 180 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping observed. It is estimated that there exists approximately 210 square feet of this material in the above listed areas.

- Area L02 – The brown on white on black paint applied to the metal Mudwell piping in the Mudwell Pump Room and north end of the Lower Pipe Gallery was found to contain 180 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping observed. It is estimated that there exists approximately 1,385 square feet of this material in the above listed areas.

- Area L03 – The brown on white on black paint applied to the metal Mudwell piping fittings and pumps in the Mudwell Pump Room and north end of the Lower Pipe Gallery was found to contain 69 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping observed. It is estimated that there exists approximately 695 square feet of this material in the above listed areas.

- Area L11 – The light gray and beige on gray on reddish brown paint applied to the metal doors and frames throughout the Filter Building and the Control Room window frame on the Control Room Level was found to contain 200 ppm lead. Where observed, this material was found to be in good condition. It is estimated that there exists approximately 900 square feet of this material in the above listed areas.

- Area L13 – The brown on white on black paint applied to the metal Backwash piping in the Upper Pipe Gallery was found to contain 71 ppm lead. Where observed, this material was found to be in good condition. It is estimated that there exists approximately 2,590 square feet of this material in the above listed area.

- Area L18 – The light green on white on black paint applied to the metal Process Air piping in the Upper Pipe Gallery was found to contain 150 ppm lead. Where observed, this material was found to be in good to fair condition, with chipping and peeling observed. It is estimated that there exists approximately 1,920 square feet of this material in the above listed area.

- Area L22 – The dark green paint applied to the metal air compressors in the Blower Room in the Upper Pipe Gallery was found to contain 150 ppm lead. Where observed, this material was found to be in good condition. It is estimated that there exists approximately 90 square feet of this material in the above listed area.

- Area L23 – The light gray on reddish brown paint applied to the metal pump motors in the Backwash Pump Room in the Upper Pipe Gallery was found to contain 140 ppm lead. Where observed, this material was found to be in good condition. It is estimated that there exists approximately 75 square feet of this material in the above listed area.

One (1) of the suspect paint materials sampled and analyzed as part of this survey was found to contain lead in a concentration equal to or exceeding 5,000 ppm:

- **Area L06 - The black paint applied to the metal Sanitary Sewer piping and fittings in the Lower Pipe Gallery was found to contain 46,000 ppm lead. Where observed, this material was found to be in good condition. It is estimated that there exists approximately 690 square feet of this material in the above listed area.**

As always, we appreciate the opportunity to provide lead-related environmental consulting services to the City of Austin and look forward to working with you on future projects. If you should have any questions regarding this survey or report, please contact our office.

Respectfully Submitted,

TERRACON CONSULTANTS, INC.

Glenn Shrode
Lead Risk Assessor
TDSHS Certification Number 2070010

Kenneth Williamson
Lead Inspector
TDSHS Certification Number 2060499

Richard Ian Howes
Lead Abatement Project Designer
TDSHS Certification Number 2090034

CITY OF AUSTIN
REQUEST FOR CONSULTANT'S PROPOSAL
ASBESTOS ROTATION CONSULTANT LIST

TO:

Terracon Consultants

Austin, Texas 78754

ATTN: Ian Howes (ph. 442-1122; fax 442-1181)

DATE: 7/1/2010

FROM: ASBESTOS/LEAD BASED PAINT MANAGEMENT GROUP
PROJECT MANAGEMENT DIVISION
DEPARTMENT OF PUBLIC WORKS
CITY OF AUSTIN
505 BARTON SPRINGS ROAD, SUITE 900
AUSTIN, TEXAS 78704

ATTN:

REQUEST NO: 10052L

PRIORITY:

NAME OF PROJECT: S.A.R. WWTP - Filter Building Rehab.

STREET ADDRESS: 13009 Fallwell Lane

AREA OF BUILDING: Filter buildings

Please prepare a proposal for the above referenced project to provide the following indicated services in accordance with your standing contract with the City of Austin.:

☐ LIMITED ASBESTOS INSPECTION OF INDICATED AREA
☐ COMPLETE ASBESTOS INSPECTION OF INDICATED AREA
☐ PREPARATION OF CONTRACT DOCUMENTS FOR ABATEMENT
☐ SITE MONITORING DURING ASBESTOS ABATEMENT
☒ Lead paint inspection

The following items

☐ WORK REQUEST
☐ ASBESTOS INSPECTION REQUEST
☐ OTHER
☐ OTHER

☐ ARE ATTACHED HEREWITH
☐ ARE BEING FORWARDED
☐ ARE AVAILABLE AT OUR OFFICE
☐ OTHER
☐ OTHER

The contact person for obtaining access to the area for inspection is:

NAME: Darryl Haba

TELEPHONE NUMBER: 974-7205

OTHER INSTRUCTIONS

☐ PLEASE GIVE THIS MATTER YOUR IMMEDIATE ATTENTION
☐ THIS IS CONFIRMATION OF VERBAL REQUEST

Please contact Chris Graf 972-0171 so that she can provide access to the filter buildings and explain the proposed project.

It is most likely prudent to conduct a complete lead paint inspection of both buildings to accommodate the project.

BY:

Darryl Haba

Darryl Haba , Project Manager

Christina Calvery, Project Manager

C. Wade Mullin, M.S., Asbestos Manager II

FORM ASB 30.02/081399

CITY OF AUSTIN

AUTHORIZATION TO PROCEED

ASBESTOS ROTATION CONSULTANT

TO:

Terracon
5307 Industrial Oaks Blvd., Suite 160
Austin, Texas 78735

ATTN: Ian Howes (ph. 442-1122; fax 442-1181)

☐ THIS IS CONFIRMATION OF A VERBAL AUTHORIZATION TO PROCEED

DATE: 7/14/2010

FROM: ASBESTOS/LEAD BASED PAINT MANAGEMENT GROUP
PROJECT MANAGEMENT DIVISION
DEPT. OF PUBLIC WORKS
CITY OF AUSTIN
P.O. BOX 1088
AUSTIN, TEXAS 78767

Assignment # 101

REQUEST NO: 10052L **PRIORITY:**

NAME OF PROJECT: S.A.R. WWTP - Lead Paint Inspection

STREET ADDRESS: 13009 Fallwell Lane

AREA OF BUILDING: Filter buildings

Please proceed with the work described in your proposal dated 7/12/2010 and your standing contract with the City of Austin for Rotational Asbestos Consultant services.

Your fee will be based on an unit cost basis with a cost not to exceed of $2,795.35 .

The following conditions and/or exceptions are understood to be correct or are to be added:

- ☐ FOR ASBESTOS INSPECTIONS
  - ☐ INCLUDES THE COLLECTION FOR LABORATORY ANALYSIS OF UP TO ____ BULK SAMPLES.
  - ☐ INCLUDE SAMPLES OF THE FOLLOWING:
  - ☒ OTHER Lead paint inspection at filter buildings 1 and 2
- ☐ PREPARATION OF CONTRACT SPECIFICATIONS FOR ABATEMENT
- ☐ FOR ABATEMENT SITE MONITORING
  - ☐ INCLUDES MONITORING FOR ____ DAYS
  - ☐ OTHER
- ☐ OTHER
- ☐

All aspects of the project should be coordinated with the Asbestos/Lead Based Paint Project Manager.
The only person(s) authorized to change the scope of the project are the representatives of the Asbestos/Lead Based Paint Management Group.
Please sign below showing your acceptance of this authorization and return to the Asbestos/Lead Based Paint Management Group.

CLIENT DEPARTMENT APPROVAL

Name:
Title:
Signature: Date

ACCEPTANCE BY CONSULTANT

Name:
Title:
Signature: Date

DEPT OF PUBLIC WORKS APPROVAL

7/14/10
Darryl Haba, Project Manager Date

Christina Calvery, Project Manager Date

C. Wade Mullin, M. S., Asbestos Manager II Date

Contract Administration Date

CONTRACT ADMINISTRATION INFORMATION

AGREEMENT PERIOD: FY 2010
FUND SOURCE: MISC.
S.A. NO: PA080000031
CHARGE NO: 4870-2307-8040
AMOUNT: $2,795.35

DO. NO:

FORM ASB 36.05/081399

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INVENTORY OF PAINT HOMOGENEOUS MATERIALS

CITY OF AUSTIN REQUEST NO.: 10052L

TERRACON PROJECT NO.: 96107298

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

INSPECTED BY: Terracon – Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

HOMOGENEOUS MATERIALS		FUNCTIONAL SPACES	SAMPLE OR ASSUME S/A	MATERIAL QUANTITY	CONDITION	LEAD CONTENT (PPM)
AREA NO.	DESCRIPTION					
L01	Dark Gray on Medium Blue on Reddish Brown on metal	Lower Pipe Gallery – Mudwell Pump Room, mudwell pump motors and driveshaft covers; Upper Pipe Gallery – Blower Room, blower motors	S	210 sq. ft.	Good to Fair - Chipping	180 ppm
L02	Brown on White on Black on metal	Lower Pipe Gallery – Mudwell Pump Room and north end, mudwell piping	S	~1,385 sq. ft.	Good to Fair - Chipping	180 ppm
L03	Brown on White on Black on metal	Lower Pipe Gallery – Mudwell Pump Room and north end, mudwell piping fittings and pumps	S	695 sq. ft.	Good to Fair - Chipping	69 ppm
L04	Medium Gray on Reddish Brown on metal	Lower Pipe Gallery – Large piping at north end	S	---	Good	<38 ppm
L05	Medium Gray on White on Black on metal	Lower Pipe Gallery – Large piping fittings at north end	S	---	Good	<41 ppm
L06	**Black on metal**	**Lower Pipe Gallery – Sanitary Sewer piping and fittings**	**S**	**~690 sq. ft.**	**Good**	**5,600 ppm**
L07	Light Green on Black on metal	Lower Pipe Gallery – Piping at north end	S	---	Fair to Poor – Chipping Peeling	<47 ppm
L08	Light Green on Black on metal	Lower Pipe Gallery – Piping fittings at north end	S	---	Good to Fair – Chipping Peeling	<38 ppm

INVENTORY OF PAINT HOMOGENEOUS MATERIALS

CITY OF AUSTIN REQUEST NO.: 10052L

TERRACON PROJECT NO.: 96107298

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

INSPECTED BY: Terracon – Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

HOMOGENEOUS MATERIALS		FUNCTIONAL SPACES	SAMPLE OR ASSUME S/A	MATERIAL QUANTITY	CONDITION	LEAD CONTENT (PPM)
AREA NO.	DESCRIPTION					
L09	Turquoise on White on Black on metal	Lower Pipe Gallery - Piping	S	—	Good to Fair – Chipping Peeling	<44 ppm
L10	Turquoise on White on Black on metal	Lower Pipe Gallery – Piping fittings	S	—	Fair to Poor – Chipping Peeling	<43 ppm
L11	Light Gray and Beige on Gray on Reddish Brown on metal	Doors and frames throughout; Control Room Level – Control Room window frame	S	~900 sq. ft.	Good	200 ppm
L12	Bright Yellow on metal	Stair tread edges throughout	S	—	Good to Fair - Weathering	<42 ppm
L13	Brown on White on Black on metal	Upper Pipe Gallery – Backwash piping	S	~2,590 sq. ft.	Good	71 ppm
L14	Brown on White on Black on metal	Upper Pipe Gallery – Backwash piping fittings	S	—	Good	<40 ppm
L15	Medium Gray on White on Black on metal	Upper Pipe Gallery – Influent piping	S	—	Good to Fair – Chipping Peeling	<46 ppm
L16	Medium Gray on White on Black on metal	Upper Pipe Gallery – Influent piping fittings	S	—	Good to Fair – Chipping Peeling	<39 ppm
L17	Black on metal	Upper Pipe Gallery – Sanitary Sewer piping and fittings	S	—	Good	<35 ppm

INVENTORY OF PAINT HOMOGENEOUS MATERIALS

CITY OF AUSTIN REQUEST NO.: 10052L

TERRACON PROJECT NO.: 96107298

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

INSPECTED BY: Terracon – Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

HOMOGENEOUS MATERIALS		FUNCTIONAL SPACES	SAMPLE OR ASSUME S/A	MATERIAL QUANTITY	CONDITION	LEAD CONTENT (PPM)
AREA NO.	DESCRIPTION					
L18	Light Green on White on Black on metal	Upper Pipe Gallery – Process Air piping	S	~1,920 sq. ft.	Good to Fair – Chipping Peeling	150 ppm
L19	Light Green on White on Black on metal	Upper Pipe Gallery – Process Air piping fittings; Control Room Level – 180° Piping fittings southwest of Control Room	S	—	Good to Fair – Chipping Peeling	<44 ppm
L20	Turquoise on White on Black on metal	Upper Pipe Gallery - Piping	S	—	Good to Fair – Chipping Peeling	<42 ppm
L21	Turquoise on White on Black on metal	Upper Pipe Gallery – Piping fittings	S	—	Fair to Poor – Chipping Peeling	<49 ppm
L22	Dark Green on metal	Upper Pipe Gallery – Blower Room, air compressors	S	~90 sq. ft.	Good	150 ppm
L23	Light Gray on Reddish Brown on metal	Upper Pipe Gallery – Backwash Pump Room, pump motors	S	~75 sq. ft.	Good	140 ppm
L24	Light Green on White on CMU and concrete	Upper Pipe Gallery – Electrical Room, south and west interior and exterior walls; Blower Room, interior walls and east exterior wall; Restroom, interior and exterior walls	S	—	Good	<40 ppm
L25	Light Gray on Tan on Black on metal	Control Room Level – Exterior, valve stem shafts at Filter Cells	S	—	Good	<43 ppm

INVENTORY OF PAINT HOMOGENEOUS MATERIALS

CITY OF AUSTIN REQUEST NO.: 10052L

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

TERRACON PROJECT NO.: 96107298

INSPECTED BY: Terracon – Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

HOMOGENEOUS MATERIALS		FUNCTIONAL SPACES	SAMPLE OR ASSUME S/A	MATERIAL QUANTITY	CONDITION	LEAD CONTENT (PPM)
AREA NO.	DESCRIPTION					
L26	Light Green on White on CMU	Control Room Level – Walls outside Control Room, Control Room exterior walls, interior south wall, and partial interior east and west walls	S	---	Good	<44 ppm
L27	Light Green on White on concrete	Control Room Level – Columns, Control Room interior north wall, and partial interior east and west walls	S	---	Good	<48 ppm

BULK PAINT SAMPLE LOG

CITY OF AUSTIN REQUEST NO.: 10052L

TERRACON PROJECT NO.: 96107298

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

INSPECTED BY: Terracon - Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

SAMPLE NO.	PHOTO NUMBER	AREA NUMBER	MATERIAL DESCRIPTION	SAMPLE LOCATION	LEAD CONTENT (PPM)
FB-L01	01	L01	Dark Gray on Medium Blue on Reddish Brown on metal	Lower Pipe Gallery – Mudwell Pump Room, east mudwell pump motor and driveshaft cover	180 ppm
FB-L02	02	L02	Brown on White on Black on metal	Lower Pipe Gallery – Mudwell Pump Room, pipe at east mudwell pump	180 ppm
FB-L03	03	L03	Brown on White on Black on metal	Lower Pipe Gallery – Mudwell Pump Room, pipe fitting at east mudwell pump	69 ppm
FB-L04	04	L04	Medium Gray on Reddish Brown on metal	Lower Pipe Gallery – North end, east side large pipe	<38 ppm
FB-L05	05	L05	Medium Gray on White on Black on metal	Lower Pipe Gallery – North end, east side pipe fitting	<41 ppm
FB-L06	**06**	**L06**	**Black on metal**	**Lower Pipe Gallery – Sanitary Sewer pipe at north end, central area, at wall**	**5,600 ppm**
FB-L07	07	L07	Light Green on Black on metal	Lower Pipe Gallery – North end, central area, pipe	<47 ppm
FB-L08	08	L08	Light Green on Black on metal	Lower Pipe Gallery – North end, east side pipe fitting	<38 ppm
FB-L09	09	L09	Turquoise on White on Black on metal	Lower Pipe Gallery – South end, west side pipe	<44 ppm
FB-L10	10	L10	Turquoise on White on Black on metal	Lower Pipe Gallery – South end, east side pipe fitting	<43 ppm
FB-L11	11	L11	Light Gray and Beige on Gray on Reddish Brown on metal	Lower Pipe Gallery – North and south doors and frames (composite)	200 ppm

BULK PAINT SAMPLE LOG

CITY OF AUSTIN REQUEST NO.: 10052L

TERRACON PROJECT NO.: 96107298

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

INSPECTED BY: Terracon - Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

SAMPLE NO.	PHOTO NUMBER	AREA NUMBER	MATERIAL DESCRIPTION	SAMPLE LOCATION	LEAD CONTENT (PPM)
FB-L12	12	L12	Bright Yellow on metal	Upper Pipe Gallery – South end stair tread edge	<42 ppm
FB-L13	13	L13	Brown on White on Black on metal	Upper Pipe Gallery – South end, west side, Backwash pipe	71 ppm
FB-L14	14	L14	Brown on White on Black on metal	Upper Pipe Gallery – South end, east side, Backwash pipe fitting	<40 ppm
FB-L15	15	L15	Medium Gray on White on Black on metal	Upper Pipe Gallery – South-central area, west side, Influent pipe	<46 ppm
FB-L16	16	L16	Medium Gray on White on Black on metal	Upper Pipe Gallery – South end, west side, Influent pipe fitting	<39 ppm
FB-L17	17	L17	Black on metal	Upper Pipe Gallery – South end, central area, at wall, Sanitary Sewer pipe	<35 ppm
FB-L18	18	L18	Light Green on White on Black on metal	Upper Pipe Gallery – North end, west side, Process Air pipe	150 ppm
FB-L19	19	L19	Light Green on White on Black on metal	Upper Pipe Gallery – North end, east side, Process Air pipe fitting	<44 ppm
FB-L20	20	L20	Turquoise on White on Black on metal	Upper Pipe Gallery – North end, west side, pipe	<42 ppm
FB-L21	21	L21	Turquoise on White on Black on metal	Upper Pipe Gallery – North end, east side, pipe fitting	<49 ppm
FB-L22	22	L22	Dark Green on metal	Upper Pipe Gallery – Blower Room, north air compressor	150 ppm
FB-L23	23	L23	Light Gray on Reddish Brown on metal	Upper Pipe Gallery --Backwash Pump Room, Pump #1 motor	140 ppm

BULK PAINT SAMPLE LOG

CITY OF AUSTIN REQUEST NO.: 10052L

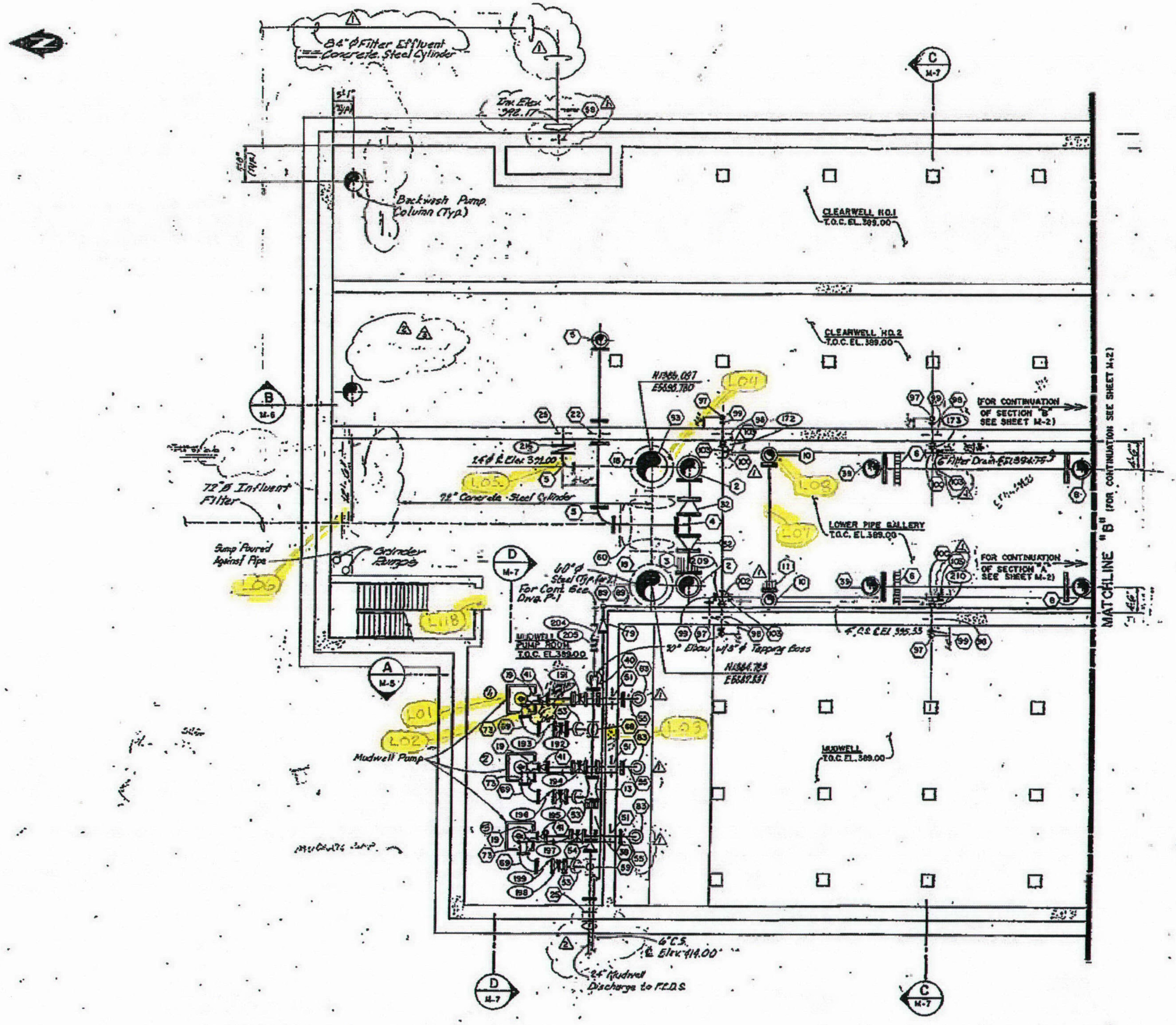
TERRACON PROJECT NO.: 96107298

BUILDING/AREA: S.A.R. WWTP – Filter Building
13009 Fallwell Lane, Austin, Texas 78617

INSPECTED BY: Terracon - Glenn Shrode and Kenneth Williamson

DATE INSPECTED: July 27, 2010

SAMPLE NO.	PHOTO NUMBER	AREA NUMBER	MATERIAL DESCRIPTION	SAMPLE LOCATION	LEAD CONTENT (PPM)
FB-L24	24	L24	Light Green on White on CMU and concrete	Upper Pipe Gallery – Electrical Room, south interior wall, at door	<40 ppm
FB-L25	25	L25	Light Gray on Tan on Black on metal	Control Room Level – Exterior, valve stem shaft at east-central Filter Cell	<43 ppm
FB-L26	26	L26	Light Green on White on CMU	Control Room Level – Wall at northeast door	<44 ppm
FB-L27	27	L27	Light Green on White on concrete	Control Room Level – Control Room, north wall, central area	<48 ppm



FITTING SCHEDULE

⬡	FITTINGS
1	20" Tee Fl.
2	20" 90° Ell. Fl.
3	20" Fl. Adapter, Dresser 128
4	24" Tee Fl.
5	24", 90° Ell. Fl.
6	42" Fl. Adapter, Dresser 128
7	20"x24" Conc. Red. Fl.
8	24"x42" Tee Fl.
9	42" 90° Ell. Fl.
10	12" 90° Ell. Fl.
11	12" Fl. Adapter, Dresser 118
12	12" Tee Fl.
13	14" Flow Meter
14	12" Wall Pipe Fl.
16	42"x60" 90° Red. Ell., Fl.
17	60" Wall Pipe Fl.x P.E.
18	60"x72" 90° Red. Ell. P.E.x Fl
19	12" Flexible Connector Fl
20	36" Wall Pipe M.J. x P.E.
21	42" Wall Pipe Fl.
22	24" Wall Pipe Fl.
23	24" 45° Ell., Fl.
25	24" Wall Pipe Fl, P.E.
26	24" 90° Ell. P.O.
31	42" Wall Pipe P.E. x M.J.
32	20"x24" Conc. Red. Fl.
33	42" Wall Pipe Fl x PE
35	48" 90° Ell. P.O.
36	48" Wall Pipe P.E. x P.O.
37	84" 90° Ell. P.O.
38	14" Flanged Adapt.
39	24"x42" 90° Red. Ell., Fl.
40	24"x14" Red. Ell., Fl.
41	12"x16" Ecc. Red. Fl.
43	36" 90° Ell. P.O.x PE
44	48"x48"x36" Tee P.O.
46	4" 45° Ell., Fl.
47	4" Wall Pipe Fl x PE
48	4" 90° Ell., Fl.
50	16" Wall Pipe Fl x P.E.
51	16" Wall Pipe, Fl
52	16" Blind Flange.
53	16" 45° Ell Fl.
54	24"x16" Conc. Red., Fl
55	16" 90° Ell., Fl.
56	24" Blind Flange
57	12" Wall Pipe Fl x PE
58	84" Wall Pipe PE x P.O
59	16"x24" Red. Ell., Fl.
60	72" Tee, P.O.
61	6" 90° Ell, Sch. Weld
64	12" Flow Meter
67	24" 90° L.R. Ell., Fl
68	24"x16" Red. Tee, Fl
69	16"x10" Red. Ell., Fl.
72	24" Wall Pipe, Fl.
73	10" Flex Connector, Fl.
75	24" Flow Meter
76	24" Fl. Adapter, Dresser 128
77	24"x18" Red. Ell., Fl.
78	18" 45° Ell. Fl.
79	6"x4" Conc. Red. S.W.
80	18" 90° Ell., Fl
81	18" Tee, Fl.
82	40" MJ Plug
83	16" Flare Casting
84	48"x36" Conc. Red.
85	4"x2" Conc. Red., S.W.
86	4"x2" Red. Tee, S.W.
87	42" MJ Plug
88	60" Dresser Coupling, Style 38
89	4" 90° Ell. S.W.
90	24" Fl. Adapter, Dresser 128
91	18" Wall Pipe, Fl. x P.E.
92	18"x24" 90° Red. Ell., Fl.
93	60"x60"x24" Fl. x P.E. x P.E.
94	48" Tee, P.O.
95	60"x36"x60" Tee, P.O
96	60" 90° Ell., P.O.
97	6" Wall Pipe Fl x PE
98	6" Wall Pipe, Fl
99	6" 90° Ell. Fl.
100	6" Tee, Fl
101	48"x60" Ecc. Red. P.O.
102	6" Cross, Fl.
103	6" Fl. Adapter, Dresser 128
104	40" 45° Ell. P.O.
105	12" Tapping Saddle for 2" Tapping
106	12" 45° Ell., Fl.
107	16"x24" Conc. Red., Fl
108	10"x16" Conc. Red., Fl.
109	10"x18" 90° Red. Ell., Fl

RECORD DRAWING
PREPARED BY ______
DATE ______

NO.	DATE	REVISION	APPROV.
4			
3	1-15-87	MODIFICATION NO. 4 RE-EVALUATION	STW
2	10-13-86	MODIFICATION NO. 4 -	DRJ
1	5/86	Addendum No. 1 Filter Drain Revised	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
PLAN @ ELEV. 396.00 SHEET 1

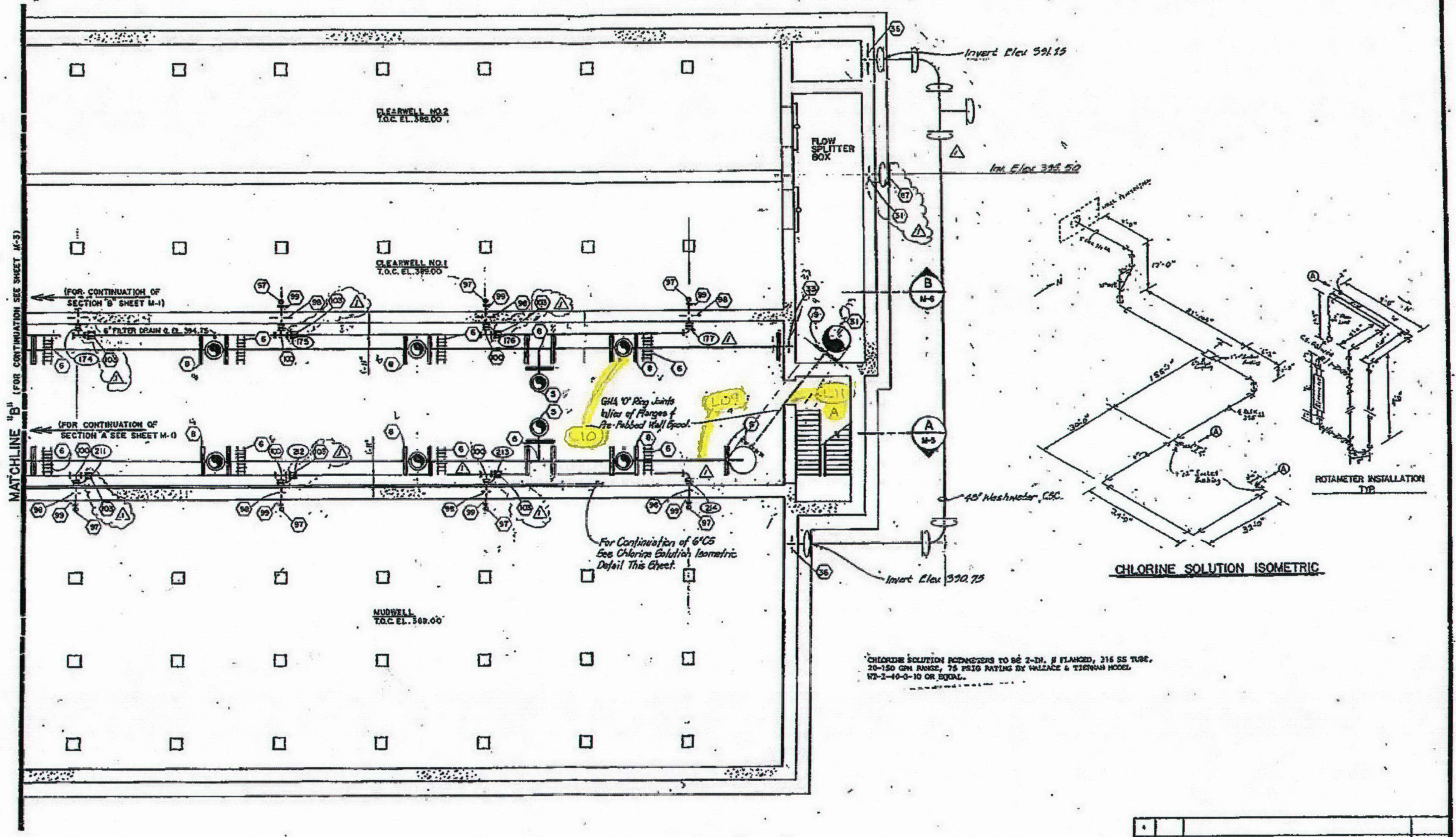
Turner Collie & Braden Inc.
CONSULTING ENGINEERS
TEXAS AUSTIN DALLAS HOUSTON FORT ARTHUR
COLORADO DENVER

5-31-86

Unit WILLIAMS	Scale 1/8" = 1'-0"	Date JUNE, 1986
Designed TPC	Checked STW	Job No. 72-07109-132 Contract 3
Drawn DSS	Approved TLB	Sheet 52 of 122

Dwg. No. M-1

ADDENDUM No. 2 Sht. 55 of 64



CHLORINE SOLUTION ISOMETRIC

ROTAMETER INSTALLATION TYP.

CHLORINE SOLUTION ROTAMETERS TO BE 2-IN. Ø FLANGED, 316 SS TUBE, 20-150 GPM RANGE, 75 PSIG RATING BY WALLACE & TIERNAN MODEL WT-2-40-G-10 OR EQUAL.

RECORD DRAWING
PREPARED BY ________
DATE ________

NO.	DATE	REVISION	APPROV.
4			
3			
2			
△ 1	9/25/86	Addendum No.2 WSHW Line Added	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
PLAN @ ELEV. 396.00 SHEET 2

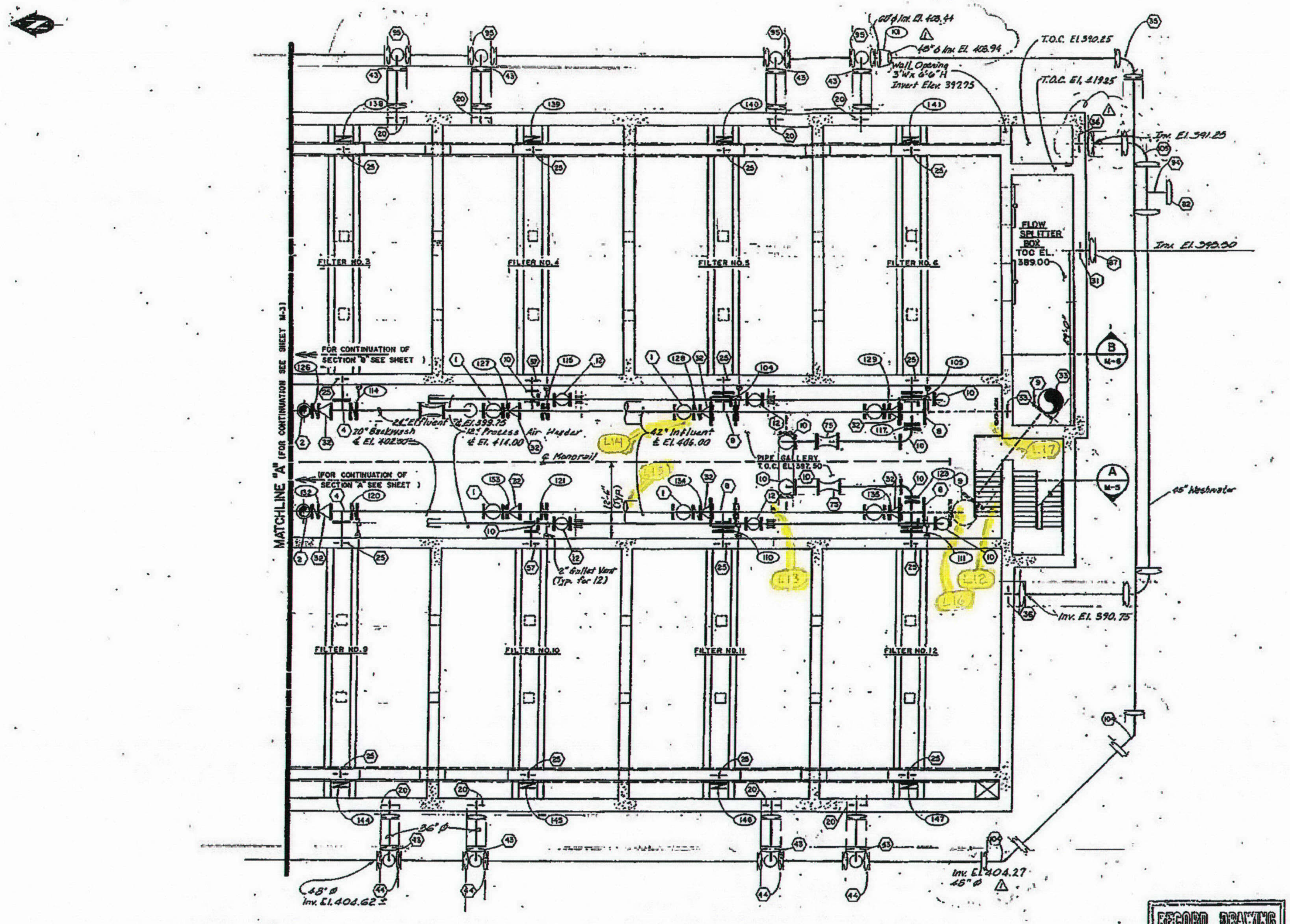
Turner Collie & Braden Inc.
CONSULTING ENGINEERS
TEXAS AUSTIN DALLAS HOUSTON PORT ARTHUR
COLORADO DENVER

STANLEY F. WILLIAMS 51295
Stanley F. Williams 5-31-86

Unit WILLIAMS	Scale 1/8" = 1'-0"	Date JUNE, 1986
Designed TPC	Checked STW	Job No. 72-07109-102 Contract 3
Drawn DSS	Approved TLB	Sheet 53 of 122

Dwg. No. M-2

ADDENDUM No.2 Sht 56 of 64



RECORD DRAWING
PREPARED BY: ________
DATE ________

4			
3			
2			
1	9/12/86	Addendum No. 1 Filter Overflow Line Revised	
NO.	DATE	REVISION	APPROV.

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
PLAN @ ELEV. 417.00 SHEET 2

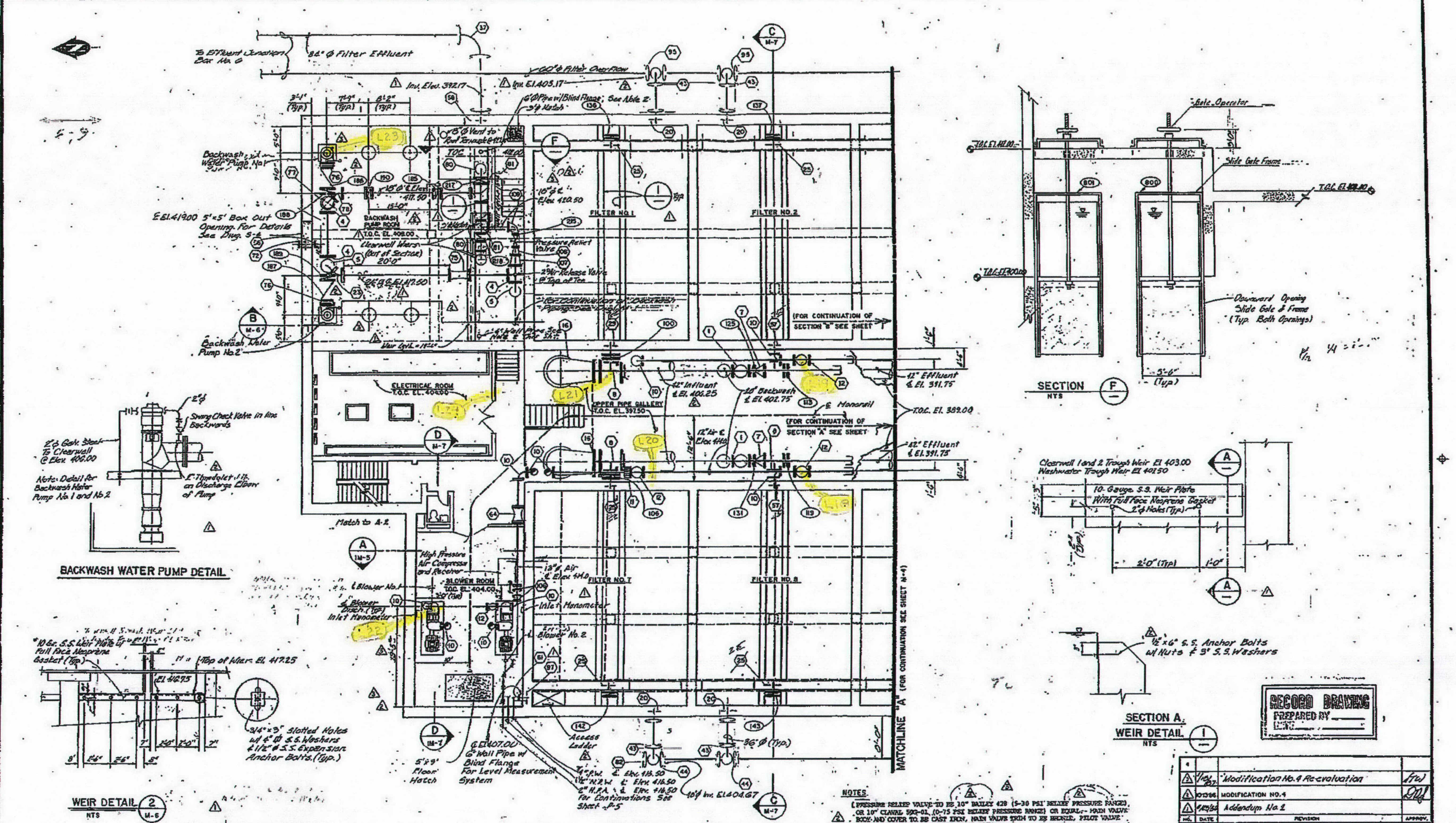
Turner Collie & Braden Inc.
CONSULTING ENGINEERS
TULSA AUSTIN DALLAS HOUSTON FORT WORTH
COLORADO DENVER

Rocky L. Williams 5-21-86

Unit WILLIAMS	Scale 1/8" = 1'-0"	Date JUNE, 1986
Designed TPC	Checked STW	Job No. 72-07109-102 Contract 3
Drawn DSS	Approved TLB	Sheet 55 of 122.

Drwg. No. M-4 L1

ADDENDUM No. 2 Sht. 58 of 64.



RECORD DRAWING
PREPARED BY ______
DATE ______

NOTES.

1. PRESSURE RELIEF VALVE TO BE 10" BAILEY 428 (5-30 PSI RELIEF PRESSURE RANGE), OR 10" CLAVAL 50G-01 (0-75 PSI RELIEF PRESSURE RANGE) OR EQUAL. MAIN VALVE BODY AND COVER TO BE CAST IRON, MAIN VALVE TRIM TO BE BRONZE, PILOT VALVE TO BE BRONZE WITH STAINLESS STEEL TRIM.
2. 6" WALL PIPE TO BE FL. X WALL COLLAR X P.E. LOCATE FLG. 6" A.F.F., & INSTALL BLIND FLG. P.E. TO BE FLUSH WITH UNDERSIDE OF SLAB.

No.	Date	Revision	Approv.
4			
3	11/87	Modification No. 4 Re-evaluation	
2	07/86	MODIFICATION NO. 4	
1	4/85	Addendum No. 2	

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
PLAN @ ELEV. 417.00 SHEET 1

Turner Collie & Braden Inc.
CONSULTING ENGINEERS

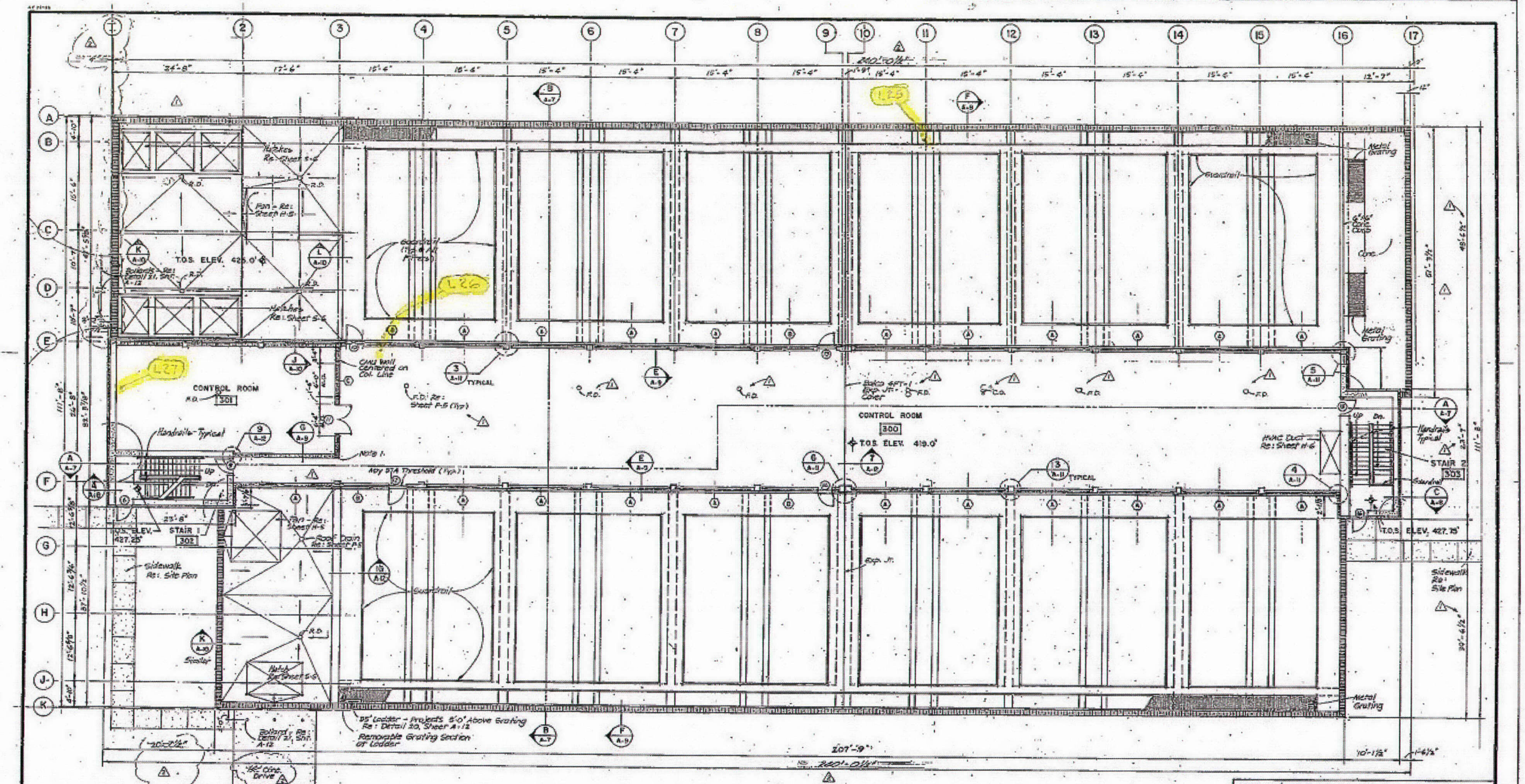
STANLEY T. WILLIAMS
51103

Bailey T. Williams 5-31-86

Dwg. No. M-3

Unit WILLIAMS	Scale 1/8" = 1'-0"	Date JUNE, 1986
Designed TPC	Checked STW	Job No. 72-07109-102 Contract 3
Drawn DSS	Approved TLB	Sheet 54 of 122

ADDENDUM No. 2 Sht. 57 of 64



FLOOR PLAN

SCALE : 1/8" = 1'-0"

KEY TO ABBREVIATIONS:

T.O.S. = TOP OF SLAB
E.J. = EXPANSION JOINT
R.D. = ROOF DRAIN
F.D. = FLOOR DRAIN
C.O. = CLEAN OUT

KEY TO MATERIALS:

▨	CONCRETE
▨	C.M.U.
▨	FACE BRICK
▥	ROWLOCK BRICK

NOTES:

1- BULLNOSE ALL CMU OUTSIDE CORNERS
2- REF. S-18 FOR HANDRAIL AND GUARDRAIL DETAILS
3- REF. STRUCT'L FOR STAIR SECTIONS AND DETAILS

RECORD DRAWING
PREPARED BY ______
DATE ______

PONCIANO MORALES III ARCHITECT A.I.A.

NO.	DATE	REVISION	APPROV.
4			
3			
2	9/86	MODIFICATION No. 4	Dmm
1	6/25/86	ADDENDUM No. 2	EM.B

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

FILTER BUILDING
FLOOR PLAN AT CONTROL ROOM LEVEL

Turner Collie & Braden Inc.
CONSULTING ENGINEERS

Unit WILLIAMS	Scale AS NOTED	Date JUNE, 1986
Designed M.S.	Checked PMH	Job 20-7-20110-402 Contract 3
Drawn M.S.	Approved T.L.S.	Sheet 24 of 122

Dwg No. A-3

ADDENDUM No 2 Sht 33 of 64

Laboratories

Environmental Hazards Services, L.L.C.
7469 Whitepine Rd
Richmond, VA 23237
Telephone: 800.347.4010

Lead Paint Chip Analysis Report

Report Number: 10-07-04321

Client: Terracon - Austin
5307 Industrial Oaks Blvd.
Suite 160
Austin, TX 78735

Received Date: 07/30/2010
Analyzed Date: 08/03/2010
Reported Date: 08/03/2010

Project/Test Address: 96107298 - S.A.R. WWTP; Filter Building
Collection Date: 07/27/2010

Client Number: 45-3685

Laboratory Results

Fax Number: 512-442-1181

Lab Sample Number	Client Sample Number	Collection Location	Pb (ug/g) ppm	% Pb by Wt.	Narrative ID
10-07-04321-001	FB-L1		180	0.018	
10-07-04321-002	FB-L2		180	0.018	
10-07-04321-003	FB-L3		69	0.0069	
10-07-04321-004	FB-L4		<38	<0.0038	
10-07-04321-005	FB-L5		<41	<0.0041	
10-07-04321-006	FB-L6		5600	0.56	
10-07-04321-007	FB-L7		<47	<0.0047	
10-07-04321-008	FB-L8		<38	<0.0038	
10-07-04321-009	FB-L9		<44	<0.0044	
10-07-04321-010	FB-L10		<43	<0.0043	
10-07-04321-011	FB-L11		200	0.020	

Client Number: 45-3685 **Report Number:** 10-07-04321

Project/Test Address: 96107298 - S.A.R. WWTP; Filter Building

Lab Sample Number	Client Sample Number	Collection Location	Pb (ug/g) ppm	% Pb by Wt.	Narrative ID
10-07-04321-012	FB-L12		<42	<0.0042	
10-07-04321-013	FB-L13		71	0.0071	
10-07-04321-014	FB-L14		<40	<0.0040	
10-07-04321-015	FB-L15		<46	<0.0046	
10-07-04321-016	FB-L16		<39	<0.0039	
10-07-04321-017	FB-L17		<35	<0.0035	
10-07-04321-018	FB-L18		150	0.015	
10-07-04321-019	FB-L19		<44	<0.0044	
10-07-04321-020	FB-L20		<42	<0.0042	
10-07-04321-021	FB-L21		<49	<0.0049	
10-07-04321-022	FB-L22		150	0.015	
10-07-04321-023	FB-L23		140	0.014	
10-07-04321-024	FB-L24		<40	<0.0040	
10-07-04321-025	FB-L25		<43	<0.0043	
10-07-04321-026	FB-L26		<44	<0.0044	
10-07-04321-027	FB-L27		<48	<0.0048	

Client Number: 45-3685 **Report Number:** 10-07-04321
Project/Test Address: 96107298 - S.A.R. WWTP; Filter Building

Lab Sample Number	Client Sample Number	Collection Location	Pb (ug/g) ppm	% Pb by Wt.	Narrative ID

Method: EPA SW846 7420
Accreditation #: TX T104704248-07TX

Reviewed By Authorized Signatory:

DeeDee Bray

The HUD lead guidelines for lead paint chips are 0.50% by Weight, 5000 ppm, or 1.0 mg/cm². The Reporting Limit (RL) is 10.0 ug Total Pb. Paint chip area and results are calculated based on area measurements determined by the client. All internal quality control requirements associated with this batch were met, unless otherwise noted.

The condition of the samples analyzed was acceptable upon receipt per laboratory protocol unless otherwise noted on this report. Results represent the analysis of samples submitted by the client. Sample location, description, area, volume, etc., was provided by the client. If the report does not contain the result for a field blank, it is due to the fact that the client did not include a field blank with their samples. EHS sample results do not reflect blank correction. This report shall not be reproduced except in full, without the written consent of the Environmental Hazards Service, L.L.C. California Certification #2319 NY ELAP #11714.

LEGEND
Pb= lead
ug = microgram
ppm = parts per million
ug/g = micrograms per gram
Wt. = weight

1-800-347-4010

ENVIRONMENTAL HAZARDS SERVICES, L.L.C.
7469 Whitepine Road Richmond, Virginia 23237 Phone (804) 275-4788 Fax (804) 275-4907

CHAIN OF CUSTODY FORM

Company Name: Terracon Consultants, Inc.
Address: 5307 Industrial Oaks Blvd., Suite 160
City, State, Zip: Austin, TX 78735
EHS Client Account #: 45-3685 A
Phone #: (512) 442-1122 **Fax #:** (512) 442-1181
P.O. #: N/A

Date: 07-28-10
Contact Name: GLENN SHRODE
Sampler Name: GLENN SHRODE
Project #: 96107298 - S.A.R. WWTP
FILTER BUILDING

10-07-04321
Due Date:
08/04/2010
(Wednesday)
3E

TC

Sample Number	Sample Date	Asbestos						Lead								Other Metals (Specify metals below)					Indoor Air Quality						Particul	
		Bulk ID by PLM	(PCM) Fiber Count	PLM Point Count	PLM Gravimetric	TEM AHERA (Air)	TEM Chatfield (Bulk)	Air	Paint (%)	Paint (PPM)	Paint (mg/cm^2)	Soil	Wipe * (See Note)	TCLP (Pb)	Waste Water	TCLP RCRA 8	Welding Fume	Toxic Metal Profile			Biocassette	Slide	Surface Swab	Surface Tape	Bulk	Culturable ♦	Air V Wipe S Area	
1, FB-L01	07.27.10									*																		REPORT IN PPM
↓ THRU	↓									*																		↓
27 FB-L27										*																		
BH																												

* Do wipe samples submitted meet ASTM E1792 requirements? Yes ☐ No ☐

Released by: GLENN SHRODE	Signature:	Date/Time: 07-28-10
Received by: COURIER - FEDEX	Signature:	Date/Time:
Released by:	Signature:	Date/Time:
Received by: BH	Signature:	Date/Time: 7/30/10

revised 2/2002

Photo 1 **Sample FB-L01**

Photo 2 **Sample FB-L02**

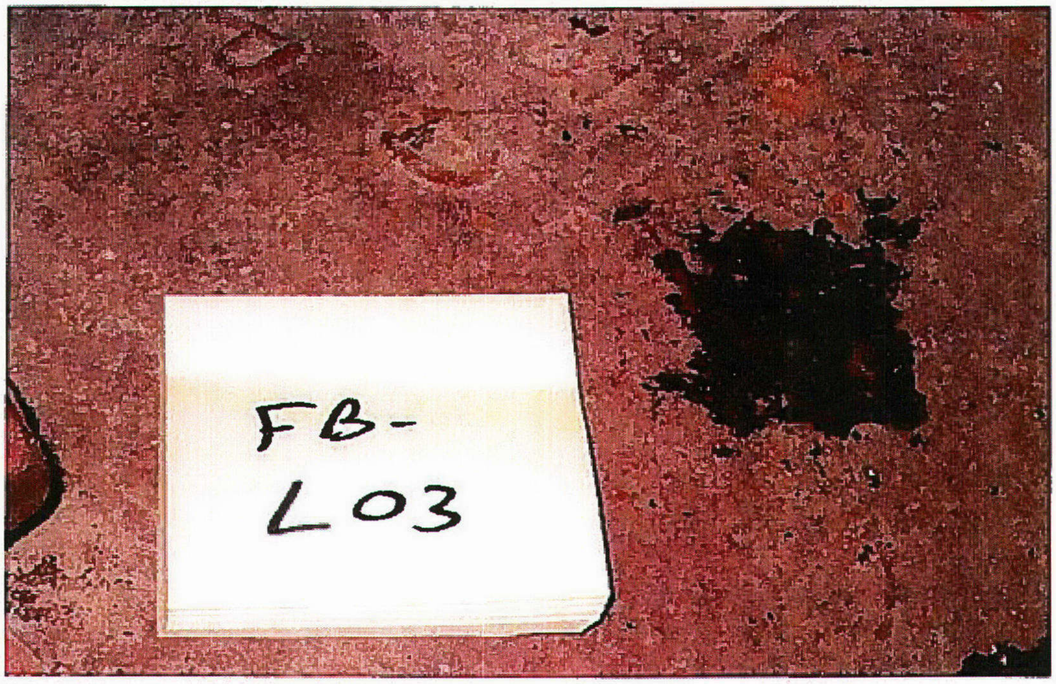


Photo 3 **Sample FB-L03**

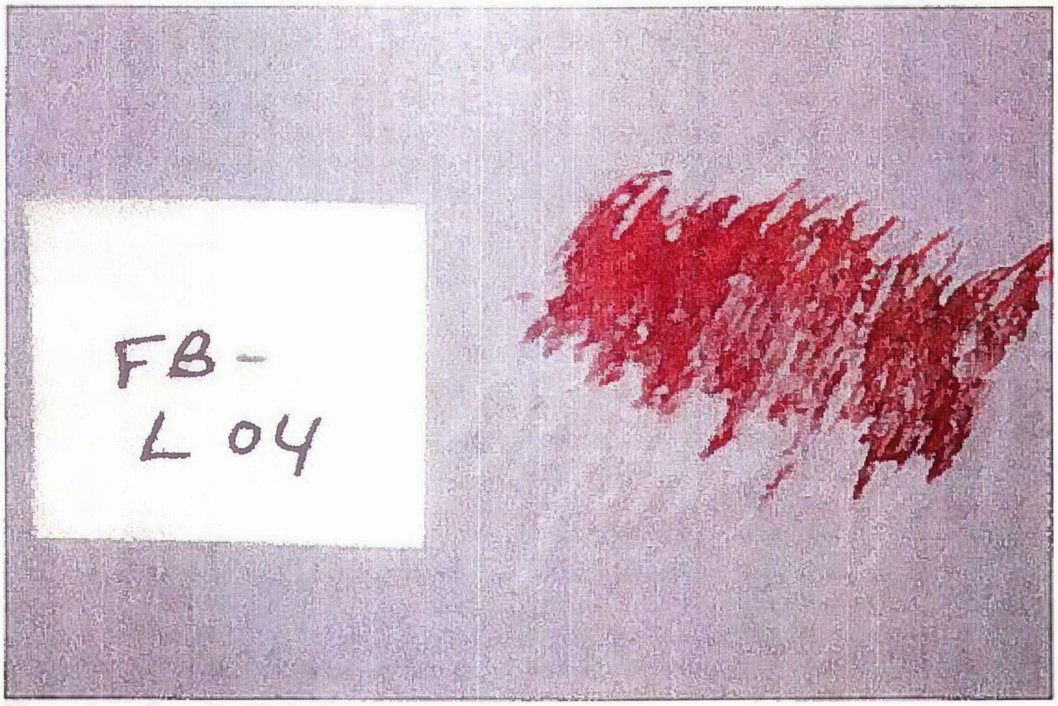


Photo 4 **Sample FB-L04**

Photo 5 Sample FB-L05

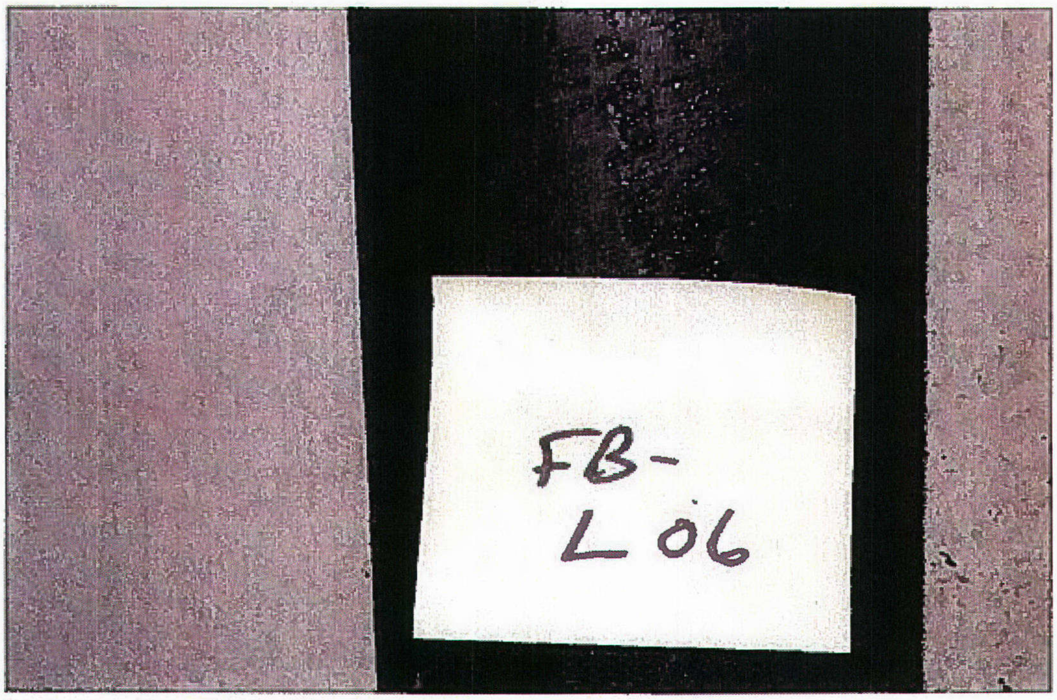


Photo 6 Sample FB-L06

Photo 7 Sample FB-L07

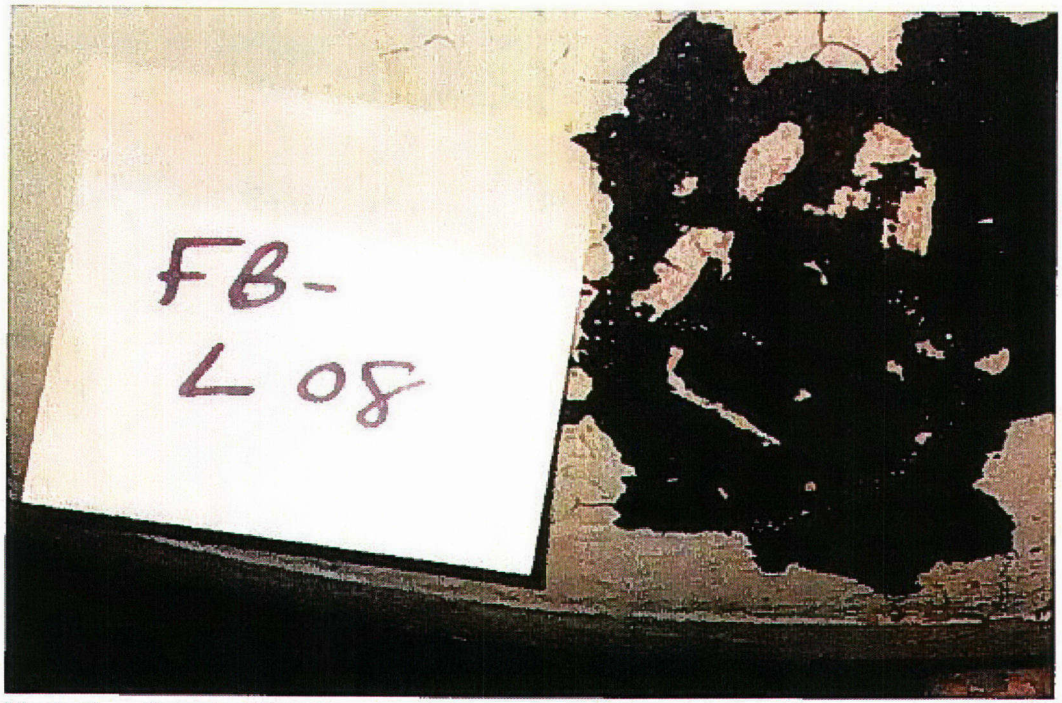


Photo 8 Sample FB-L08

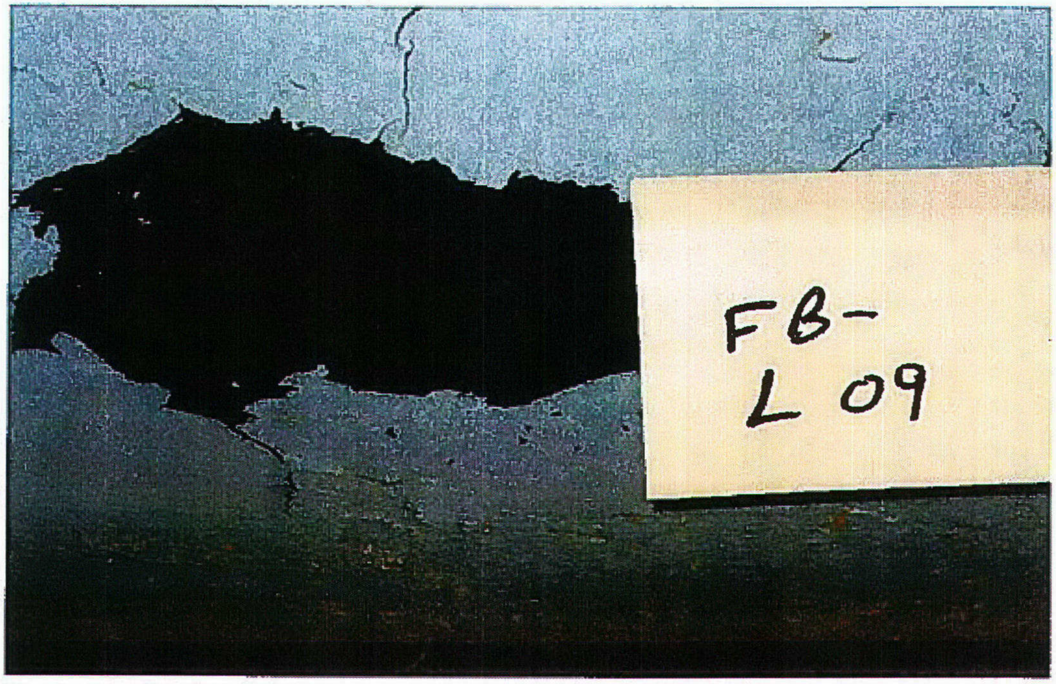


Photo 9 **Sample FB-L09**

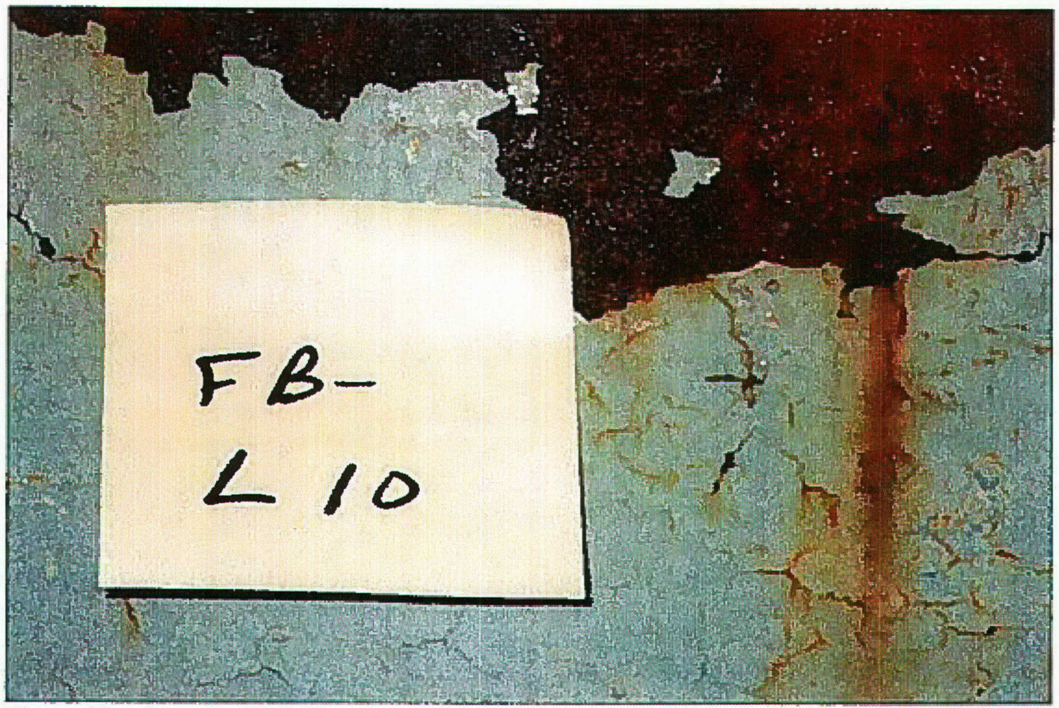


Photo 10 **Sample FB-L10**

Photo 11 Sample FB-L11

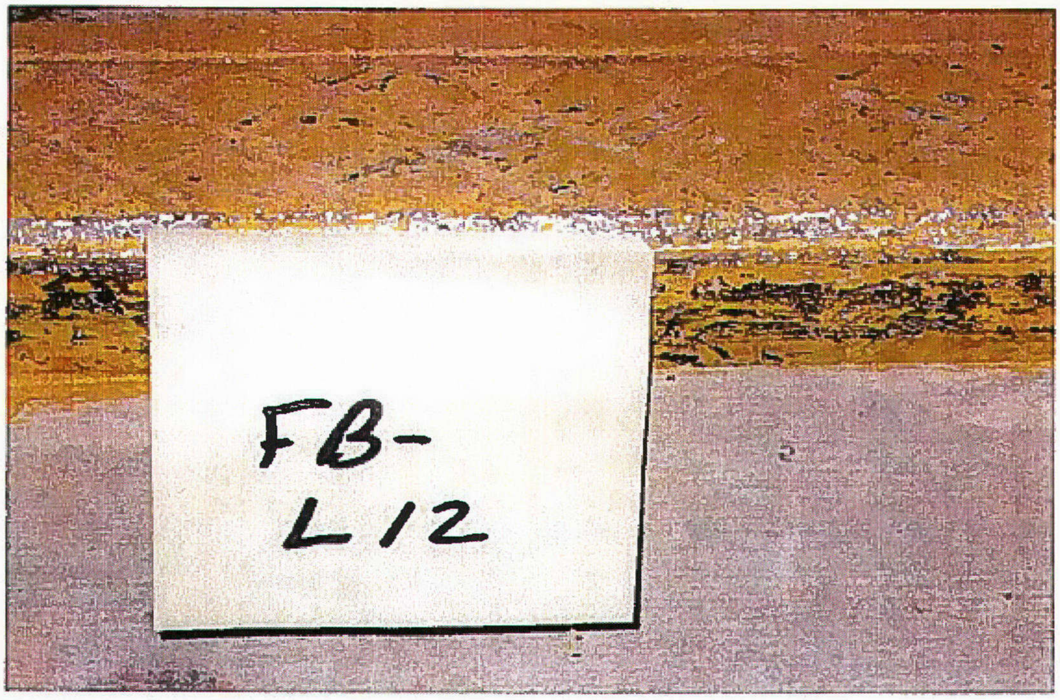


Photo 12 Sample FB-L12

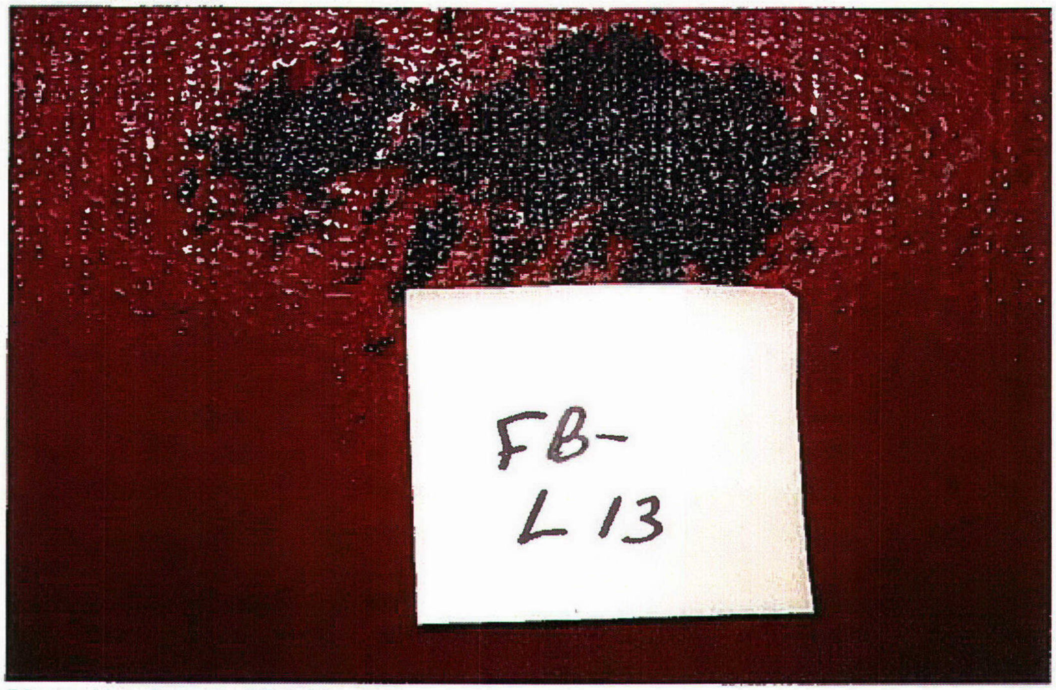


Photo 13 Sample FB-L13

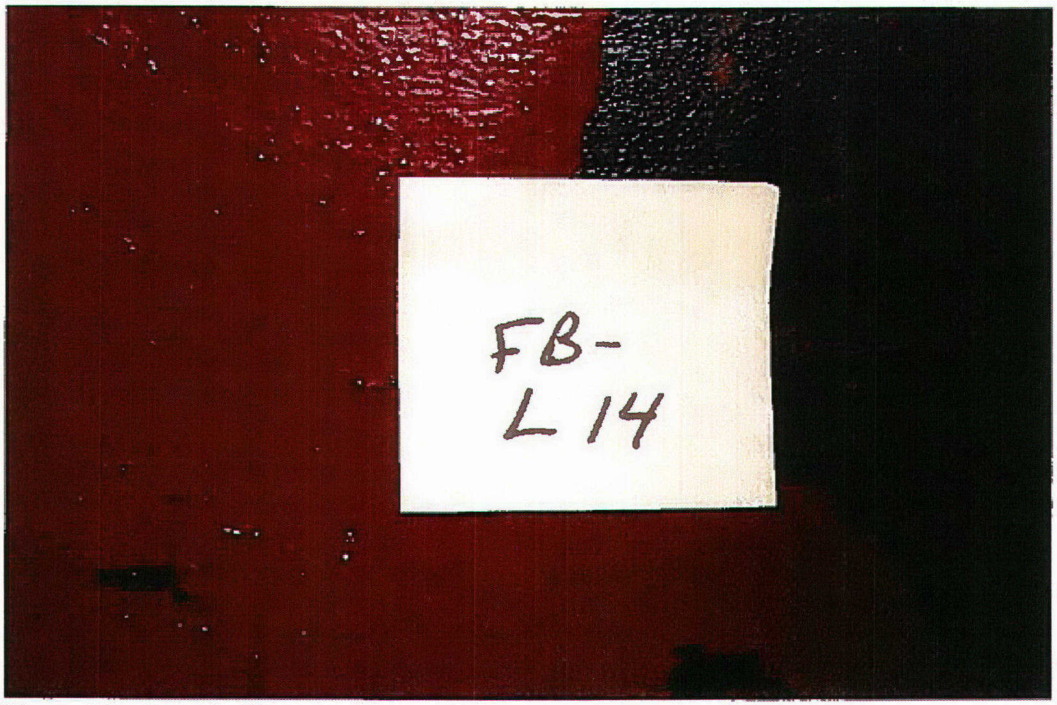


Photo 14 Sample FB-L14

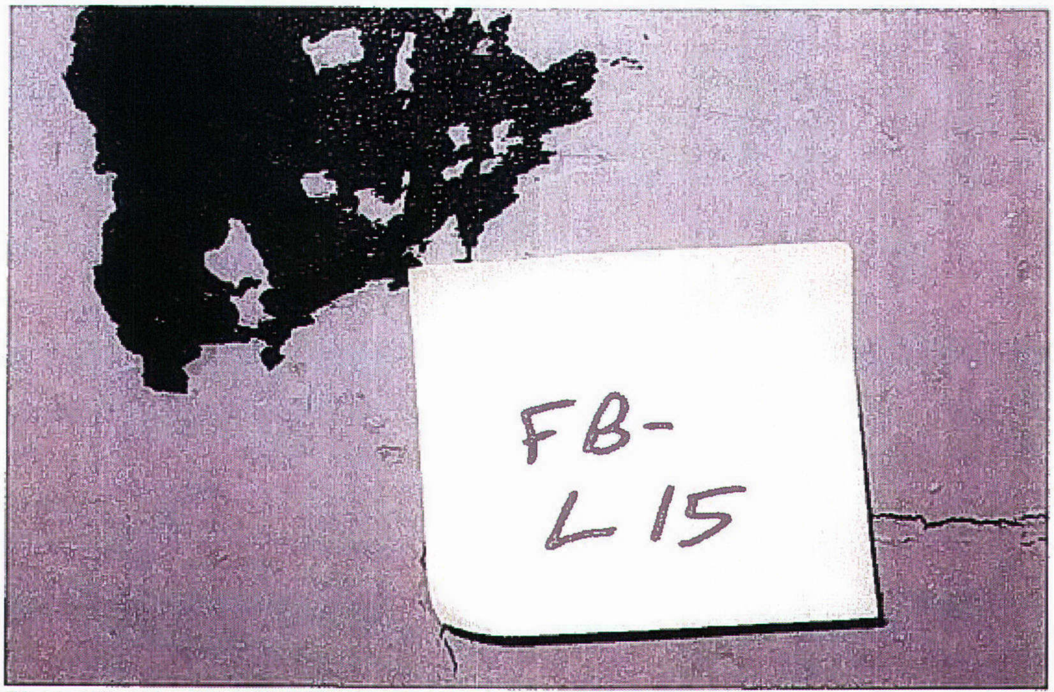


Photo 15 Sample FB-L15

Photo 16 Sample FB-L16

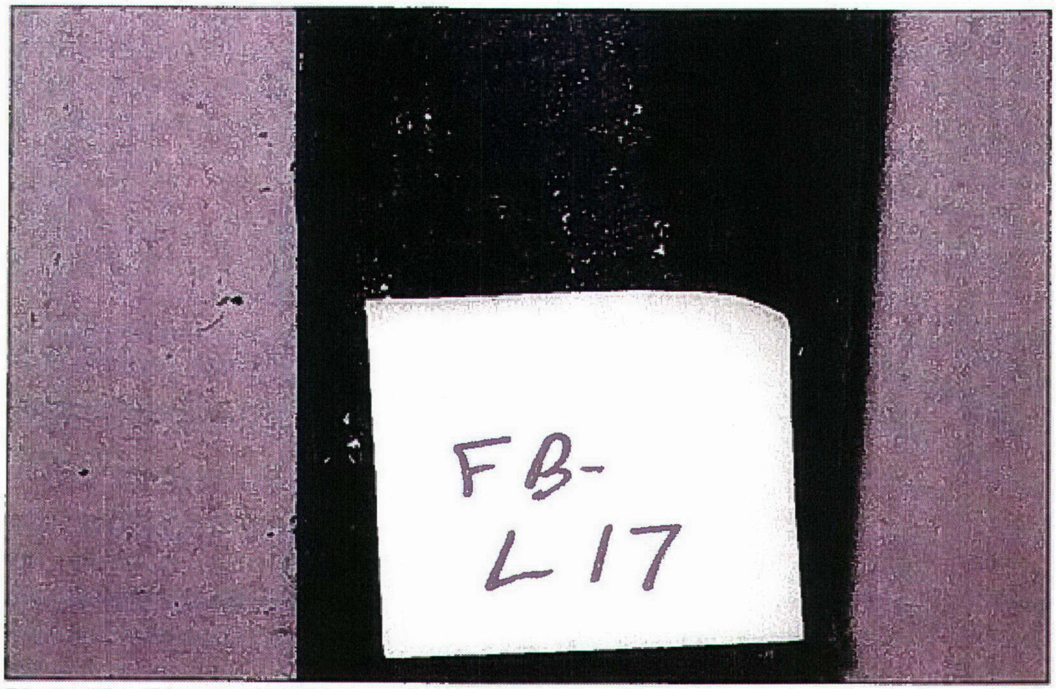


Photo 17 **Sample FB-L17**

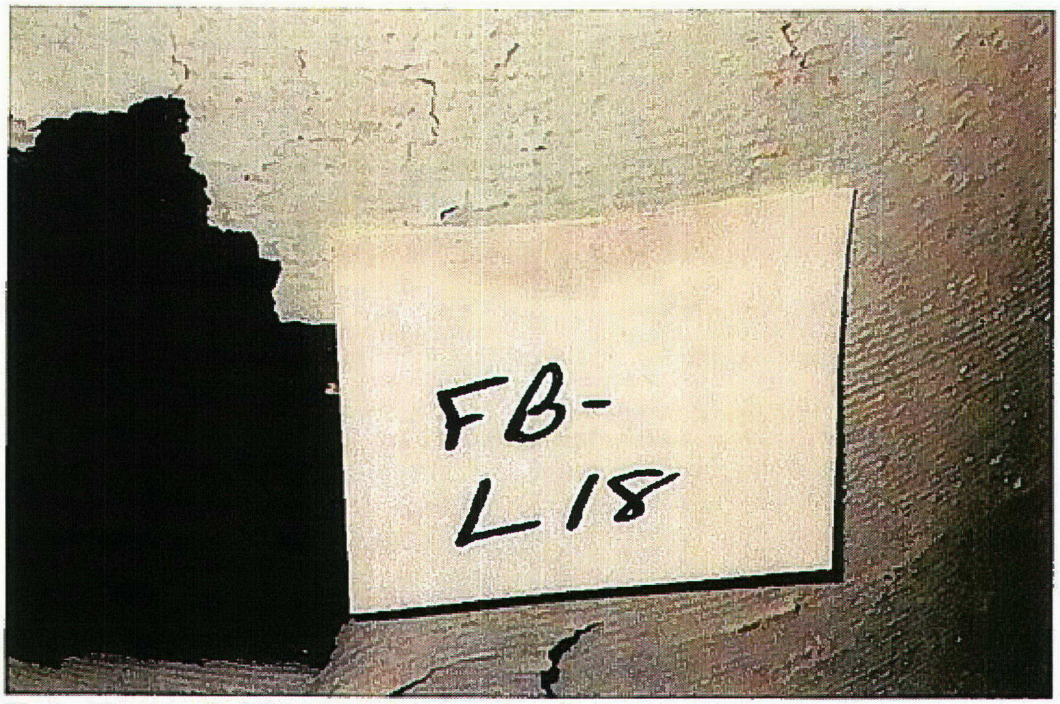


Photo 18 **Sample FB-L18**

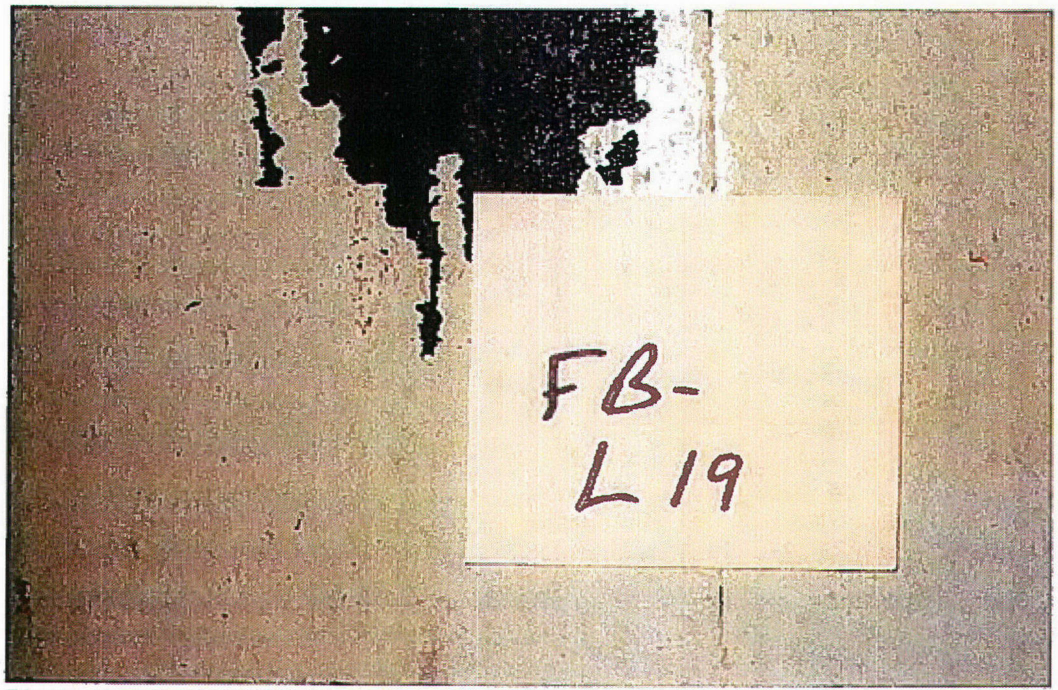


Photo 19 Sample FB-L19

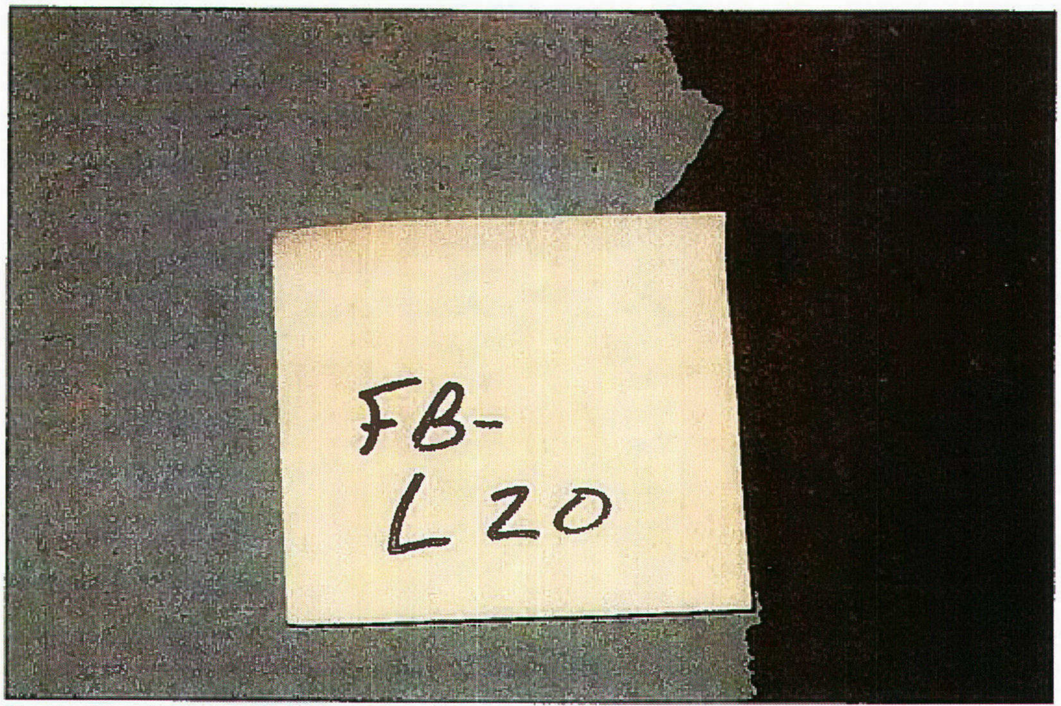


Photo 20 Sample FB-L20

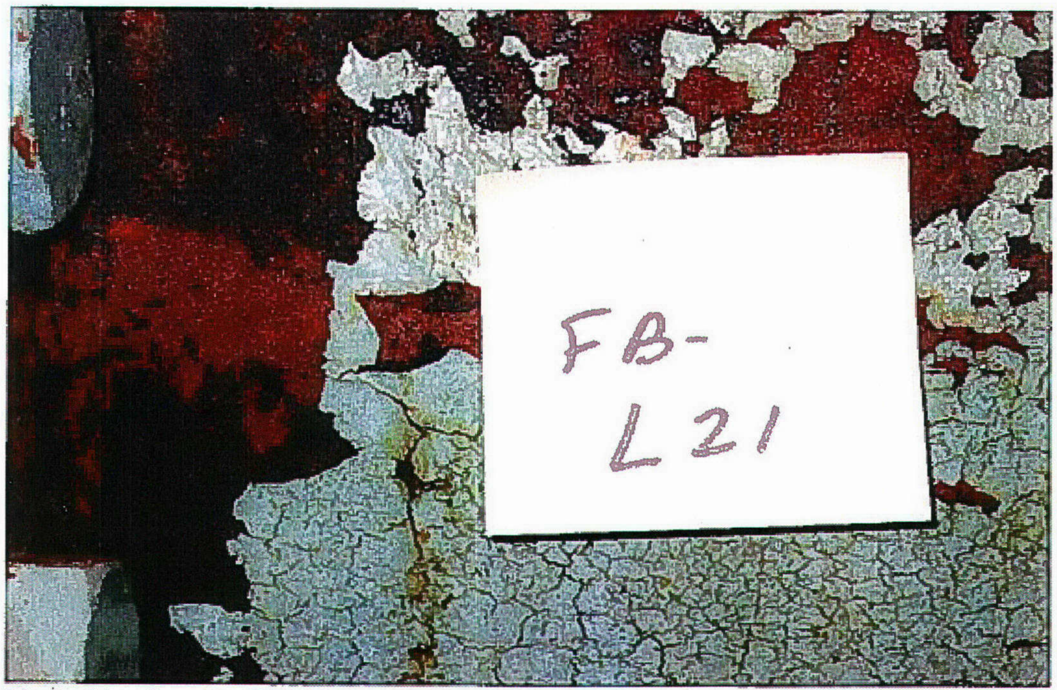


Photo 21 Sample FB-L21

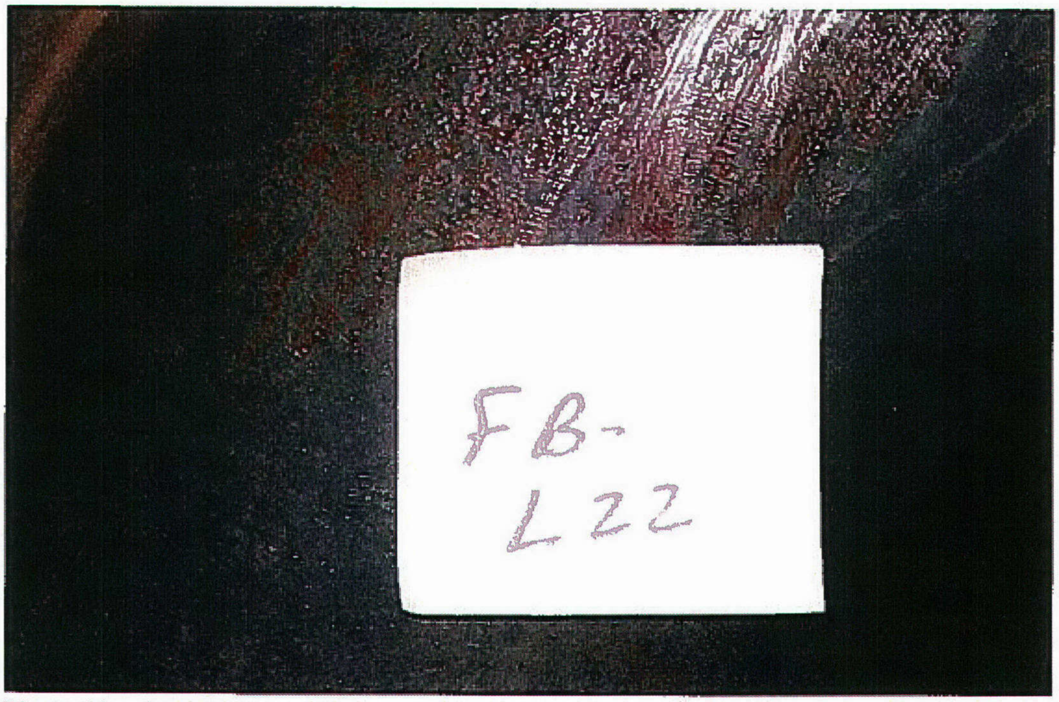


Photo 22 Sample FB-L22

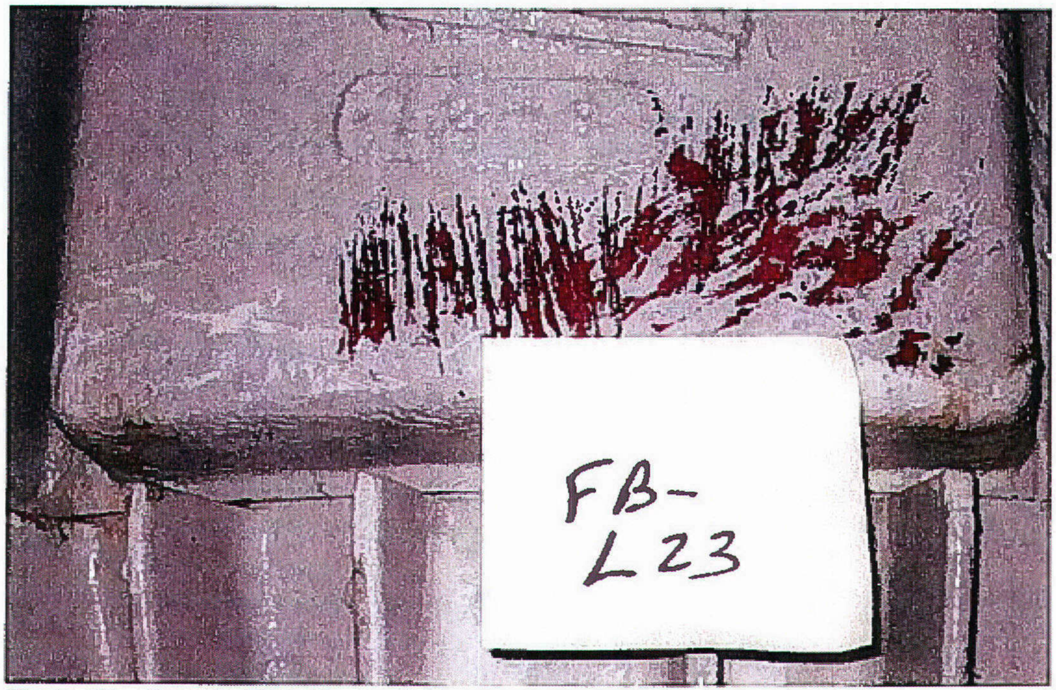


Photo 23 **Sample FB-L23**

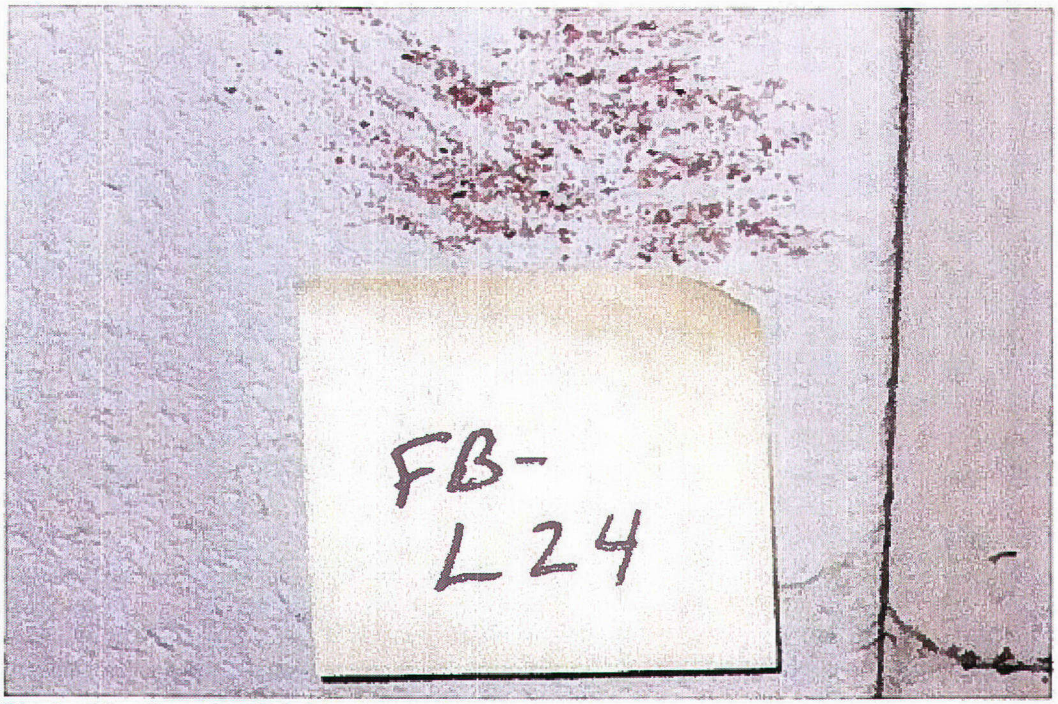


Photo 24 **Sample FB-L24**

Photo 25 Sample FB-L25

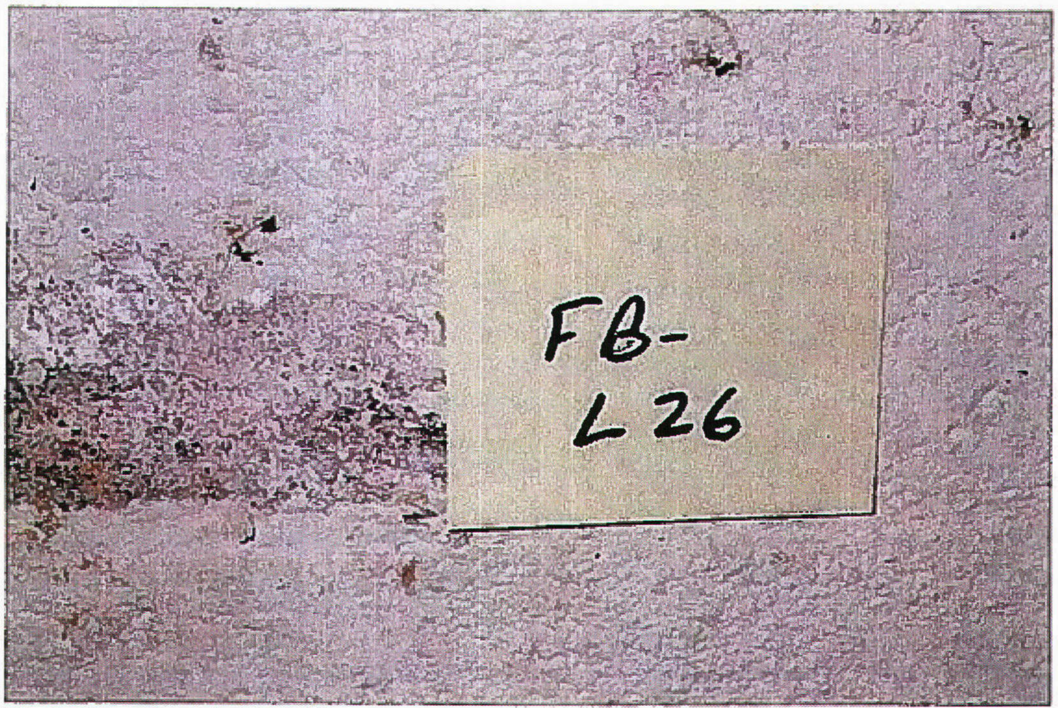


Photo 26 Sample FB-L26

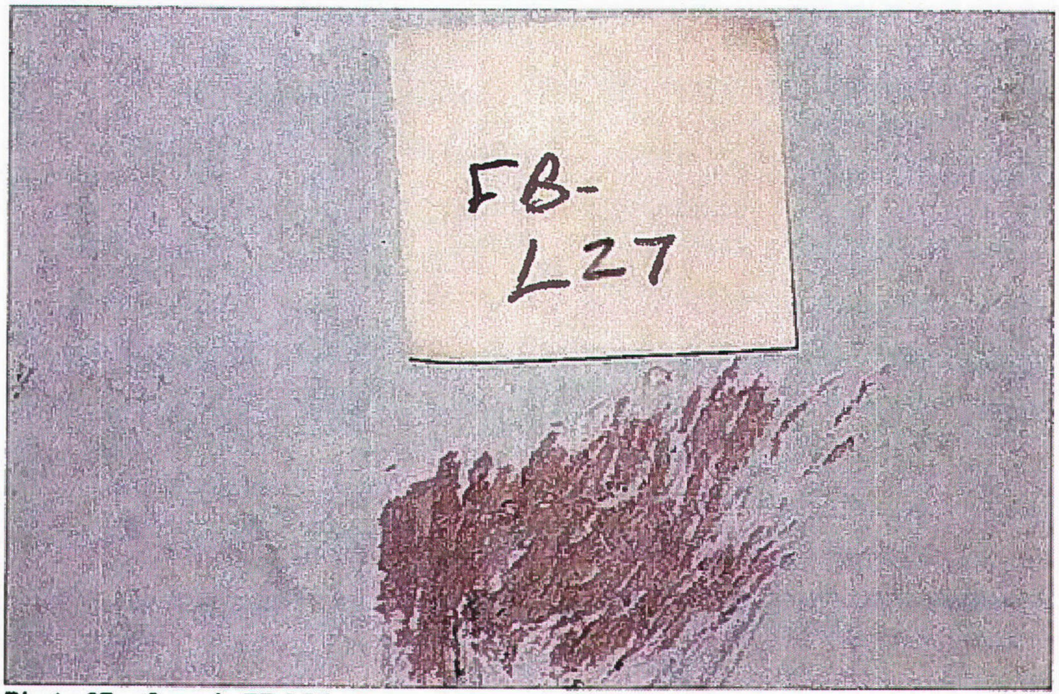


Photo 27 **Sample FB-L27**

TEXAS DEPARTMENT OF STATE HEALTH SERVICES

Be it known that

TERRACON CONSULTANTS INC

is certified to perform as a

Lead Firm

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction; as long as this license is not suspended or revoked.

David L. Lakey, M.D.
Commissioner of Health

License Number: 2110106
Control Number 6213

Expiration Date: 3/20/2012
(Void After Expiration Date)

VOID IF ALTERED NON-TRANSFERABLE

TEXAS DEPARTMENT OF STATE HEALTH SERVICES

Be it known that

GLENN SHRODE

is certified to perform as a

Lead Risk Assessor

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

David L. Lakey, M.D.
Commissioner of Health

License Number: 2070010

Expiration Date: 6/24/2011

Void After Expiration Date

VOID IF ALTERED

Control Number 6344

NON-TRANSFERABLE

TEXAS DEPARTMENT OF STATE HEALTH SERVICES

Be it known that

KENNETH L WILLIAMSON

is certified to perform as a

Lead Inspector

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

David Lakey MD

David L. Lakey, M.D.
Commissioner of Health

License Number: 2060499

Expiration Date: 5/27/2011

Void After Expiration Date

VOID IF ALTERED

Control Number 6075

NON-TRANSFERABLE

TEXAS DEPARTMENT OF STATE HEALTH SERVICES

Be it known that

RICHARD I HOWES

is certified to perform as a

Lead Abatement Project Designer

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

David L. Lakey, M.D.
Commissioner of Health

License Number: 2090034

Expiration Date: 11/19/2011

Void After Expiration Date

VOID IF ALTERED

Control Number 5931

NON-TRANSFERABLE

AIHA
Laboratory Accreditation
Programs, LLC

AIHA Laboratory Accreditation Programs, LLC

acknowledges that

Environmental Hazards Services, LLC

7469 White Pine Road, Richmond, VA 23237
Laboratory ID: 100420

has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA-LAP), LLC thereby conforming to the ISO/IEC 17025:2005 international standard, *General Requirements for the Competence of Testing and Calibration Laboratories.* The above named laboratory, along with all premises from which key activities are performed, as listed above, have been accredited by AIHA-LAP, LLC in the following:

LABORATORY ACCREDITATION PROGRAMS

√	INDUSTRIAL HYGIENE	Accreditation Expires: 05/01/2012
√	ENVIRONMENTAL LEAD	Accreditation Expires: 05/01/2012
√	ENVIRONMENTAL MICROBIOLOGY	Accreditation Expires: 05/01/2012
☐	FOOD	Accreditation Expires:

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached Scope of Accreditation. Continued accreditation is contingent upon successful on-going compliance with AIHA-LAP, LLC requirements. This certificate is not valid without the attached Scope of Accreditation. Please review the AIHA-LAP, LLC website (www.aihaaccreditedlabs.org) for the most current scope of accreditation.

Dave Sandusky

Dave Sandusky, CIH
Chairperson, Analytical Accreditation Board

Date Issued: 04/01/2010

AIHA
Laboratory Accreditation
Programs, LLC

The laboratory participates in the following AIHA-LAP, LLC-approved proficiency testing programs:

- √ Paint
- √ Soil
- √ Settled Dust by Wipe
- √ Airborne Dust

Appendix 2.2:

Filter Media Sieve Analyses

Prepared By:

HVJ Associates, Inc.

May 31, 2011

HVJ
ASSOCIATES

Ms. Christine Graf, PE
City of Austin – Austin Water Utility
Facility Engineering Division
625 East 10th Street, Suite 415
Austin, Texas 78701

Ms. Graf,

Please find enclosed the laboratory test results for the SAR Filter Media. You delivered six filter media samples to our Austin laboratory facility. You assigned a grain size analysis and specific gravity for each sample. If you should have any questions, please call us at once.

HVJ ASSOCIATES, INC.

Steven Weiman

Steven Weiman, SET
Firm PE Registration No. F-000646

H·V·J ASSOCIATES

Houston 6120 S. Dairy Ashford Rd.
Austin Houston, TX 77072-1010
Dallas 281.933.7388 Ph
San Antonio 281.933.7293 Fax
www.hvj.com

TO: Ms. Christine Graf, PE
City of Austin - Austin water Utility
625 East 10th Street, #415
Austin, Texas 78701

PROJECT NAME: SAR Filter Media Lab Tests
PROJECT NO.: AC11-13480

REPORT DATE: 5/16/11
REPORT NO: AC1113480
SAMPLE NO.: 12A Center
SAMPLE DEPTH: Top 12"
MATERIAL DESCRIPTION: Filter Media

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	55	Init Wt. - Tare	889.12
Tare Wt.	**116.18**		
Init. Dry Wt.	**1005.30**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	0	0.00	100.00
10	2.000	736.1	82.79	17.21
20	0.850	886.6	99.72	0.28
40	0.420	886.8	99.74	0.26
60	0.250	886.8	99.74	0.26
140	0.105	886.90	99.75	0.25
200	0.075	886.90	99.75	0.25

SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry) 2.556

Apparent Specific Gravity: 2.637

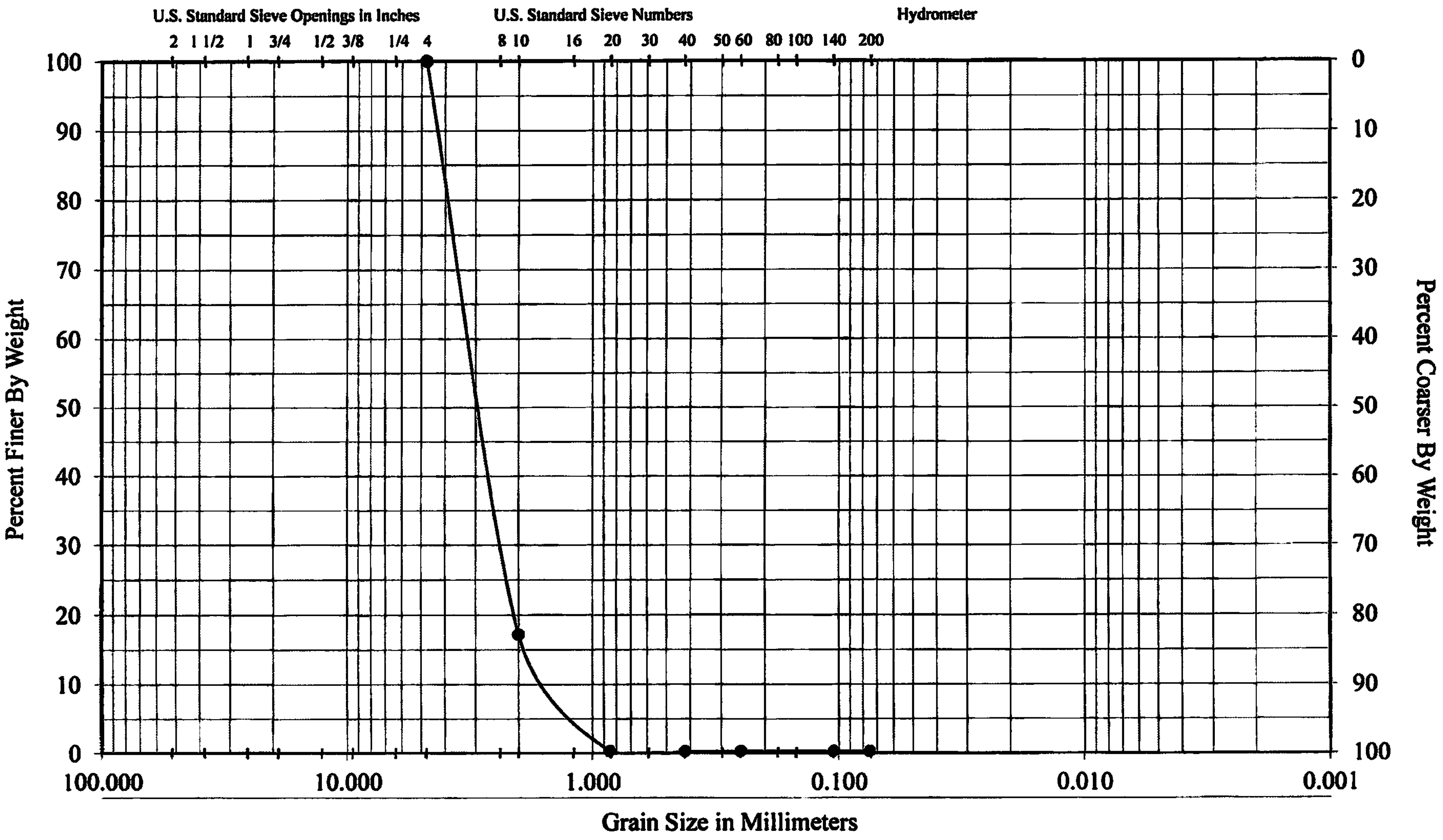
Bulk Specific Gravity: (SSD basic) 2.587

Absorption: 1.19 %

REMARKS:
Attachment: Grain Size Distribution Curve

Fadi Faraj
Fadi N. Faraj, PE
Firm Registration No.: F-000646

STATE OF TEXAS
FADI N. FARAJ
96707
LICENSED PROFESSIONAL ENGINEER



Sample No.	Depth, Ft.	Classification
12A Center	Top 12"	Filter Media

Uniformity Coefficient (Cu)
$Cu = D_{60}/D_{10} = 2.07$

Effective Size (mm)
$D_{10} = 1.5$

HVJ ASSOCIATES

Houston
Austin
Dallas
San Antonio

6120 S. Dairy Ashford Rd.
Houston, TX 77072-1010
281.933.7388 Ph
281.933.7293 Fax
www.hvj.com

TO: Ms. Christine Graf, PE
City of Austin - Austin water Utility
625 East 10th Street, #415
Austin, Texas 78701

PROJECT NAME: SAR Filter Media Lab Tests
PROJECT NO.: AC11-13480

REPORT DATE: 5/16/11
REPORT NO: AC1113480
SAMPLE NO.: 12B Center
SAMPLE DEPTH: Top 12"
MATERIAL DESCRIPTION: Filter Media

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	56	Init Wt. - Tare	1159.04
Tare Wt.	**118.26**		
Init. Dry Wt.	**1277.30**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	0.3	0.03	99.97
10	2.000	975.6	84.17	15.83
20	0.850	1155.7	99.71	0.29
40	0.420	1155.9	99.73	0.27
60	0.250	1155.9	99.73	0.27
140	0.105	1156.00	99.74	0.26
200	0.075	1156.00	99.74	0.26

SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry) 2.282

Apparent Specific Gravity: 2.607

Bulk Specific Gravity: (SSD basic) 2.407

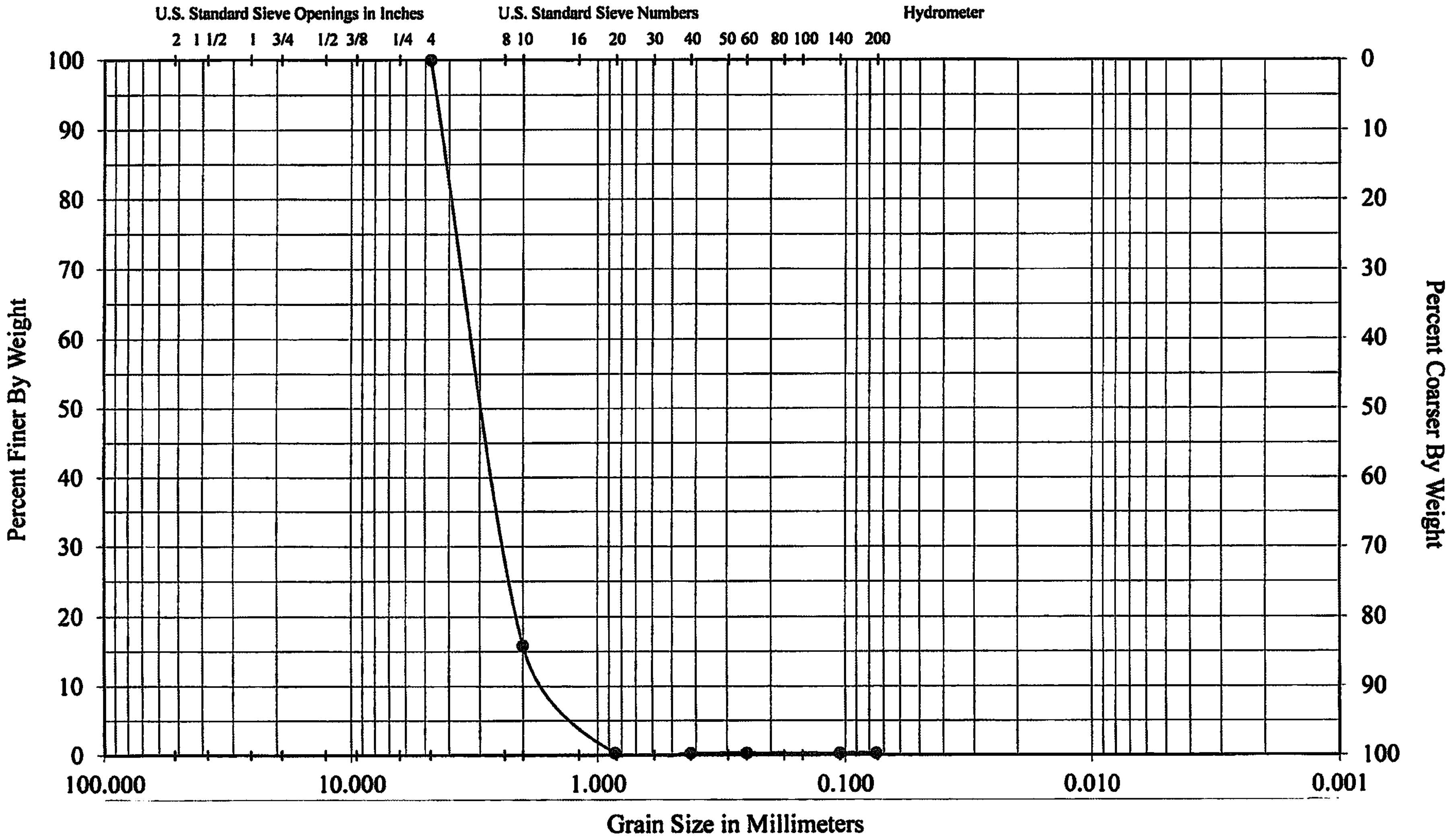
Absorption: 5.46 %

REMARKS:
Attachment: Grain Size Distribution Curve

Fadi Faraj

Fadi N. Faraj, PE
Firm Registration No.: F-000646

FADI N. FARAJ
96707



Sample No.	Depth, Ft.	Classification	Uniformity Coefficient (Cu)
12B Center	Top 12"	Filter Media	Cu = D_{60}/D_{10}=1.94

Effective Size (mm)
D_{10}=1.60

HVJ ASSOCIATES

Houston
Austin
Dallas
San Antonio

6120 S. Dairy Ashford Rd.
Houston, TX 77072-1010
281.933.7388 Ph
281.933.7293 Fax
www.hvj.com

TO:	Ms. Christine Graf, PE		REPORT DATE:	5/16/11
	City of Austin - Austin water Utility		REPORT NO:	AC1113480
	625 East 10th Street, #415		SAMPLE NO.:	12A xBox
	Austin, Texas 78701		SAMPLE DEPTH:	Top 12"
PROJECT NAME:	SAR Filter Media Lab Tests		MATERIAL DESCRIPTION:	Filter Media
PROJECT NO.:	AC11-13480			

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	QQ	Init Wt. - Tare	1146.06
Tare Wt.	**118.54**		
Init. Dry Wt.	**1264.60**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	0	0.00	100.00
10	2.000	1003.1	87.53	12.47
20	0.850	1142.9	99.72	0.28
40	0.420	1143.1	99.74	0.26
60	0.250	1143.1	99.74	0.26
140	0.105	1143.10	99.74	0.26
200	0.075	1143.10	99.74	0.26

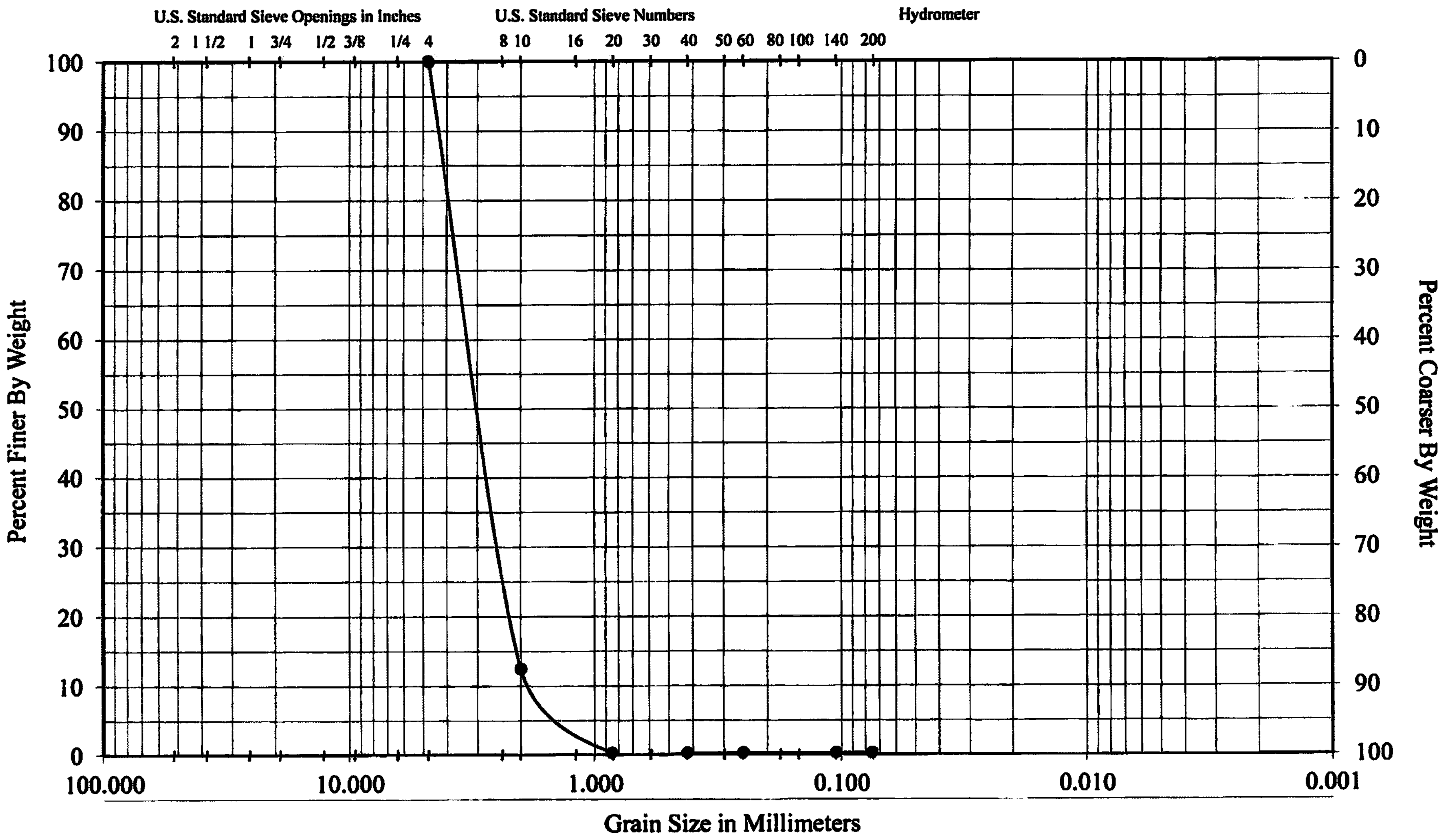
SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry)	2.226	**Apparent Specific Gravity:**	2.648
Bulk Specific Gravity: (SSD basic)	2.385	**Absorption:**	7.15 %

REMARKS:
Attachment: Grain Size Distribution Curve

Fadi N. Faraj, PE
Firm Registration No.: F-000646

FADI N. FARAJ
98707



Sample No.	Depth, Ft.	Classification	Uniformity Coefficient (Cu)
12A xBox	Top 12"	Filter Media	$Cu = D_{60}/D_{10} = 1.77$

Effective Size (mm)
$D_{10} = 1.75$

HVJ
ASSOCIATES

Houston
Austin
Dallas
San Antonio

6120 S. Dairy Ashford Rd.
Houston, TX 77072-1010
281.933.7388 Ph
281.933.7293 Fax
www.hvj.com

TO:	Ms. Christine Graf, PE	REPORT DATE:	5/16/11
	City of Austin - Austin water Utility	REPORT NO:	AC1113480
	625 East 10th Street, #415	SAMPLE NO.:	12A xBox
	Austin, Texas 78701	SAMPLE DEPTH:	24" - 36"
PROJECT NAME:	SAR Filter Media Lab Tests	MATERIAL DESCRIPTION:	Filter Media
PROJECT NO.:	AC11-13480		

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	BB	Init Wt. - Tare	1106.96
Tare Wt.	**252.44**		
Init. Dry Wt.	**1359.40**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	0.4	0.04	99.96
10	2.000	1046.8	94.57	5.43
20	0.850	1103.1	99.65	0.35
40	0.420	1103.2	99.66	0.34
60	0.250	1103.2	99.66	0.34
140	0.105	1103.20	99.66	0.34
200	0.075	1103.30	99.67	0.33

SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry) 2.203

Apparent Specific Gravity: 2.664

Bulk Specific Gravity: (SSD basic) 2.376

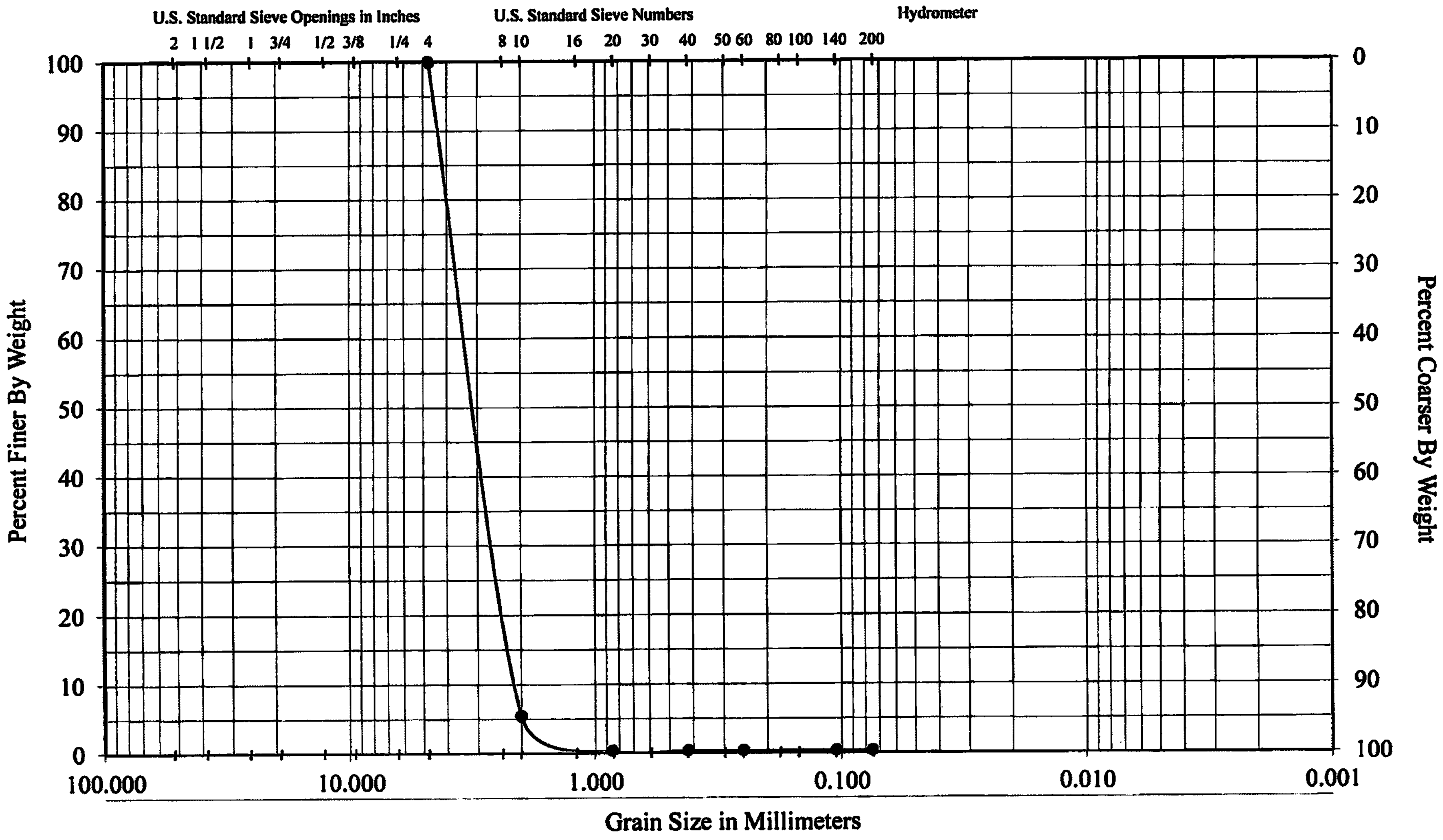
Absorption: 7.85 %

REMARKS:
Attachment: Grain Size Distribution Curve

Fadi Faraj

Fadi N. Faraj, PE
Firm Registration No.: F-000646

STATE OF TEXAS
FADI N. FARAJ
96707
LICENSED
PROFESSIONAL ENGINEER



<u>Sample No.</u>	<u>Depth, Ft.</u>	<u>Classification</u>
12A xBox	Top 24"-36"	Filter Media

Uniformity Coefficient (Cu)
$Cu = D_{60}/D_{10} = 1.57$

Effective Size (mm)
$D_{10} = 2.1$

HVJ ASSOCIATES

Houston
Austin
Dallas
San Antonio

6120 S. Dairy Ashford Rd.
Houston, TX 77072-1010
281.933.7388 Ph
281.933.7293 Fax
www.hvj.com

TO: Ms. Christine Graf, PE
City of Austin - Austin water Utility
625 East 10th Street, #415
Austin, Texas 78701

PROJECT NAME: SAR Filter Media Lab Tests

PROJECT NO.: AC11-13480

REPORT DATE: 5/16/11

REPORT NO: AC1113480

SAMPLE NO.: 12A xBox

SAMPLE DEPTH: 36"

MATERIAL DESCRIPTION: Filter Media

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	AW	Init Wt. - Tare	1226.97
Tare Wt.	**254.03**		
Init. Dry Wt.	**1481.00**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	0.4	0.03	99.97
10	2.000	1154.8	94.12	5.88
20	0.850	1222.8	99.66	0.34
40	0.420	1223	99.68	0.32
60	0.250	1223	99.68	0.32
140	0.105	1223.10	99.68	0.32
200	0.075	1223.10	99.68	0.32

SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry) 2.31

Apparent Specific Gravity: 2.672

Bulk Specific Gravity: (SSD basic) 2.446

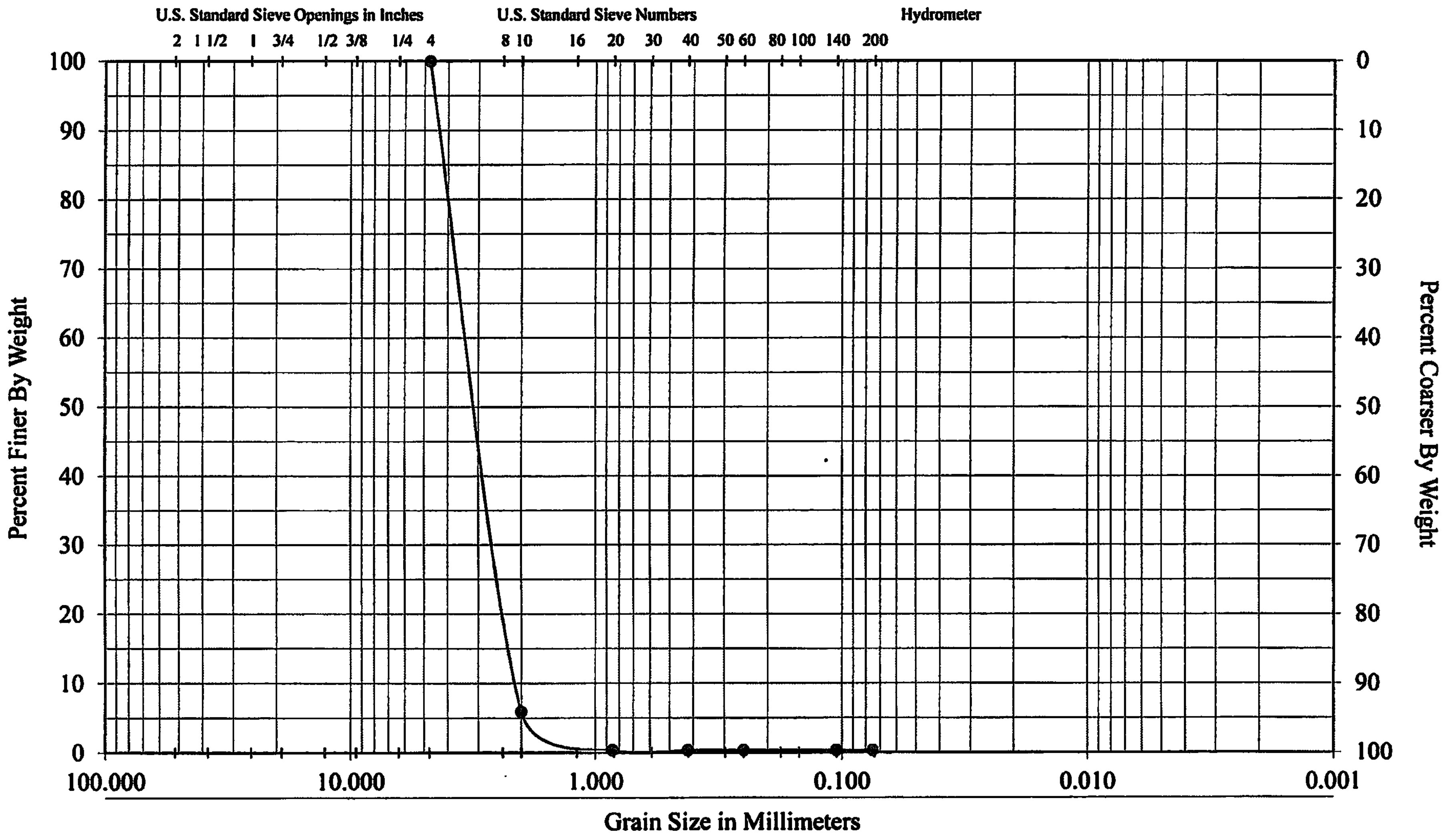
Absorption: 5.85 %

REMARKS:
Attachment: Grain Size Distribution Curve

Fadi Faraj

Fadi N. Faraj, PE
Firm Registration No.: F-000646

FADI N. FARAJ
86707



Sample No.	Depth, Ft.	Classification	Uniformity Coefficient (Cu)
12A xBox	36"	Filter Media	$Cu = D_{60}/D_{10} = 1.57$

Effective Size (mm)

$D_{10} = 2.1$

HVJ
ASSOCIATES

Houston
Austin
Dallas
San Antonio

6120 S. Dairy Ashford Rd.
Houston, TX 77072-1010
281.933.7388 Ph
281.933.7293 Fax
www.hvj.com

TO:	Ms. Christine Graf, PE	REPORT DATE:	5/16/11
	City of Austin - Austin water Utility	REPORT NO:	AC1113480
	625 East 10th Street, #415	SAMPLE NO.:	12A Far Right
	Austin, Texas 78701	SAMPLE DEPTH:	Top 12"
PROJECT NAME:	SAR Filter Media Lab Tests	MATERIAL DESCRIPTION:	Filter Media
PROJECT NO.:	AC11-13480		

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	DD	Init Wt. - Tare	947.77
Tare Wt.	**117.13**		
Init. Dry Wt.	**1064.90**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	1.4	0.15	99.85
10	2.000	888.5	93.75	6.25
20	0.850	946	99.81	0.19
40	0.420	946	99.81	0.19
60	0.250	946	99.81	0.19
140	0.105	946.10	99.82	0.18
200	0.075	946.10	99.82	0.18

SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry) 2.247

Apparent Specific Gravity: 2.655

Bulk Specific Gravity: (SSD basic) 2.401

Absorption: 6.85 %

REMARKS:

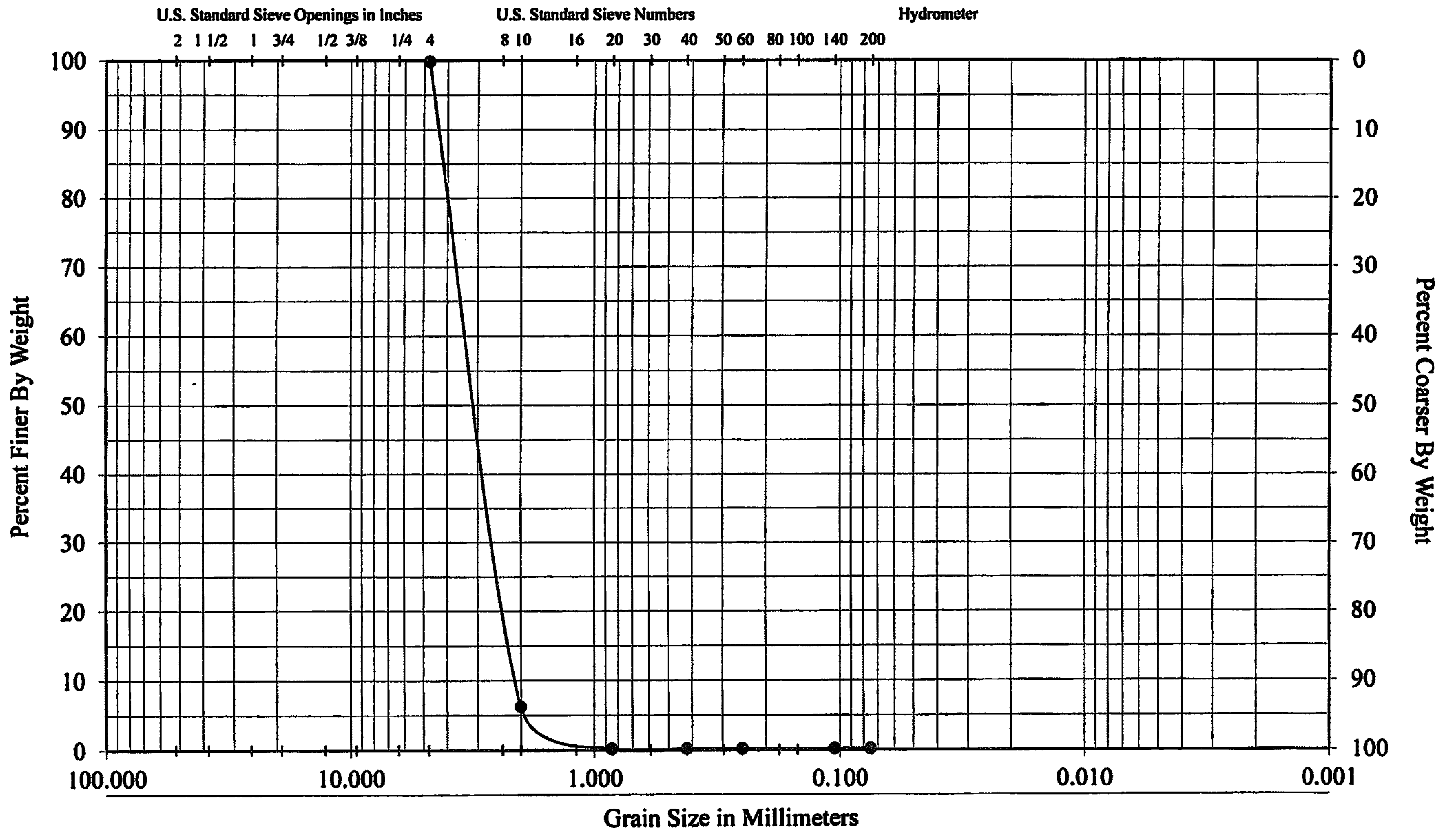
Attachment: Grain Size Distribution Curve

Fadi Faraj

Fadi N. Faraj, PE

Firm Registration No.: F-000646

FADI N. FARAJ
98707



Sample No.	Depth, Ft.	Classification
12A Far Right	Top 12"	Filter Media

Uniformity Coefficient (Cu)
$Cu = D_{60}/D_{10} = 1.57$

Effective Size (mm)
$D_{10} = 2.1$

HVJ ASSOCIATES

Houston
Austin
Dallas
San Antonio

6120 S. Dairy Ashford Rd.
Houston, TX 77072-1010
281.933.7388 Ph
281.933.7293 Fax
www.hvj.com

TO:	Ms. Christine Graf, PE City of Austin - Austin water Utility 625 East 10th Street, #415 Austin, Texas 78701	REPORT DATE:	5/16/11
		REPORT NO:	AC1113480
		SAMPLE NO.:	12A xBox
		SAMPLE DEPTH:	12"-24"
PROJECT NAME:	SAR Filter Media Lab Tests	MATERIAL DESCRIPTION:	Filter Media
PROJECT NO.:	AC11-13480		

SIEVE ANALYSIS DATA (ASTM C-136)

Tare No.	BB	Init Wt. - Tare	484.60
Tare Wt.	**417.60**		
Init. Dry Wt.	**902.20**		

Sieve Size/No.	Sieve Size (mm)	Weight Ret.	% Retained	% Passing
4	4.750	0.3	0.06	99.94
10	2.000	451.1	93.09	6.91
20	0.850	484.5	99.98	0.02
40	0.420	484.6	100.00	0.00
60	0.250	484.6	100.00	0.00
140	0.105	484.60	100.00	0.00
200	0.075	484.60	100.00	0.00

SPECIFIC GRAVITY OF FINE AGGREGATES (ASTM C128)

Bulk Specific Gravity: (Oven Dry) 2.461

Apparent Specific Gravity: 2.634

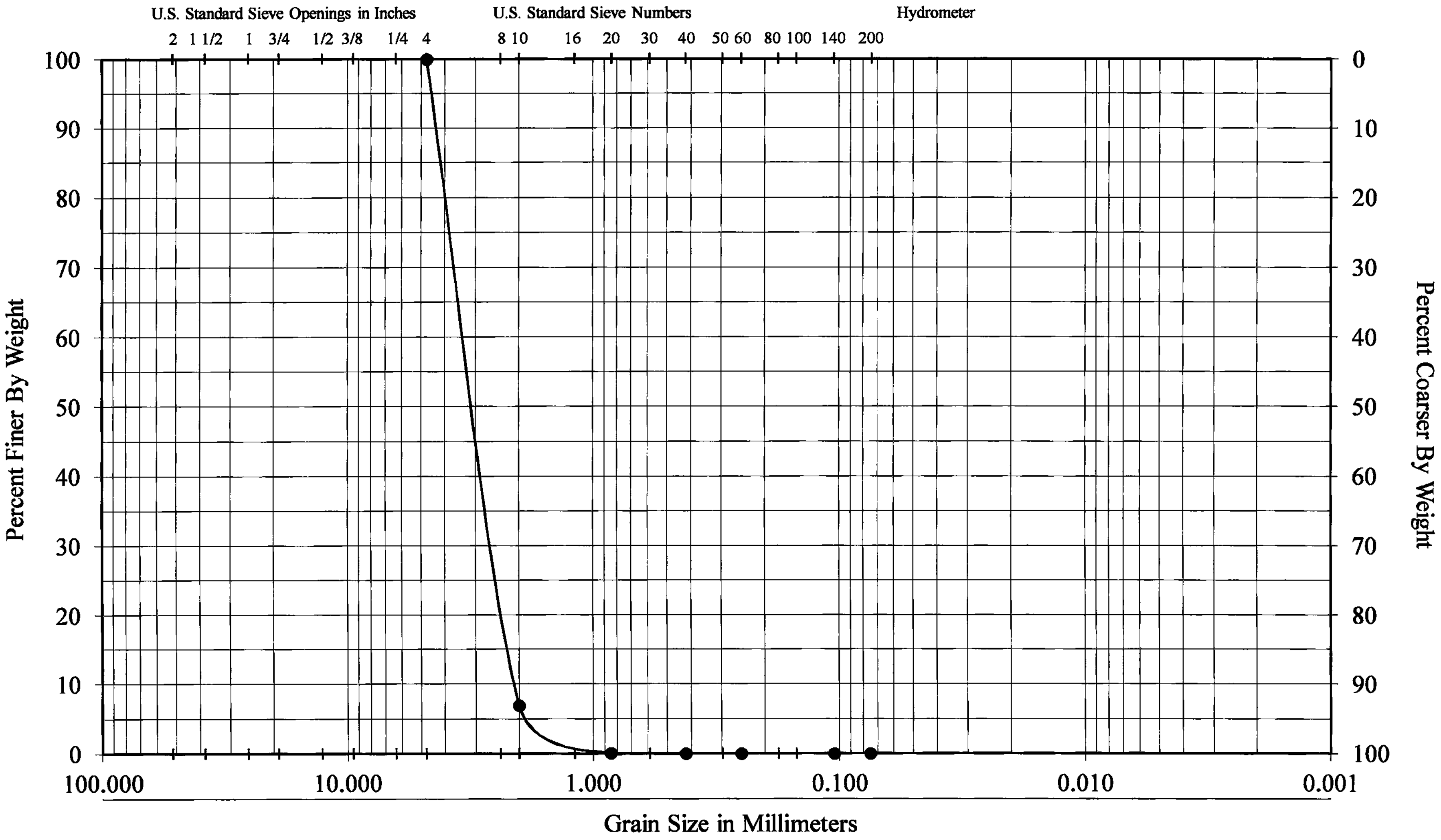
Bulk Specific Gravity: (SSD basic) 2.527

Absorption: 2.67%

REMARKS:
Attachment: Grain Size Distribution Curve

Jason Schwarz, PE
Firm Registration No.: F-000646

6/9/11
JASON C. SCHWARZ
99343



Sample No.	Depth, Ft.	Classification	Uniformity Coefficient (Cu)
12A xBox	Top 12"-24"	Filter Media	Cu = D_{60}/D_{10}=1.62

Effective Size (mm)
D_{10}=2.1

Appendix 2.3:

Equipment Survey Table

Prepared Based on Field Inspections
Conducted During April and May 2011

Equipment Type	Name and Location	Field Observed Condition	Age	Recommendation
General				
PLC Cabinet	Filter Bldg Control Room - Control Cabinet	Very old, outdated, modified and canibalized. In very poor condition and needs immediate upgrading.	24	Replace with an up-to-date PLC based control system capable of interfacing with Plant's SCADA System with both capability for both central and local operation.
Control Alarm	Filter Bldg Control Room - Control Panel Alarm		25	
Vertical Turbine Pump	Junction Box No. 5 - High Water Filter Influent Pump No. 1		6	
Vertical Turbine Pump	Junction Box No. 5 - High Water Filter Influent Pump No. 2		6	
Plug Valve	??? - Influent Plug Valve - 216		23	
Level Transmitter	Upper Gallery - Filter 1-6 Level Transmitter - LIT-010	Retrofitted Milltronic meter, giving reading of 2.02, no units shown.	11	Meter should be professionally calibrated or replaced with a newer unit.
Level Transmitter	Upper Gallery - Filter 7-12 Level Transmitter - LIT-007	Retrofitted Milltronic meter no local output and missing key pad. However, reading was available at the PLC	11	Meter should be professionally calibrated or replaced with a newer unit.
42" BFV and Electric Motor Operated Actuator	Lower Gallery - Filter 1-6 Effluent Control Valve	Outdated EO only operable in manual mode and left at full open. Operator was leaking grease, but motor appeared to have been replaced in 1998	25	Electric Operator and Controls should be replaced to allow for automatic control of the filter effluent. Replace valve
42" BFV and Electric Motor Operated Actuator	Lower Gallery - Filter 7-12 Effluent Control Valve	Outdated EO only operable in manual mode and left at full open. Operator had been leaking grease, but operator and floor below appeared to have been cleaned, indicating the operator had possibly been serviced recently.	25	Electric Operator and Controls should be replaced to allow for automatic control of the filter effluent. Replace valve .
Coatings	Upper and Lower Levels - Effluent (Green) Coating	In poor condition with paint peeling at some locations	25	Needs controlled sand blasting and recoating in place.
Coatings	Upper and Lower Levels - Influent (Grey) Coating	In poor condition with paint peeling at some locations	25	Needs controlled sand blasting and recoating in place.
Coatings	Upper and Lower Levels - Backwash and Drain (Brown) Coating	Most sections in good condition. Peeling in some some areas.	25	Spot controlled sand blast and recoat in place.
Coatings	Upper and Lower Levels - Air Piping Coating	Lower level piping in poor condition. Upper level in fair condtion with some small areas peeling	25	Lower level air piping needs controlled sand blasting and recoating in place. Upper level air piping needs spot controlled sand blast and recoat in place.
Filter No. 1				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 100	Outdated EO but appeared to be in operating condition, reportedly valve was never operated.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 112	No EO for Valve, reportedly valve was never operated.	23	Install new EO and remove and replace valve
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 136	No EO for Valve, reportedly valve was never operated.	25	Install new EO and remove and replace valve
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 124	No EO for Valve, reportedly valve was never operated.	24	Install new EO and remove and replace valve
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 148	Very old but appeared to be in operating condition. Reportedly valve has not been operated in 20 years.	23	EO would not provide an additional 20-25 years of service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 160	Appered to be in operating condition, reportedly valve was never operated.	23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.

6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 2. Filters 1 and 2 non-operational for some time.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.
Filter No. 2				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 101	Outdated EO but appeared to be in operating condition, reportedly valve has not been operated for some time.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 113	Outdated EO but appeared to be in operating condition, reportedly valve has not been operated for some time.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 137	Outdated EO but appeared to be in operating condition, reportedly valve has not been operated for some time.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 125	Outdated EO but appeared to be in operating condition, reportedly valve has not been operated for some time.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 149	Outdated EO but appeared to be in operating condition, reportedly valve has not been operated for some time.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 161		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Outdated Control Panel shared with Filter No. 1 . Filters 1 and 2 non-operational for some time.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.
Filter No. 3				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 102	EO is outdated and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 114	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 138	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.

24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 126	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 150	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 162		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 4 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.
Filter No. 4				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 103	Old and outdated EO but appeared to be in operating condition.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 115	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 139	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO should be serviced and maintained. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 127	EO appears to be a new replacement unit.	9	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 151	Old and outdated EO but appeared to be in operating condition.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 163	operated	23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 3 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.

Filter No. 5				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve Electric Operator - 104	EO is old, outdated, and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 116	Old and outdated EO but appeared to be in operating condition.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 140	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 128	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 152	Old and outdated EO but appeared to be in operating condition.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 164	operated	23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 6 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.
Filter No. 6				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 105	Old and outdated EO but appeared to be in operating condition.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 117	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 141	Valve works, but can be operated by use of manual handwheel only.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 129	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 153	EO is old, outdated, and leaking grease, operable only by manual handwheel.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 165		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 5 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.

Filter No. 7				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 106	EO is old, outdated, and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 118	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 142	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 130	EO is old, outdated, and leaking grease, but appeared to be operable.	9	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 154	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 166	??	23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 8 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.
Filter No. 8				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 107	Old and outdated EO but appeared to be in operating condition.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 119	Valve works, but can be operated by use of manual handwheel only.	25	Install new EO and remove and replace valve
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 143	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 131	EO is old, outdated, and leaking grease. operable only by manual handwheel.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 155	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 167		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 7 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.

Filter No. 9				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 108	Old and outdated EO but appeared to be in operating condition.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 120	EO is old, outdated, and leaking grease. but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 144	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO should be serviced and maintained. Valve needs removal and replacement
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 132	EO appears to be a new replacement unit.	9	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 156	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 168		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 10 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.
Filter No. 10				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 109	Old and outdated EO but appeared to be in operating condition.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 121	EO is old, outdated, and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 145	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 133	EO is old, outdated, and leaking grease. but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 157	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 169		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 9 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.

Filter No. 11 - Out of Service due to head differential in cells				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 110	EO is old, outdated, and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 122	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 146	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 134	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 158	Old and outdated EO but appeared to be in operating condition.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 170		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 12 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability
Filter No. 12				
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Influent Valve - 111	EO is old, outdated, and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Effluent Valve - 123	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
20" BFV and Electric Motor Operated Actuator (EO)	Upper Gallery - Wash Water Valve - 147	EO is old, outdated, and leaking grease, but appeared to be operable.	24	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
24" BFV and Electric Motor Operated Actuator (EO)	Filter Catwalk - BackWash Waste Valve - 127	EO is old, outdated, and leaking grease, but appeared to be operable.	25	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
10" Resilient Butterfly Valve and Electric Motor Operated Actuator (EO)	Upper Gallery - Air Inlet Valve - 159	EO is old, outdated, and leaking grease, but appeared to be operable.	23	EO would not provide an additional 20 year service life. Valve needs removal and replacement.
2" Safety Valve	Upper Gallery - Air Vent Valve - 171		23	May not provide an additional 20-25 years of service life.
16" Venturi Flow Meter	Upper Gallery - Filter Effluent Flowmeter	Currently disconnected, not operational and not used.	23	Needs replacement of all pipe connections, instruments and calibration. Expected to provide additional 20-25 years of service life with new pipes, instruments and calibration.
6" Ballcentric Plug Valve	Lower Gallery - Filter Drain Valve	Valve appears to be in good condtion with no grease leaking from the operator. Not currently used by operations staff, and are only manually operated.	24	Valve should be retrofitted for automatic operation to allow for the draining of each filter to the media level prior to backwashing and for maintenance.
Local Control Panel	Control Deck Level Interior	Old and outdated Control Panel shared with Filter No. 11 but appeared to be operating under manual operations.	25	Control Panel needs replacement using PLC based Local and Remote Control and Operations capability.

Mudwell				
16" Eccentric Plug	Lower Gallery - Mudwell Pump No. 1 Plug Valve - 500	Plug valves in place appear to be very old, outdated units, but handwheel operators were free of grease and valves appeared to be operable.	23	Replace 16" Swing Check Valve
16" Swing Check	Lower Gallery - Mudwell Pump No. 1 Swing Check Valve - 501	Pump running upon inspection, SCV appeared to be operating correctly.	23	Replace 16" Swing Check Valve
16" Eccentric Plug	Lower Gallery - Mudwell Pump No. 1 Plug Valve - 502	Plug valves in place appear to be very old, outdated units, but handwheel operators were free of grease and valves appeared to be operable.	23	Plug Valves should be serviced, cleaned, and greased to maintain use into the future.
16" Eccentric Plug	Lower Gallery - Mudwell Pump No. 2 Plug Valve - 503	Plug valves in place appear to be very old, outdated units, but handwheel operators were free of grease and valves appeared to be operable.	23	Plug Valves should be serviced, cleaned, and greased to maintain use into the future.
16" Swing Check	Lower Gallery - Mudwell Pump No. 2 Swing Check Valve - 504	Pump not running. SCV appeared to be stuck in the open position, as indicated by the weight assist arm, which was up in the air.	23	Replace 16" Swing Check Valve
16" Eccentric Plug	Lower Gallery - Mudwell Pump No. 2 Plug Valve - 505	Plug valves in place appear to be very old, outdated units, but handwheel operators were free of grease and valves appeared to be operable.	23	Plug Valves should be serviced, cleaned, and greased to maintain use into the future.
16" Eccentric Plug	Lower Gallery - Mudwell Pump No. 3 Plug Valve - 506	Plug valves in place appear to be very old, outdated units, but handwheel operators were free of grease and valves appeared to be operable.	23	Plug Valves should be serviced, cleaned, and greased to maintain use into the future.
16" Swing Check	Lower Gallery - Mudwell Pump No. 3 Swing Check Valve - 507	Pump not running, assist arm sitting parrallel to the floor, appeared to be stuck partially open. This was noted and the operator closed the discharge plug valve for Pump 3.	23	Replace 16" Swing Check Valve
16" Eccentric Plug	Lower Gallery - Mudwell Pump No. 3 Plug Valve - 508	Plug valves in place appear to be very old, outdated units, but handwheel operators were free of grease and valves appeared to be operable.	23	Plug Valves should be serviced, cleaned, and greased to maintain use into the future.
Pump 2 Motor	Lower Gallery - Mudwell Pump No. 2 Motor	Pump and motor found to be out of operation in speaking with Plant Operators	24	Pumps and motors should be replaced with modern, energy efficient models.
Pump 2	Lower Gallery - Mudwell Pump No. 2	Pump and motor found to be out of operation in speaking with Plant Operators	24	Pumps and motors should be replaced with modern, energy efficient models.
Pump 1 Motor	Lower Gallery - Mudwell Pump No. 1 Motor	Observed to be operating. Packing gland leaking a lot of water, entire MWP area floor flooded, not draining.	24	Pumps and motors should be replaced with modern, energy efficient models.
Pump 1	Lower Gallery - Mudwell Pump No. 1	Observed to be operating. Packing gland leaking a lot of water, entire MWP area floor flooded, not draining.	24	Pumps and motors should be replaced with modern, energy efficient models.
Pump 3 Motor	Lower Gallery - Mudwell Pump No. 3 Motor	Operator indicated the motor had been shorting out, so was not being used. Possibly a problem with the motor, or seized pump	24	Pumps and motors should be replaced with modern, energy efficient models.

Pump 3	Lower Gallery - Mudwell Pump No. 3	Operator indicated the motor had been shorting out, so was not being used. Possibly a problem with the motor, or seized pump	24	Pumps and motors should be replaced with modem, energy efficient models.
Level Transmitter	Mudwell - Mudwell Level Transmitter	Level transmitter appeared to be working properly and gave consistent readings at the PLC.	11	Make sure the transmitter is maintained and calibrated, but transmitter may no have much useful life remaining.
Backwash System				
Backwash Pump No. 1	Upper Gallery Backwash Room - Pump No. 1	Motor/pump packing seal completely dry and cracked. Appears to not be in service.	24	Pump needs repacking, motors do not have another 25 years of service.
Backwash Pump No. 2	Upper Gallery Backwash Room - Pump No. 2	Motor/pump packing seal leaking	24	Pump needs repacking, motors do not have another 25 years of service.
24" Swing Check	Upper Gallery Backwash Room - Pump No. 1 Swing Check Valve	small water leak observed at the assist arm penetration. Valve is very old and in poor condition	25	24" SCV should be replaced or rebuilt
24" Swing Check	Upper Gallery Backwash Room - Pump No. 2 Swing Check Valve	no leaks observed at the assis arm penetration. Valve is very old and in poor condition	25	24" SCV should be replaced or rebuilt
18" Butterfly Valve	Upper Gallery Backwash Room - North High Valve - 190		25	
18" Butterfly Valve	Upper Gallery Backwash Room - South High Valve - 185		25	
24" Venturi Water	Upper Gallery Backwash Room - Wash Water Flowmeter	Flowmeter gave consistent readings over 2 backwash cycles	25	Flowmeter needs to be calibrated to ensure accuracy.
12" Venturi	Upper Gallery Blower Room - Wash Air Flowmeter	Flowmeter gave consistent readings over 2 backwash cycles	25	Flowmeter needs to be calibrated to ensure accuracy.
10" Pressure Relief Valve	Upper Gallery Backwash Room - Pressure Relief Vale - 215	Pressure relief valve appeared to be disconnected from instrumentation	25	Provide a new pressure relief valve or replace the instruments to allow the PRV to be used as intended.
Clearwell Bleedover Valve 1	Upper Gallery Backwash Room - BFV - 217		25	
Clearwell Bleedover Valve 2	Upper Gallery Backwash Room - BFV - 218		25	
Clearwells				
Level Transmitter	Clearwell No. 1 Level Transmitter - LIT-205		25	
Level Transmitter	Clearwell No. 2 Level Transmitter - LIT-206		25	
Discharge Slide Gate	Upper Gallery Backwash Room - Clearwell Gate No. 1 - Gate 178	Slide gate was observed to be fully open. Operators indicated that these gates are rarely adjusted from the current setting.	25	Make sure that operators are maintained and properly greased. Due to the rare use of this item, replacement may not be necessary
Discharge Slide Gate	Upper Gallery Backwash Room - Clearwell Gate No. 2 - Gate 179	Slide gate was observed to be ~90-95% open. Operators indicated that these gates are rarely adjusted from the current setting.	25	Make sure that operators are maintained and properly greased. Due to the rare use of this item, replacement may not be necessary
Miscellaneous Equipment				
Monorail Electric Winch/Hoist	Upper Gallery - Crane 5-ton Hoist	Crane has never been used	24	Crane needs to be inspected and excercised to maintain operability.
Junction Box	Junction Box No. 6 - Filter Building Discharge		23	
Sump Pump No. 1	Lower Gallery - Filter Building Sump Pump No. 1	Mudwell pump area not draining to the sump	24	Addition of grout to the floor to allow for water to drain to the building sump.
Sump Pump No. 2	Lower Gallery - Filter Building Sump Pump No. 2	Mudwell pump area not draining to the sump	24	Addition of grout to the floor to allow for water to drain to the building sump.
Flood Alarm	Lower Gallery - Filter Building Flood Alarm		25	

Appendix 2.4:

Site Visit Memos

Prepared Following Field Inspections
During April and May 2011

AECOM

AECOM
400 W. 15th Street
Suite 500
Austin, Texas 78701
www.aecom.com

512 472 4579 tel
512 472 7519 fax

Memorandum

To	AECOM File	Pages	3
CC	Marci O'Connell		
Subject	SAR Filter Building – Filter Building Facilities Inspection		
From	Abu Alam		
Date	04/25/2011		

On Monday, April 25 AECOM engineers observed the existing facilities in the Upper Pipe Gallery of the Filter Building. Additional areas of the filter building, such as the Backwash pump room and blower facilities, were also inspected.

Blower Facilities

The inspection began in the air blower room. Located in this room are two (2) Lamson Centrifugal Blowers. In talks with the operations staff, there are very few operational difficulties with this type of blower. The maintenance staff also pointed out that each of the two (2) double door swing check valves (1 for each blower) on the outlet of the blowers had been replaced just days before this inspection. A portion of the local control panel for Blower No. 1 had shorted out and was being replaced at the time of this inspection as well.

The Blowers appeared to be in overall good condition. The blower motors appeared to be old (1986) and outdated and should be replaced with modern, energy-efficient models.

The Venturi flow meter for the air backwash gave consistent readings throughout the two (2) backwash cycles witnessed, but needs to be calibrated to ensure accurate readings. Physical appearance showed that the Venturi flow meter and the piping surrounding it needs to be sand blasted, cleaned and recoated with an appropriate industrial coating.

Backwash Pump Room

The backwash pumping facilities were inspected next and were found to be in overall poor condition. It appeared that the Backwash Pump No. 2 has not been operated for some time.

The Backwash Pump Motors are very old (1987) and needs to be replaced to extend the life of this facility.

BW Pump No. 2 packing gland was completely dry and cracking, giving the appearance that this pump is not in service. Pump No. 1 packing gland was leaking water, and water pooling up on the pump head.

The 24" swing check valves (SCV) are very old (1986) and needs to be replaced, or rebuilt. SCV for Pump No. 2 had a small leak at the swing assist lever, and no leaks were observed at Pump 1 SCV.

In addition, the majority of the valves in the Backwash Pump Room need to be serviced and/or replaced, including two (2) butterfly valves and one (1) globe valve. The Backwash Water Venturi flow meter gave consistent readings throughout the two (2) backwash cycles witnessed, but needs to be calibrated to ensure accuracy of readings.

The brown coating for the backwash water pipes appeared to be in reasonably good condition, but needs to be cleaned and some areas spot blasted and recoated.

A large amount of corrosion was witnessed in the Backwash Pump room, especially on the supports for the large air duct which passes through the room. These supports need to be replaced, along with any other miscellaneous metals in the room found to be deteriorating. The room was also found to be full of spiders and cobwebs. Periodic cleaning and housekeeping of the room is needed.

Upper Pipe Gallery

AECOM engineers then went through the Upper Pipe Gallery and inspected the condition of the Influent, Effluent, Air, and Backwash piping, valves, and other equipment found in this Upper Pipe Gallery of the Filter Building.

24" Filter Influent Butterfly Valves

Five of the twelve (12) 24" filter electric motor operated influent valves were found leaking oil and/or grease onto the floor and piping below. All of the operators are old (1987), outdated units. Even though some of the operators were not leaking, none of the twelve (12) operators could be used reliably for another 25 years of useful life. The butterfly valves themselves need to be pulled and rebuilt/reseated or replaced to provide an additional 25 years of service life.

24" Filter Effluent Butterfly Valves

All twelve (12) 24" filter effluent valves have old, outdated electric operators which were leaking oil and/or grease onto the floor below. The electric operator for Filter No. 1 was missing and appeared to have been likely scavenged for parts or used to replace one of the other failed operators. These electric operators ~~do~~ would not be able to provide another 25 years of useful service life. The valves themselves likely need to be pulled and rebuilt/reseated or replaced to provide an additional 25 years of life.

20" Backwash Water Valves

All twelve (12) 20" backwash water valves have old (1986), outdated electric operators which were leaking oil and/or grease onto the floor below. The electric operator for Filter No. 1 was missing and was likely scavenged for parts or used to replace one of the other failed operators. These electric operators do not have another 25 years of useful life remaining. The valves themselves likely need to be pulled and rebuilt/reseated or replaced to provide an additional 25 years of life.

10" Air Inlet Resilient Butterfly Valves

Seven (7) of the (12) 10" Air Inlet Valves had electric operators which were leaking oil and/or grease onto the floor and piping below. All of the operators are old (1988), outdated units. Even though some of the operators were not leaking, none of the twelve (12) operators have another 25 years of useful life remaining. The valves themselves likely need to be pulled and rebuilt/reseated or replaced to provide an additional 25 years of life.

16" Filter Effluent Venturi Flow Meters

The filter effluent flow meters for all twelve (12) filter cells were either disconnected from their instrumentation or the instrumentation was completely missing. This means that operations staff has no way of measuring the amount of clean water coming out of each filter and/or the total amount of filtered water leaving the building. These Venturi flow meters need to be repaired, new components added, or replaced with alternative measuring devices so that the flow rate through each filter can be measured, controlled, and totalized for in-process and downstream uses.

Painting and Protective Coatings

The overall condition of the coatings pipes, valves and fittings were inspected in the Upper Gallery. Considerable peeling of paints and coatings were noticed and it was determined that, in order to provide an additional 25 years of service life, the vast majority of the piping in the Upper Pipe Gallery of the Filter Building needs to be sand-blasted and recoated with Epoxy or other suitable coating systems. The coating on the Filter Effluent pipes (green color) and Filter Influent pipes (gray color) appeared to be in the worst condition. All green and gray piping needs to be sand blasted and recoated. The Filter Backwash water piping (brown color), as well as the air inlet lines (light green color), also need to be spot blasted and recoated in areas with localized coating peeling.

The twelve (12) 24" Backwash Waste Valves (located outside of the lower pipe gallery) were inspected from the Filter Catwalk. The electric operators for ten (10) of the twelve (12) are old (1986), outdated and some are missing (Filter No. 1) or are only operable by manual hand-wheel only (Filter Nos. 6 and 8). The Two electric operators on Filters 4 and 9 appeared to be newer, replacement units, and may not need to be replaced.

Note: Need to add the two level sensors and their installation columns in the Upper pipe Gallery.

AECOM

AECOM
400 W. 15th Street
Suite 500
Austin, Texas 78701
www.aecom.com

512 472 4579 tel
512 472 7519 fax

Memorandum

To	AECOM File	Pages	2
CC	Marci O'Connel		
Subject	SAR Filter Building – Lower Pipe Gallery Equipment Observation Site Visit		
From	Abu Alam		
Date	05/02/2011		

On Monday, May 2, AECOM engineers observed the operations and current condition of the Lower Pipe Gallery equipment at the SAR Filter Building. Also observed were the following:

1. Operating positions of the Slide gates at the outlets of Clear Well No. 1 and Clearwell No. 2;
2. Operating positions of the Sluice gates at the inlets to the Clearwell No.1 and Clear No. 2;
3. Flow and Surge conditions in Junction Box No. 5;
4. Operating positions of the Sluice Gates in Junction Box No. 6; and
5. Operating positions of the Sluice Gates of Junction Box No. 9.

The Slide Gate at the outlet of Clearwell No. 2 was found to be set at full open position and the Slide Gate at the outlet of Clearwell No. 1 was set at about 90 to 95 percent open position. **At the set positions found in the field, these two outlet Slide Gates would not cause backwater and flooding condition reported by the SAR representatives at normal flow river level.**

Junction Box No. 5 was observed to be very noisy. On close examination, a surge condition was noticed at the out of Sluice Gate 802 with surges of air bursting out, against the water flow direction, at interval of about 20 seconds or less. Very little air was coming out of the 12" Air Vent designed to release any air entrained in the pipe from Train C connected to the 60" fabricated pipe which ties into the Filter Building Influent Pipe immediately downstream of Junction Box No. 5. Entrainment of a significant quantity of air was noted at the entrance to the 60" pipe leading from Junction Box No. 9 to Junction Box 5. SAR Operators partially closed the Sluice Gate at our request to see if air entrainment could be minimized by creating a small backwater effec. However, partial closure of the Sluice Gate did not reduce air entrainment in Junction Box No. 9 and air surging at the Gate in Junction Box No. 5. **However, it was noted that during the short period of partial closure of the Sluice Gate in Junction Box No. 9 a considerable amount of foam (4-6 inches thick) accumulated in Junction Box No. 9. Once the Sluice Gate was raised, this foam was able to pass the gate and entered into the 60" line leading to Junction Box No. 5. It appears that Foam from Train C may be continuously entering the 60" pipe. It is likely that this foam is accumulating on top of the 60" fabricated pipe and may be obstructing the 12" Air Vent. As a result, entrained air cannot escape freely through the 12" Vent Pipe and may be causing the observed surge. This surging issue needs to be resolved to prevent damage to the pipe and the gate.**

The operating positions of the two Sluice Gates in Junction Box No. 6 were observed. One Sluice Gate was found to be set at approximately 50% open position and the other was found at 100% open position. SAR representatives explained that this partial closure of the first gate is needed to allow some flow to pass through the second gate and to increase contact time and mixing for dechlorination of Filter Effluent. No backwater was observed in Junction Box No. 6 under this partial (50%) closure of the first gate. **Operators assisting AECOM**

Engineers stated that they have not seen any water backing up in Junction Box No. 6, No. 9, or inside the Filter Plant under normal water levels in the River. However, they have to shut down the Filters when the river is at flood conditions.

In the Lower Pipe gallery, one of the three Mud Well Pumps (Pump No. 1) was operating at the time of AECOM observation. Operators assisting AECOM Engineers stated that Mud Well Pump No. 2 has not been operated for some time and that the motor for Pump No. 3 has been having short-circuiting issues lately and will not run continuously.

It was noted that the check valve on Pump No. 2 appeared to be stuck at the full open position and that the check valve on Pump No. 3 appeared to be stuck partially open. This condition of open check valves on Pump Nos. 2 and 3 while Pump No. 1 is operating would allow some pumped flow to reenter the Mud Well through Pump Nos. 2 and 3, effectively circulating water in and out . However, AECOM Engineers did not notice any reverse rotation of the Pump Nos. 2 or 3 due to backflow through these two pumps. The appearance of these valves being partially open was noted to Randy Pohren, who sent an Operator to close the discharge Plug Valve of Pump No. 3. **AECOM Engineers suggested that the Operators should note the flow rate out of the Mudwell to see if, by closing this valve, there has been any noticeable increase in pumping rates. The check vales on the pump discharges and the Keystone Plug valves on both the suction and discharge lines of all three pumps are old, in very poor condition and are being operated beyond their service life.**

The packing gland in Operating Mud Well Pump No. 1 was observed to be leaking profusely. The floor area around the three Mud Well Pumps was found to be flooded during AECOM inspection due to leaking of the packing glands. It was noted that the flooding was pooling away from the Filter Building Sump. Two SAR representatives reported that the packing glands in the three Mud Well Pumps were never replaced during their service life of more than 25 years. The packing glands have been adjusted and tightened a number of times during the service life. **The three Mud Well Pumps were observed to be in very poor operating condition.**

The condition of the 12 manually operated 6"Drain valves (one from each Filter) were observed next. All the drain valves were observed to be in good operating condition with no leaks from any of the Gear boxes.

The Filter Effluent Valves were inspected and discussed with SAR personnel. It was noted that the operator for the 60" BFV for Filters 1-6 was leaking grease and the motor had been replaced in June of 1998. Filters 7-12 effluent valve and operator appeared to have been recently serviced, or at least cleaned. Grease which had been leaking was cleaned off of the operator and the floor below. The operator motor on this valve appeared to be the original to the unit. Both of these valves were originally intended to be used to control the effluent flow rate and thus the water level within the filter cells, automatically. These units are currently set in manual mode and at full open.

In the lower gallery, the paint on the 12" air supply pipes and fittings for backwashing were found be peeling extensively and requires sand blasting and recoating. The air supply lines in the upper gallery were found to be in relatively good condition with localized peeling that will require spot sand blasting and recoating.

The Mud Well Pump discharge pipes and fittings were observed to be peeling at a few localized places but otherwise appeared to be mostly in good condition.

The paint on most of the 6" Filter drain pipes were found to be in reasonably good condition with paint peeling in only localized areas peel.

Considerable peeling of painting on all the 42" Filter Effluent Pipes and fittings were found during AECOM inspection. These pipes and fittings require sand blasting and recoating.

The paint on the 60" Filter Influent Riser Pipes were noted to be peeling and requires sand blasting and recoating.

AECOM

AECOM
400 W. 15th Street
Suite 500
Austin, Texas 78701
www.aecom.com

512 472 4579 tel
512 472 7519 fax

Memorandum

To	AECOM File	Pages	2
CC	Marci O'Connell		
Subject	SAR Filter Building – Backwashing of Effluent Filters		
From	Abu Alam		
Date	05/02/2011		

On Monday, April 25 AECOM engineers observed the current filter backwashing steps and procedures practiced by the City of Austin. Backwashing of two filters (#4 and # 5) were observed. The filters at the SAR WWTP are deep bed (48") single media sand filters (Design Effective size: 1.9 mm to 2.1 mm and Uniformity coefficient: 1.60 Maximum)

Filter # 4 was backwashed in the morning by one of the City of Austin Operators. Following procedures were used for backwashing the Filter:

1. Operator selected Filter # 4 for backwash by using a Selector Switch on the Main Control Panel in the MCC/PLC Room.
2. Operator then moved to the Filter Operations Control Panel for Filter #4 located in the Main Gallery.
3. Operator then used a Selector switch to close the Influent Valve to Filter #4 and allowed the tow filter beds to drain to the top of the wall of the Influent Gullet.
4. The Butterfly valve at the Gullet outlet was then opened by the Operator to allow the backwash water to drain.
5. Aeration Blower # 2 was then started from the Filter Control Panel and the two Air Inlet Valves were then opened to allow air to flow into the Air/Water Backwash Nozzles located in the Filter Underdrain. This started the initial air scour of the Filter Bed.
6. As air started to flow up through the filter bed the sand bed expanded. Air flow from the blower was noted to be 4500 scfm. At this flow rate air flow rate through the two beds (12'w x 36' L) was estimated to be 5.20 scfm/ft^2.
7. Expansion of the beds was noted to be excessive. Filter media was seen to come up to near the top of the Effluent Gullet and was estimated at over 2.5 ft. This amounted to a bed expansion of over 60 percent.
8. Air scour was continued for about 11 minutes and the backwash water was then initiated manually.
9. Air flow distribution through the filter bed was non-uniform with parts of the bed receiving excessive amount of air while other parts of the filter received lesser amount of air. As a result parts of the two filter beds were clear with air coming out through the bed while at other parts where air flow was less foam accumulated on the water surface.
10. Backwash water flow rate was noted to be 7,625 gpm. This amounts to a flow rate of 8.83 gpm/ft^2. Once the water backwash started the total air flow rate dropped to 4260 scfm. This amounted to a flow rate of 4.93 scfm/ft^2.
11. Combined air and water backwash was continued for over 10 minutes. Bed expansion during this combined air and water backwash was noted to be about 3.0 ft. This amounted to about 75 percent expansion of the filter bed.
12. Air supply was then shut down and the filter bed was washed by water alone. Back wash with water was continued for over 10 minutes.

13. It was noted that backwash water coming out of through parts of the filter bed remained cloudy throughout the entire backwash period. This indicated that the filter bed was not completely clean after the backwash.

Filter # 5 was backwashed in the afternoon by one of the City of Austin Operators. Following procedures were used for backwashing the Filter:

1. As before Operator selected Filter # 5 for backwash by using a Selector Switch on the Main Control Panel in the MCC/PLC Room.
2. Operator then moved to the Filter Operations Control Panel for Filter # 5 located in the Main Gallery.
3. Operator then used a Selector switch to close the Influent Valve to Filter # 5 and allowed the tow filter beds to drain to the top of the wall of the Influent Gullet.
4. The Butterfly valve at the Gullet outlet was then opened by the Operator to allow the backwash water to drain.
5. Aeration Blower # 2 was then started from the Filter Control Panel and the two Air Inlet Valves were then opened to allow air to flow into the Air/Water Backwash Nozzles located in the Filter Underdrain. This started the initial air scour of the Filter Bed.
6. As air started to flow up through the filter bed the sand bed expanded. Air flow from the blower was noted to be 4500 scfm. At this flow rate air flow rate through the two beds (12'w x 36' L) was estimated to be 5.20 scfm/ft^2.
7. Expansion of the beds was noted to be excessive. Filter media was seen to come up to near the top of the Effluent Gullet and was estimated at over 2.5 ft. This amounted to a bed expansion of over 60 percent.
8. Air scour was continued for about 12 minutes and the backwash water was then initiated manually.
9. Air flow distribution through the filter bed was non-uniform with parts of the bed receiving excessive amount of air while other parts of the filter received lesser amount of air. As a result parts of the two filter beds were clear with air coming out through the bed while at other parts where air flow was less foam accumulated on the water surface.
10. Backwash water flow rate was noted to be 8,000 gpm. This amounts to a flow rate of 9.26 gpm/ft^2. Once the water backwash started the total air flow rate dropped to 4,250 scfm. This amounted to a flow rate of 4.92 scfm/ft^2.
11. Combined air and water backwash was continued for about 15 minutes. Again bed expansion during this combined air and water backwash was noted to be about 3.0 ft. This amounted to about 75 percent expansion of the filter bed.
12. Air supply was then shut down and the filter bed was washed by water alone. Back wash with water was continued for about 15 minutes.
13. It was noted that backwash water coming out of through parts of the filter bed remained cloudy throughout the entire backwash period. This indicated that the filter bed was not completely clean after the backwash.

AECOM

AECOM
400 W. 15th Street
Suite 500
Austin, Texas 78701
www.aecom.com

512 472 4579 tel
512 472 7519 fax

Memorandum

To	AECOM File	Pages	1
CC	Marci O'Connell		
Subject	SAR Filter Building – Filter Media Inspection		
From	Abu Alam		
Date	05/17/2011		

On Tuesday, May 17, AECOM engineers visited the SAR Filter Building to confirm an anomaly noted in the IMC Consulting Preliminary Filter Examination Report. In IMC's field investigation and subsequent report it was noted that one of the cells in Filter No. 11 was found to be missing the vast majority of its filtration media, approximately 42 inches of the 48 inches of the media was found to be missing.

AECOM engineers went back out to the site in order to confirm this finding.

Upon inspection, the media is clearly visible and has pooling water on one side of the filter, with only water visible on the other. Measuring from the top of concrete at the filter catwalk, down to the visible media in the left cell, it was found to be an average of about 15 feet. Using the same method on the right cell, the measuring device confirmed the IMC report that the media was at an elevation approximately 19-feet below the top of concrete. This would entail that there is only 6-8 inches of media remaining in this filter cell. AECOM will evaluate this loss of filter media in one side of Filter No. 11 to determine the cause for filter media loss.

Appendix 2.5:

Electrical Condition and Required Improvements for Upgrading Existing Filters

Prepared by

Harutunian Engineering Incorporated
December 2011

STATE OF TEXAS
K. A. HARUTUNIAN
59181
LICENSED
PROFESSIONAL ENGINEER

1/3/2012

City of Austin

South Austin Regional Wastewater Treatment Plant
Filter Improvements Project

TECHNICAL MEMORANDUM
FILTER IMPROVEMENTS ELECTRICAL

December 2011

CITY OF AUSTIN

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

TECHNICAL MEMORANDUM
FILTER IMPROVEMENTS PROJECT

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Exhibit E-1: Filter Building Proposed Overall One-Line Diagram

1.0 INTRODUCTION AND OBJECTIVES

Harutunian Engineering, Inc. (HEI) performed the preliminary electrical design for the South Austin Regional Wastewater Treatment Plant (SARWWTP) Filter Improvements project as outlined in this Technical Memorandum (TM).

Analysis was performed for the facility using the specific proposed process/mechanical loads provided which are summarized in Table 1.0.

Table 1.0 Proposed Process/Mechanical and HVAC Loads for Filter Building
City of Austin South Austin Regional Wastewater Treatment Plant

Process Equipment	Rated Horsepower per unit	Total Quantity	Rated Service Factor
Process/Mechanical Alternative 1 (1)			
Air Scour Blower (ASB)	200	2	1.0
Backwash Pump (BWP)	150	2	1.0
Mudwell Pump (MWP)	100	3	1.0
Filter Drain Valve	1.5	12	1.0

Notes:
1. All other loads are assumed to have the same rating as the existing equipment and are not listed here.

An objective of this TM is to propose an electrical design alternative in order to support the proposed process/mechanical system design, to propose options or variations to the proposed design alternative, and finally to present preliminary electrical construction cost opinions for the proposed design alternative and options.

1.1 TM Organization

The first section of the TM discusses the existing electrical system. The second section of the TM details the proposed electrical system to support the process/mechanical system. This is followed by a detailed description of the design alternative.

2.0 EXISTING ELECTRICAL SYSTEM

2.1 Existing System Description

This subsection describes general characteristics associated with the existing power distribution system of the Filter Building. The major equipment of the power distribution system is located indoors in the Electrical Room of the existing Filter Building. The Filter Building power distribution system is served by two close-coupled 480V motor control centers MCC-A and MCC-B, each with 2000 ampere ampacity.

MCC-A and MCC-B receive the Filter Building's electrical service via the 1500kVA 4160V:480V outdoor located transformers T3 and T4 respectively. The 480V service feeders from the transformers to the MCCs route through an above ground electrical closet and a wireway to connect to the MCCs. Service transformers T3 and T4 are served from separate feeders from the 4160V load break switchgears MCC-5000A and MCC-5000B located inside the Filter Power Center.

MCC-A and MCC-B are each Westinghouse 5 Star with 2000A ampacity, 42kA short circuit bracing, and are arranged in a close-coupled Main-Tie-Main configuration with key interlocked main and tie circuit breakers. These motor control centers date to the original construction of the Filter Building, circa 1988, and serve all of the loads in the Filter Building.

The MCCs also serve other lighting, auxiliary power, and control power loads through two dry-type transformers and their respective panelboards. The existing air scour blowers, backwash pumps, and mudwell pumps are started with reduced voltage autotransformer (RVAT) type starters located in the motor control centers. Starters for the sump pumps, supply fans, and exhaust fans are started full voltage and are also located in the motor control centers. The existing MCCs do not contain power factor correction capacitors and power factor correction was not observed for any load in the Filter Building.

There are two 480V 400A panels in the Electrical Room, DA and DB, serving the filter valve actuators for filter nos. 1 through 6, and 7 through 12 respectively. MCC-A serves panel DA and MCC-B serves panel DB. There are no provisions for automatic switching of the source for these filter valve power panels during an outage. Under the existing configuration, the power source to the filter valve actuators can only be switched from one MCC to the other by opening one of the main MCC breakers and closing the tie circuit breaker.

There are two 225kVA 480V:120/208V dry-type transformers in the Electrical Room, T5 and T6. Each of these transformers receives service from each MCC; the associated feeder circuit breakers are key-interlocked such that only one circuit breaker is energized per transformer. The respective transformer primary feeders combine in a junction box at the primary winding of each transformer. Note there are no provisions for automatic switching of the source during an outage. The feeding breakers must be manually opened and closed to restore service. The respective transformers serve panelboards located in the electrical room as well as in the control room.

2.2 Existing System Assessment

The existing design load of the entire filter building incorporating significant diversity is 1327kVA, excluding inrush. The application of diversity in the determination of the existing design load includes the following considerations:

- A maximum of one filter backwash at a time. Backwashes of multiple filters are not overlapped.
- While a backwash is in progress for a given filter, the motorized valves of other filters do not change position
- Redundant process/mechanical equipment is de-energized
- No load operates in its service factor
- Significant load diversity applied to auxiliary power distribution system panelboards

Additionally, it appears that certain motors may be operating at less than their full load nameplate value. It also appears that the electric heating and air conditioning may not be simultaneously operating at their full rating.

The bus ampacity of MCC-A and MCC-B as well as their respective service feeders and service transformers T3 and T4 are adequately sized to handle the design load of the facility provided the significant filter building load diversity is applied as previously discussed. The application of the described load diversity precludes the ability for load increases or load additions to the existing motor control centers.

Most of the distribution equipment in the Filter Building is the original equipment installed circa 1988. This facility has flooded in the past. Additionally, water has entered the MCC in the past through the main service conduits independent of other building flood events. Combined, the past flood events have exacerbated the deterioration of the electrical distribution equipment. With the past six months, one of the air scour blower motor starter sections experienced a substantial fire that required complete refurbishment of all interior starter components. Substantial corrosion was observed on the motor control centers and other equipment in the electrical room and this equipment has passed its useful service life.

3.0 SUMMARY OF PROPOSED ELECTRICAL SYSTEM

This section of the TM will detail the proposed electrical system. It begins with a brief summary description of the proposed design alternative, followed by a detailed description of the proposed system, issues regarding power quality, power metering and protection, and a general description of the miscellaneous electrical subsystems. HEI has developed a design alternative to support the proposed process/mechanical system design. The design alternative provides an overall design concept for the proposed electrical improvements.

Specific design recommendations can be provided after the design workshop is conducted.

3.1 Proposed Power Distribution System – Overview

This subsection describes the general characteristics of the power distribution system design alternative. The following subsections provide detailed descriptions of each of the major components of the proposed distribution system.

Table 3.1 illustrates the load requirements of the Filter Building (excluding system inrush) based upon the preliminary load data shown in Table 1.0 as well as existing load information.

Table 3.1 Listing of Design Loads for the Filter Building, Excluding System Inrush

City of Austin South Austin Regional Wastewater Treatment Plant

Process Area	Preliminary Proposed Load (kVA)
	Process/Mechanical Alternative
Filter Building (1) (2)	1327

Table Notes:

1. Proposed motor efficiency and power factor were assumed by HEI. All loads were computed using the pump motor service factor shown in Table 1.0. Provisions for spare loads were not included.
2. The existing load value presented takes into account the process/mechanical equipment that is associated with the proposed process/mechanical design alternative as well as the significant diversity of the existing Filter Building load previously described. The load value assumes no changes are made to existing loads or the diversity other than those previously described herein.

Based on the power requirements of the air scour blower and pump loads and the available manufactured distribution equipment, the proposed loads will operate at 480V. The total proposed load for the Filter Building is expected to remain relatively unchanged. No changes are anticipated for the dual feed 4160V service from the Filter Power Center to the existing 4160V:480V 1500kVA outdoor located pad mounted transformers.

It is proposed that the 1500kVA transformers serve new 480V 2000A main-tie-main secondary selective indoor located close-coupled switchboard and motor control center lineups (SWBD/MCC). These new SWBD/MCC lineups would replace the existing close-coupled motor control center (MCC). The existing duct bank and feeders routing between the service transformers and the north side of the Filter Building will be reused in the renovation. Additionally, the existing service conduit bank routing along the north wall between the Control Room and the Electrical Room will be reused to feed the proposed close-coupled SWBD/MCCs.

Needs for future facility expansion have not been identified. Subsequently, provisions for future facility expansion have not been included in the power distribution system design. Should changes to the load diversity be desired, the power distribution system will need to be expanded accordingly.

All of the proposed power distribution equipment will be located indoors, inside of the Filter Building, in the environmentally controlled electrical and control rooms. Some of the proposed distribution equipment will be placed in locations in the electrical room that were previously reserved for future medium voltage switchgear that was to serve effluent pumps. It is the team's understanding that effluent pumps are no longer required and the space in the electrical room is available for use under this project. Using this space will facilitate more optimal use of the electrical room.

The standardization of the equipment is proposed to facilitate maintenance by minimizing the amount of equipment stocked and decreasing unit costs due to bulk purchases of similar equipment.

3.1.1 Low Voltage Power Distribution System

This subsection of the TM describes the low voltage power distribution system for the Filter Building.

Under this alternative, each SWBD/MCC will serve an automatic transfer switch (ATS) that is dedicated to serve a 480V power distribution panel (PDP). This PDP will serve multiple 480V:120/208V dry-type transformers and panelboards for lighting, auxiliary, and control power loads throughout the building.

Multiple 480V:208/120V auxiliary and control power transformers are proposed to serve 120/208V panelboards for auixiliary power and control power distribution. These will in large part replace the existing auxiliary power distribution system. Some modifications to the panelboard and transformer locations from the existing locations are anticipated to optimize use of space. Preference will be given to locating the majority of the distribution equipment in the electrical room. It appears that certain equipment may need to be located in the control room.

It is proposed that each SWBD/MCC will serve a second ATS that feeds a dedicated 480V PDP that will distribute power to dedicated filter cell panelboards. Each 480V filter cell panelboard will serve the motorized valve loads associated with the respective filter. It is anticipated that all motorized valve actuators will be provided with integral starters. To enhance maintenance, additional automatic transfer switches with associated distribution panels can be added in order to assign specific groups of filters to separate buses.

It is anticipated that all motorized valve actuators will be provided with integral starters

3.2 Power Quality Issues

This subsection describes power quality considerations for the proposed power distribution system.

3.2.1 Power Factor Considerations

Power factor correction capacitors (PFCCs) are proposed for the major process loads to improve the efficiency of the distribution system, provide more capacity, and to avoid any future power factor penalties that may be imposed by the utility. It is proposed that dedicated PFCCs be provided for each proposed pump sized three horsepower and greater that is provided with an induction motor. It is anticipated that induction motors will be provided for this project. The size of the existing electrical room precludes the installation of the power factor correction capacitors in the MCCs, although this is preferred. It is anticipated that the capacitors will be located at the motor terminal boxes.

3.2.2 Starting of Large Process Motors

It is proposed that large process motors will be started with reduced voltage starters. Reduced voltage motor starters will be applied on motors when the motor horsepower is greater than 50 horsepower.

The starting of large motors can cause significant inrush currents which results in large voltage dips on the distribution buses. These voltage dips can negatively affect equipment. The air scour blowers, backwash pumps, and mudwell pumps are proposed to be served by reduced voltage autotransformer (RVAT) starters.

The "solid state" reduced voltage starter (RVSS) type could potentially be used for an adjustment to the preliminary electrical and I&C construction cost opinion. Of all the available reduced voltage starter types, the use of RVSS type starters would help facilitate the most gradual application of motor torque to the pump during starting. If the use of solid state reduced voltage starters is considered, attention will also need to be given to address the application of power factor correction capacitors at this existing facility. The use of an RVSS starter with a PFCC located at the motor terminal box is problematic. As discussed previously, the PFCCs for this project will need to be located at the motor terminal box. The use of RVSS starters is not anticipated for this project.

3.2.3 Proposed Motor and Power Distribution Equipment Efficiency

To minimize overall energy costs, all process equipment, ventilation equipment, and air handling unit motors and distribution transformers will be specified as high efficiency where possible. When it is not possible or economically practical for such equipment to be high efficiency, the highest efficiency equipment possible or economically practical will be employed.

Refer to other subsections of this TM and the process/mechanical TM for additional efficiency related analysis associated with the specific proposed design alternatives.

3.3 Power Metering and Protection Issues

Microprocessor-based power monitoring equipment is proposed to be installed at the incoming power source (line side) in the low voltage switchboard.

For the air scour, backwash, and mudwell pump motors, a microprocessor-based motor protection relay unit will be installed on the MCC at the load side of the branch feeder/starters serving the load.

Each power-monitoring/protection unit is proposed to have standard control interface ports, including RS-232C and RS-485 serial communication ports for peripheral programming and data transfer via the Ethernet communication protocol over an Ethernet communication network. This network is proposed to interface with the respective PLC. The above-discussed values monitored by the power monitoring units and motor protection relays will be telemetered to the Top-End system by the PLC. Each unit will also have a digital display of measured/telemetered parameters for local display. Also refer to the distributed control system architecture Exhibits for additional information regarding the data communication network interconnection.

3.3.1 Lighting and Convenience Receptacles

As a cost savings measure, it is proposed to re-serve existing lighting and convenience receptacle circuiting where possible. The Preliminary Conceptual Electrical and I&C Construction Cost Opinion will need to be increased to add new lighting and convenience receptacles.

3.3.2 Raceway System

The electrical wiring raceways will consist of a conduit system. Conduit routing methodology will be aboveground and exposed. To the extent possible, the conduit system will be routed exposed.

Where duct banks are required, conduit bodies and systems concealed below slab or buried underground shall be corrosion resistant and shall be made of Schedule No. 40 PVC per NEC requirements. In recognition of the project life cycle, it is proposed to encase such conduit systems in a reinforced concrete-encased duct bank.

Conduits shall not be filled greater than the 40-percent maximum fill percentage as allowed by the NEC.

Raceway Routing Inside of the Existing Filter Building:

The existing record drawings of the Filter Building indicate numerous raceway systems were installed embedded in the floor slab of the various levels of the Filter Building structure. It also appears that rigid galvanized conduits were used for the raceway system. There are certain risks associated with the reuse of such an existing raceway system that warrant further discussion.

Field investigation of the existing raceway systems has not been performed and the integrity of the conduit system embedded within the floor of the building for wire installation is unknown. In consideration of the application, the assumption was made that the existing conduits cannot be reused and new conduits are required. It is anticipated to continue with this assumption during the subsequent phases of this project and the Preliminary Conceptual Electrical and I&C Construction Cost Opinion reflects this assumption.

Additionally, the routing of new raceway systems is made problematic as it is not presently known where the existing raceway systems are located in the floors of the building. Additional field investigations such as "x-ray" of the structure are warranted to identify candidate routes for the new raceway system that will minimize impact to the existing structure. If these investigations are performed during the construction phase, then a project change order(s) and subsequent increase in construction cost may be needed to implement the project's objectives once the actual field conditions are discovered.

The majority of the proposed raceway system is anticipated to be routed in the Pipe Gallery level of the building structure.

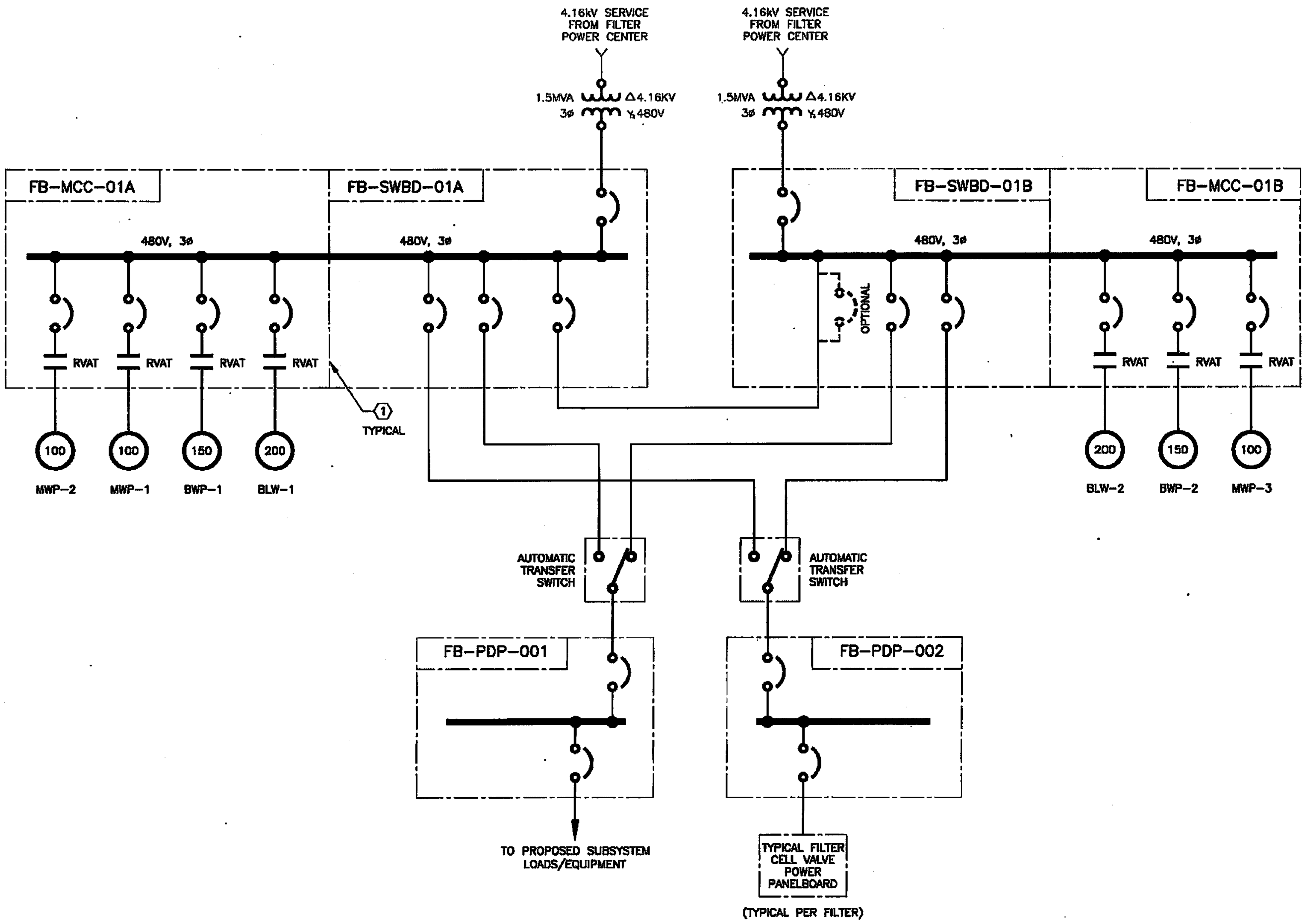
Modifications may be needed to the existing HVAC duct work located in the electrical room to facilitate the raceway system installation. Similarly, modifications to a roof hatch may be warranted in the backwash pump room to facilitate raceway routing in this room. It appears certain hatches in this room may have been intended for the effluent pumps which may no longer be required.

3.3.3 Electrical, Instrumentation, and Control Wiring

All 600-Volt power wiring will be copper with 600-Volt insulation when serving equipment rated 600 Volts and below. All 600-Volt I&C system wiring will be copper. It is proposed to maintain separation between the power/control and instrumentation wiring such to facilitate safety and maintenance of the process equipment during operation.

It is proposed to utilize 600-Volt rated single conductor control/power cable for process related equipment.

For the non-fiber optic-based I&C wiring systems, it is proposed that the physical routing of the conduit/duct bank systems associated with the I&C systems be segregated from those of the power distribution system.



KEY NOTES:

① EQUIPMENT SHOWN ARE CLOSE-COUPLED.

GENERAL NOTES:

1. THIS EXHIBIT IS INTENDED TO REPRESENT AN OVERVIEW OF THE PROPOSED POWER DISTRIBUTION SYSTEM. ONLY MAJOR ELECTRICAL EQUIPMENT HAS BEEN SHOWN FOR CLARITY.
2. THIS PRELIMINARY DESIGN EXHIBIT IS BEING SUBMITTED AS PART OF A PRELIMINARY DESIGN TECHNICAL MEMORANDUM AND IS FOR INFORMATIONAL PURPOSES ONLY. REFER TO THE TECHNICAL MEMORANDUM FOR ADDITIONAL INFORMATION PERTAINING TO THIS EXHIBIT. THIS EXHIBIT IS PRELIMINARY AND IS NOT TO BE USED FOR BIDDING, PERMITTING, OR CONSTRUCTION PURPOSES.
3. DARK LINEWORK DENOTES PROPOSED ITEMS. LIGHT LINEWORK DENOTES EXISTING ITEMS.

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<u>It is not to be used for construction, bidding, or permit purposes.</u>

HARUTUNIAN
ENGINEERING
INCORPORATED
TEXAS REGISTERED
ENGINEERING FIRM
F-2408

SOUTH AUSTIN REGIONAL WWTP
FILTER IMPROVEMENTS PROJECT
CITY OF AUSTIN , TEXAS
CIP NO. 3333.018

FILTER BUILDING
PROPOSED OVERALL ONE-LINE DIAGRAM
DESIGN ALTERNATIVE NO. 1

AECOM
AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

EXHIBIT No. E-1 | JOB No. 2011-400 | DATE: JULY, 2011

South Austin Regional WWTP Filters Improvements Project Preliminary Conceptual Electrical and I&C Construction Cost Opinion

Proposed Category	Cost Per Each Category in Dollars	Total Quantity	Total Cost In Dollars
Filter System Electrical and I&C Support Common to All Alternatives			
Backwash Pumping Units			
Field I&C Equipment	$7,610.77	2	$15,221.54
Raceway, wiring, and support	$14,885.96	2	$29,771.92
Backwash Pumping Units Subtotal			**$44,993.46**
Backwash Pump Station Discharge Header Support			
Field I&C Equipment	$11,796.91	1	$11,796.91
Raceway, wiring, and support	$21,291.02	1	$21,291.02
Backwash Pump Station Discharge Header Support Subtotal			**$33,087.93**
Clearwell Support			
Field I&C Equipment	$10,595.25	2	$21,190.50
Raceway, wiring, and support	$2,813.70	2	$5,627.40
Clearwell Support Subtotal			**$26,817.90**
Air Scour Blowers			
Field I&C Equipment	$11,950.24	2	$23,900.48
Raceway, wiring, and support	$32,584.46	2	$65,168.92
Air Scour Blowers Subtotal			**$89,069.40**
Air Scour Blowers Discharge Header Support			
Field I&C Equipment	$8,971.89	1	$8,971.89
Raceway, wiring, and support	$15,805.26	1	$15,805.26
Air Scour Blowers Discharge Header Support Subtotal			**$24,777.15**
Power Distribution System			
Distribution Equipment	$1,145,911.21	1	$1,145,911.21
Raceway, wiring, and support	$434,375.94	1	$434,375.94
Power Distribution System Subtotal			**$1,580,287.15**

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Proposed Category	Cost Per Each Category in Dollars	Total Quantity	Total Cost In Dollars
Miscellaneous Process/Mechanical Equipment Support (Air compressor, Sump pumps, etc.)			
Raceway, wiring, and support	$8,234.76	1	$8,234.76
Miscellaneous Process/Mechanical Equipment Support (Air compressor, Sump pumps, etc.) Subtotal			**$8,234.76**
Demolition of existing systems			
Filter Field I&C Equipment	$3,933.73	12	$47,204.76
Temporary Systems	$36,867.75	1	$36,867.75
Main Distribution and Control Equipment	$37,057.80	1	$37,057.80
Raceway, wire, and support	$13,561.20	1	$13,561.20
Demolition of existing systems Subtotal			**$134,691.51**
Influent Header and Gallery Support			
Field I&C Equipment	$21,533.06	1	$21,533.06
Raceway, wiring, and support	$20,312.04	1	$20,312.04
Influent Header and Gallery Support Subtotal			**$41,845.10**
Mudwell Pumping Units			
Field I&C Equipment	$11,464.03	3	$34,392.09
Raceway, wiring, and support	$12,492.83	3	$37,478.49
Mudwell Pumping Units Subtotal			**$71,870.58**
Mudwell Pump Station Common Support			
Field I&C Equipment	$15,227.67	1	$15,227.67
Raceway, wiring, and support	$14,577.66	1	$14,577.66
Mudwell Pump Station Common Support Subtotal			**$29,805.33**
Heating, Ventilation, and Air Conditioning Equipment Support			
Raceway, wiring, and support	$57,199.28	1	$57,199.28
Heating, Ventilation, and Air Conditioning Equipment Support Subtotal			**$57,199.28**
Filter System Electrical and I&C Support Common to All Alternatives Subtotal (No Contingency):			**$2,142,679.55**

South Austin Regional WWTP Filters Improvements Project Preliminary Conceptual Electrical and I&C Construction Cost Opinion Summary

Proposed Category	Cost Per Each Category in Dollars	Total Quantity	Total Cost In Dollars
Filter System I&C Design Alternative No. 1			
Main Control Panel and Common OIU			
Control Panels	$485,488.81	1	$485,488.81
Raceway, wiring, and support	$40,198.28	1	$40,198.28
Main Control Panel Subtotal:			**$525,687.09**
Filter Cell Support			
Filter Control Console	$57,300.71	12	$687,608.54
Field I&C Equipment	$43,570.20	12	$522,842.43
Raceway, wiring, and support	$46,146.31	12	$553,755.67
Filter Cell Support Subtotal			**$1,764,206.64**
EIC Support Common to All Design Alternatives			**$2,142,679.55**
Total Design Alternative No. 1 Filter System Electrical and I&C (No Contingency):			**$4,432,573.28**
Filter System I&C Design Alternative No. 2			
Main Control Panel			
Control Panel	$452,332.29	1	$452,332.29
Raceway, wiring, and support	$34,246.72	1	$34,246.72
Main Control Panel Subtotal:			**$486,579.01**
Filter Cell Support			
Filter Control Console	$70,019.38	12	$840,232.56
Field I&C Equipment	$43,570.20	12	$522,842.43
Raceway, wiring, and support	$46,146.31	12	$553,755.67
Filter Cell Support Subtotal			**$1,916,830.65**
EIC Support Common to All Design Alternatives			**$2,142,679.55**
Total Design Alternative No. 2 Filter System Electrical and I&C (No Contingency):			**$4,546,089.21**

South Austin Regional WWTP Filters Improvements Project Preliminary Conceptual Electrical and I&C Construction Cost Opinion Summary

Proposed Category	Cost Per Each Category in Dollars	Total Quantity	Total Cost In Dollars
Filter System I&C Design Alternative No. 3			
Main Control Panel and Common OIU			
Control Panels	$485,488.81	1	$485,488.81
Raceway, wiring, and support	$40,198.28	1	$40,198.28
Main Control Panel Subtotal:			**$525,687.09**
Filter Cell Support			
Filter Control Console	$86,363.76	12	$1,036,365.17
Field I&C Equipment	$43,570.20	12	$522,842.43
Raceway, wiring, and support	$48,881.35	12	$586,576.15
Filter Cell Support Subtotal			**$2,145,783.75**
EIC Support Common to All Design Alternatives			**$2,142,679.55**
Total Design Alternative No. 3 Filter System Electrical and I&C (No Contingency):			**$4,814,150.39**

Notes:

1) Excludes analysis transmitters
2) Contingency is not included and is assumed to be added to the overall construction cost opinion

Appendix 2.6:

Condition of Existing Instrumentation and Control System and Required Improvements for Upgrading Existing Filters

Prepared by

Harutunian Engineering Incorporated
December 2011

K. A. Harutunian

STATE OF TEXAS
K. A. HARUTUNIAN
59181
LICENSED
PROFESSIONAL ENGINEER

1/3/2012

City of Austin

South Austin Regional Wastewater Treatment Plant

FILTER BUILDING IMPROVEMENTS PROJECT INSTRUMENTATION AND CONTROLS SYSTEMS

December 2011

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CITY OF AUSTIN

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT

TECHNICAL MEMORANDUM
FILTER BUILDING IMPROVEMENTS
INSTRUMENTATION AND CONTROL SYSTEM

TABLE OF CONTENTS

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1.0 INTRODUCTION AND OBJECTIVES 3
  1.1 TM Organization 3

2.0 EXISTING FILTER BUILDING I&C SYSTEM 3

3.0 PROPOSED I&C SYSTEM OVERVIEW 4

LIST OF EXHIBITS

Exhibit I-1: Filter Building Overall Proposed Control System Architecture

1.0 INTRODUCTION AND OBJECTIVES

Harutunian Engineering, Inc. (HEI) performed the preliminary Instrumentation and Control (I&C) system design for the South Austin Regional Wastewater Treatment Plant (SARWWTP) project as outlined in this Technical Memorandum (TM).

An objective of this TM is to propose multiple I&C system design alternatives in order to support the proposed process/mechanical system modifications and to propose options or variations to the design alternatives.

1.1 TM Organization

The first section of the TM discusses the existing I&C system of the Filter Building. The second section of the TM details the proposed I&C system components. This is followed by a detailed description of all the design alternatives. A brief summary listing of all available options that may be applied to the design alternatives is provided.

2.0 EXISTING FILTER BUILDING I&C SYSTEM

This subsection describes general characteristics associated with the existing I&C system of the Filter Building.

There is a limited I&C system for the existing Filter Building. The control system architecture for the Filter Building consists of a programmable logic controller (PLC) installed as part of the SAR I&C project circa 1994, used for monitoring selected (minimal) points generated by the legacy hardwired filter control system. AWU I&C personnel have installed one PLC for monitoring and control of the backwash pumps, mudwell pumps, and air scour blowers. The PLCs are located indoors in the air conditioned control room level of the existing Filter Building. The PLCs are linked to the Top-End computer system via a dual channel fiber optic based communication link. Two series of PLCs are used at this facility, the Modicon 984 series installed as part of the SAR I&C project and the Modicon Quantum series installed by AWU I&C personnel for control of the backwash pumps, mudwell pumps, and air scour blowers.

The control logic for each filter is implemented using discrete hardwired control relays located in the filter control consoles. The hardwired control system provides means for manual step-by-step selection of the backwash process by Operations Personnel from the filter control consoles. Filter backwashing is performed manually from the filter consoles by Operations personnel, and Operations personnel must manually select each step of the backwash process to backwash each filter. Additionally, Operations personnel manually verify backwash permissives throughout the backwash process. Based upon feedback from Operations personnel, backwashing filters in this manner is a time consuming method of operation. The control equipment located in the filter control consoles appears to be in condition comparable to its age. Main control panel located equipment is further deteriorated due to environmental exposure.

This facility has flooded in the past. The past flooding has damaged numerous I&C system components located in the electrical room and pipe gallery level and exacerbated the deterioration of the I&C system equipment. Numerous failed components and related wiring appear to have been abandoned in place, further complicating maintenance. The PLC installed by AWU I&C personnel replicates certain hardwired control system functions that were lost when the building flooded in an attempt to restore operation to the Filter Building. An admirable effort has been made by AWU I&C personnel in their attempt to transition from a hardwired control system to a PLC based control system for the mudwell pumps, air scour blowers, and backwash pumps. It is noted that the PLC implementation by the AWU I&C personnel, while functional, is a minimalist type implementation, does not follow the present AWU standards for PLC based control system implementation, and is vulnerable to "single point of failure" type issues.

Numerous valve actuators in the filter gallery level are located such that they are inaccessible. The influent level elements are located near the ceiling of the filter gallery level and are also inaccessible. Various I&C components have been harvested from non-operational elements of other Filters to effect repairs to the filter control system.

There is machine monitoring in the form of winding and bearing temperature RTDs associated with the existing air scour blowers. This data is not telemetered to the Top-End system.

While the Quantum PLC was installed comparatively recently and is still supported by Modicon, the Modicon 984 PLC series is obsolete. The remaining existing hardwired I&C system components date to the initial Filter Building construction (circa 1986) and have passed their useful service life.

3.0 PROPOSED I&C SYSTEM OVERVIEW

The Filter Building is designed for operation using a Programmable Logic Controller (PLC) based control system with remote monitoring and control. The control system design criteria is to have as much reasonable automation as possible to achieve maximum efficiency and be sensitive to energy usage and cost without causing complexity to operations or maintenance personnel. This will be accomplished by utilizing a Distributed Control System (DCS) with an overall PLC for the Filter Building. The quantity and allocation of PLCs within the Filter Building is described in further detail below.

The majority of control functions shall be performed by PLCs in conjunction with a minimal quantity of hardwired (based upon electromagnetic relays) control functions. Hardwired control functions will be incorporated only for critical hydraulic functions, personnel safety/protection, machine protection, or where it provides the greatest cost effectiveness in the design. The control philosophy is thereby one that is highly reliant upon a functioning PLC network for automatic control. In the event of a PLC failure, provisions are to be available to operate any or all segments of the process, if necessary, with fully attended operation in a hand mode of operation. The control switches located adjacent to each piece of process equipment would enable the operator to run the equipment with close observation of field instrument monitors and would require fully attended operation.

It is proposed that, depending on the application, most individual process equipment would have means to provide the operator the ability to engage or disengage the equipment from operation. Such means, here called a Field Control Station (FCS), would be located near the equipment and generally would only be used should a particular PLC become nonfunctional or during maintenance activities for that process equipment. Operation at the FCS level of control will not include automatic coordination with the rest of the process and will require the operator's complete attention in order to operate the facility.

It is proposed to locate the PLC and most I&C equipment (except FCSs and field instruments) inside a centralized Main Control Panel (MCP), which is dedicated to the Filter Building and located indoors in the control room level in an air conditioned environment. The quantity of MCPs will be tailored to the application and is described in further detail below.

Proposed major primary sensing elements to monitor process variables necessary for monitoring and controlling the facility will be made available at the field (at instrument level on the field instrument), at an Operator Interface Unit (OIU), and at the top-end computer in the Administration building. The OIU provides a graphical presentation of the process with a touch-screen interface.

The following subsections of this TM describe specific features of the I&C system design concepts followed by general characteristics of the I&C systems.

3.1.1 Filter Building I&C System Design Alternative No. 1

Exhibit I-1 shows a conceptual control system architecture design alternative for the Filter Building.

As shown in the figure, the existing dual-channel single-mode Ethernet fiber optic network will be terminated at the Filter Building to facilitate communication between the Filter Building and the existing SAR Top-End computer system. It is proposed to install a dual-channel Ethernet copper network with star topology to facilitate communication between the individual controllers, respective OIUs, and power monitoring/protection units within the Filter Building. A dual channel single mode fiber optic based network between controllers within the Filter Building can be provided for an increase in the preliminary electrical and I&C construction cost opinion.

Dual-channel Ethernet media is recommended for reliability and ease of maintenance; however, a single-channel network may be implemented as a cost savings measure. It is observed that in the event a single-channel network interconnection between the Filter Building and the Top-End computer system is selected for implementation, the failure of the single-channel network communications system would affect plant operations. This failure could render the Filter Building isolated from the other process areas with no data transfer between them.

As shown for the Filter Building on Exhibit I-1, it is anticipated that one local control panel (LCP) will be provided per filter to contain I&C equipment dedicated to a respective filter. A visible OIU will be provided on the face of a centrally located LCP in the control room level for control and indication of selected points within the system in lieu of using discrete operators and indicators or additional OIUs assigned to each filter. One controller will be allocated per filter and the controller will be used to monitor and control the entire filter, i.e. filter motorized valves, filter level monitoring, etc. This design is modular, easily standardized, cost effective, and also assists in spatial planning considerations.

Additionally, one general purpose MCP is anticipated to contain the remainder of the I&C equipment that is commonly used by all filters such as the backwash pumping units, air scour blowers, and mudwell pumping units. A visible OIU will be provided on the face of the MCP for control and indication of selected points within the system in lieu of using discrete operators and indicators, and to assist in providing overall control of the Filter Building from the control room level of the building.

AWU has standardized on Modicon PLCs and the application of the various Modicon PLC families for use on this project will made based upon cost effectiveness with the general organization as follows:

- Quantum series for Main Filter Building PLC
- M340 series for individual Filter Cell and pumping unit PLCs as needed

Additionally, receptacles will be provided at each filter control console and main control panel to facilitate the communication network for the Filter Building mobile computer workstations.

3.1.1.1 Filter Building I&C Design Alternative No. 2

This design alternative includes Filter Building I&C Design Alternative No. 1 as a base system and alters only the application of OIUs. Under Filter Building I&C Design Alternative No. 2, each filter is provided with a dedicated OIU mounted on the filter control consoles. Under this alternative, an OIU is provided for the main control panel. Consideration will be given to a lesser cost OIU for the filter control consoles in this application.

3.1.1.2 Filter Building I&C Design Alternative No. 3

This design alternative includes Filter Building I&C Design Alternative No. 1 as a base system. Under Filter Building I&C Design Alternative No. 3, each filter control console is additionally provided with dedicated discrete operators (selector switch, push buttons, etc.) for control and monitoring of filter specific valve actuators from the filter control console. The main control panel is also supplemented with dedicated discrete operators for control and monitoring of air scour blowers, backwash pumps, mudwell pumps, etc. Compared to the other I&C design alternatives, this alternative is spatially more intensive.

3.1.2 Machine Monitoring

Machine monitoring is anticipated for the air scour blowers, backwash pumps, and mudwell pumps. The design anticipates that the machine monitoring will be performed by the respective unit PLC in coordination with the associated motor protective relay. It is further anticipated that each vibration monitoring point is monitored with an individual vibration transmitter which is then connected to the respective unit PLC. It follows that should the unit PLC fail under this alternative, then the corresponding machine monitoring protection functionality performed by the PLC would not be available.

3.2 Field Control Station

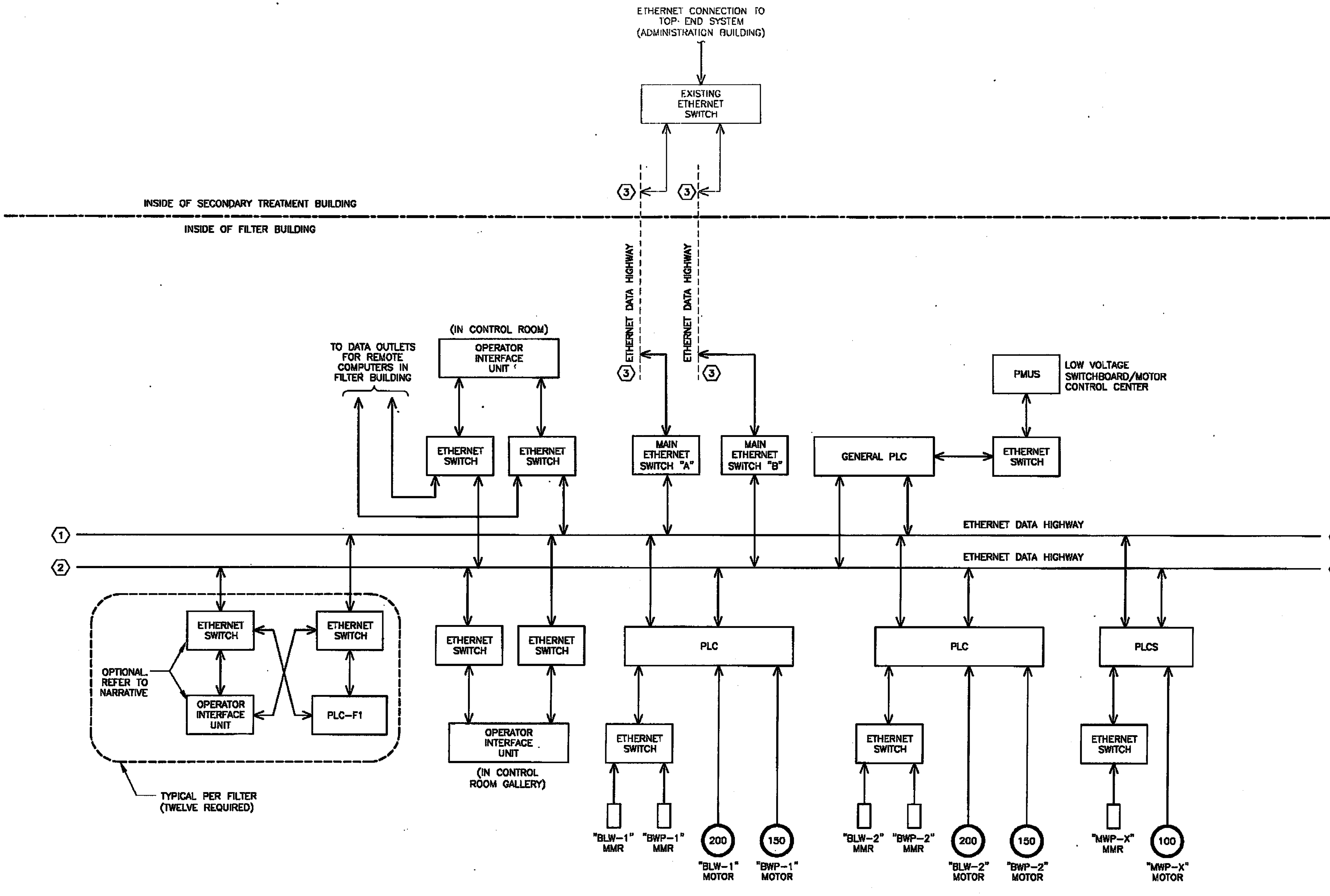
The FCS provides local ON/OFF control of all process equipment with associated ON/OFF indication, if required. Local control allows the equipment to be operated locally at the equipment's location. Limited field control stations are anticipated for this project as follows:

- Pumping Units: Local/Off/DCS selector switches with Start/Stop push buttons.
- Motorized Valves: Open/Stop/Close pushbuttons and Local/Off/Remote selector switches incorporated into each valve actuator where the actuators are accessible. Flow modulating valves will also have valve position displays provided. Separately mounted and accessible field control stations will be provided in cases where the valve actuator is not accessible.

The final FCS design, including components for specific equipment will be reviewed and finalized during an I&C coordination meeting held during the design phase.

3.3 Security System

The preliminary electrical and I&C construction cost opinion will need to be increased to include support for a security system.



KEY NOTES:

① DEVICES WITH A LINK TO THIS LINE REPRESENT A DIRECT LINK TO MAIN ETHERNET SWITCH "A".

② DEVICES WITH A LINK TO THIS LINE REPRESENT A DIRECT LINK TO MAIN ETHERNET SWITCH "B".

③ TRANSITION BETWEEN FIBER AND COPPER IMPLIES A TRANSCEIVER DEVICE.

GENERAL NOTES:

1. THIS EXHIBIT IS INTENDED TO REPRESENT AN OVERVIEW OF THE PROPOSED COMMUNICATIONS NETWORK. ONLY MAJOR ELECTRICAL EQUIPMENT HAS BEEN SHOWN FOR CLARITY.
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LEGEND:

--------	FIBER OPTIC ETHERNET
————	COPPER ETHERNET

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HARUTUNIAN
ENGINEERING
INCORPORATED
TEXAS REGISTERED
ENGINEERING FIRM
F-2408

SOUTH AUSTIN REGIONAL WWTP
FILTER IMPROVEMENTS PROJECT
CITY OF AUSTIN , TEXAS
CIP NO. 3333.015

FILTER BUILDING
PROPOSED CONTROL SYSTEM
ARCHITECTURE

AECOM
AECOM
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WWW.AECOM.COM

EXHIBIT No. I-1 | JOB No. 2011-400 | DATE: JULY, 2011

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Raceway, wiring, and support	$57,199.28	1	$57,199.28
Heating, Ventilation, and Air Conditioning Equipment Support Subtotal			**$57,199.28**
Filter System Electrical and I&C Support Common to All Alternatives Subtotal (No Contingency):			**$2,142,679.55**

South Austin Regional WWTP Filters Improvements Project Preliminary Conceptual Electrical and I&C Construction Cost Opinion Summary

Proposed Category	Cost Per Each Category in Dollars	Total Quantity	Total Cost In Dollars
Filter System I&C Design Alternative No. 1			
Main Control Panel and Common OIU			
Control Panels	$485,488.81	1	$485,488.81
Raceway, wiring, and support	$40,198.28	1	$40,198.28
Main Control Panel Subtotal:			**$525,687.09**
Filter Cell Support			
Filter Control Console	$57,300.71	12	$687,608.54
Field I&C Equipment	$43,570.20	12	$522,842.43
Raceway, wiring, and support	$46,146.31	12	$553,755.67
Filter Cell Support Subtotal			**$1,764,206.64**
EIC Support Common to All Design Alternatives			**$2,142,679.55**
Total Design Alternative No. 1 Filter System Electrical and I&C (No Contingency):			**$4,432,573.28**
Filter System I&C Design Alternative No. 2			
Main Control Panel			
Control Panel	$452,332.29	1	$452,332.29
Raceway, wiring, and support	$34,246.72	1	$34,246.72
Main Control Panel Subtotal:			**$486,579.01**
Filter Cell Support			
Filter Control Console	$70,019.38	12	$840,232.56
Field I&C Equipment	$43,570.20	12	$522,842.43
Raceway, wiring, and support	$46,146.31	12	$553,755.67
Filter Cell Support Subtotal			**$1,916,830.65**
EIC Support Common to All Design Alternatives			**$2,142,679.55**
Total Design Alternative No. 2 Filter System Electrical and I&C (No Contingency):			**$4,546,089.21**

South Austin Regional WWTP Filters Improvements Project Preliminary Conceptual Electrical and I&C Construction Cost Opinion Summary

Proposed Category	Cost Per Each Category in Dollars	Total Quantity	Total Cost In Dollars
Filter System I&C Design Alternative No. 3			
Main Control Panel and Common OIU			
Control Panels	$485,488.81	1	$485,488.81
Raceway, wiring, and support	$40,198.28	1	$40,198.28
Main Control Panel Subtotal:			**$525,687.09**
Filter Cell Support			
Filter Control Console	$86,363.76	12	$1,036,365.17
Field I&C Equipment	$43,570.20	12	$522,842.43
Raceway, wiring, and support	$48,881.35	12	$586,576.15
Filter Cell Support Subtotal			**$2,145,783.75**
EIC Support Common to All Design Alternatives			**$2,142,679.55**
Total Design Alternative No. 3 Filter System Electrical and I&C (No Contingency):			**$4,814,150.39**

Notes:

1) Excludes analysis transmitters
2) Contingency is not included and is assumed to be added to the overall construction cost opinion

Appendix 2.7:

Engineer's Construction Cost Estimation Table

Prepared by

AECOM

August 2011

SARWWTP FILTER BUILDING IMPROVMENTS
CONSTRUCTION COST ESTIMATE

Project: **SAR WWTP Filter Improvements Project**
AECOM Job No.: **60213591**
Date: **12/20/11**
Prepared By: **Kit Perkins**
File Name: **TM2 - Construction Estimate**
Design Stage: **Preliminary**

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

Objective:
Summarize the estimated construction costs for the SAR WWTP Filter Improvements Project.
Rehabilitation of existing filters.

SAR WWTP FILTER IMPROVEMENTS - FILTER REHABILITATION										
Division	**Item No.**	**Description**	**Unit**	**Qty.**	**Unit Material Cost**	**Material Cost**	**Labor Multiplier**	**Unit Labor Cost**	**Labor Cost**	**Subtotal**
2-Sitework	1	Misc. Site Work	LS	1	$ 25,000	$ 25,000	100%	$ 25,000	$ 25,000	$ 50,000
	2	Demolition - Filter Underdrain	EA	12	$ 1,250	$ 15,000	100%	$ 1,250	$ 15,000	$ 30,000
	3	Filter Media Removal and Cleaning	EA	12	$ 5,000	$ 60,000	100%	$ 5,000	$ 60,000	$ 120,000
					MATERIAL SUBTOTAL:	$ 100,000		LABOR SUBTOTAL:	$ 100,000	
									SUBTOTAL SITEWORK (02000):	**$ 200,000**
3-Concrete	4	Concrete - (Filter Underdrain)	CY	260	$ 600	$ 156,000	0%	$ -	$ -	$ 156,000
					MATERIAL SUBTOTAL:	$ 156,000		LABOR SUBTOTAL:	$ -	
									SUBTOTAL CONCRETE (03000):	**$ 156,000**
9-Finishes	5	Pipe Coating (Sand Blast/Recoat)	SF	14,000	$ 11	$ 154,000	100%	$ 11	$ 154,000	$ 308,000
					MATERIAL SUBTOTAL:	$ 154,000		LABOR SUBTOTAL:	$ 154,000	
									SUBTOTAL FINISHES (09000):	**$ 308,000**
10-Specialties	6	Filter Media (Remove and Replace)	CY	1536	$ 250	$ 384,000	50%	$ 125	$ 192,000	$ 576,000
	7	Filter Underdrain (Forms and Nozzels)	LS	1	$ 850,000	$ 850,000	100%	$ 850,000	$ 850,000	$ 1,700,000
	8	Filter Roof Structure	SF	14,532	$ 15	$ 217,980	35%	$ 5	$ 76,293	$ 294,273
					MATERIAL SUBTOTAL:	$ 1,451,980		LABOR SUBTOTAL:	$ 1,118,293	
									SUBTOTAL SPECIALTIES (10000):	**$ 2,570,273**
11-Equipment	9	10" Resilient BFV (Operator)	EA	12	$ 4,898	$ 58,776	70%	$ 3,429	$ 41,143	$ 99,919
	10	20" BFV (Operator)	EA	12	$ 5,169	$ 62,028	70%	$ 3,618	$ 43,420	$ 105,448
	11	24" BFV (Operator)	EA	36	$ 5,625	$ 202,500	70%	$ 3,938	$ 141,750	$ 344,250
	12	42" BFV (Operator)	EA	4	$ 6,972	$ 27,888	70%	$ 4,880	$ 19,522	$ 47,410
	13	6" Ballcentric Valve (Operator)	EA	12	$ 4,000	$ 48,000	70%	$ 2,800	$ 33,600	$ 81,600
	14	16" Badger Venturi Flow Meter	EA	12	$ 10,600	$ 127,200	70%	$ 7,420	$ 89,040	$ 216,240

	15	Bridge Crane (Manual Hoist)	LS	1	$ 20,000	$ 20,000	70%	$ 14,000	$ 14,000	$ 34,000
	16	Backwash Pumps - Motor	EA	2	$ 23,000	$ 46,000	70%	$ 16,100	$ 32,200	$ 78,200
	17	Backwash Pumps - Pump Repair	EA	2	$ 20,000	$ 40,000	70%	$ 14,000	$ 28,000	$ 68,000
	18	Mudwell Pumps / Motors	EA	3	$ 49,666	$ 148,998	70%	$ 34,766	$ 104,299	$ 253,297
	19	Blowers - Electric Motor Repair	EA	2	$ 10,000	$ 20,000	70%	$ 7,000	$ 14,000	$ 34,000
				MATERIAL SUBTOTAL:		$ 801,390	LABOR SUBTOTAL:		$ 560,973	
									SUBTOTAL EQUIPMENT (11000):	**$ 1,362,363**
15-Mechanical	20	10" Resilient BFV (Valve)	EA	12	$ 1,684	$ 20,208	100%	$ 1,684	$ 20,208	$ 40,416
	21	20" Butterfly Valve (Valve)	EA	12	$ 4,508	$ 54,096	100%	$ 4,508	$ 54,096	$ 108,192
	22	24" Butterfly Valve (Valve)	EA	36	$ 6,480	$ 233,280	100%	$ 6,480	$ 233,280	$ 466,560
	23	42" Butterfly Valve (Valve)	EA	4	$ 21,291	$ 85,164	70%	$ 14,904	$ 59,615	$ 144,779
	24	16" Swing Check Valve	EA	3	$ 9,519	$ 28,557	70%	$ 6,663	$ 19,990	$ 48,547
	25	24" Swing Check Valve	EA	2	$ 19,757	$ 39,514	70%	$ 13,830	$ 27,660	$ 67,174
	26	16" Plug Valve	EA	6	$ 4,000	$ 24,000	70%	$ 2,800	$ 16,800	$ 40,800
	27	10" Pressure Relief Valve	EA	1	$ 8,500	$ 8,500	70%	$ 5,950	$ 5,950	$ 14,450
	28	6" Ballcentric Valve	EA	12	$ 1,147	$ 13,764	70%	$ 803	$ 9,635	$ 23,399
	29	2" Air Release Valve	EA	12	$ 1,750	$ 21,000	100%	$ 1,750	$ 21,000	$ 42,000
				MATERIAL SUBTOTAL:		$ 528,083	LABOR SUBTOTAL:		$ 468,233	
									SUBTOTAL MECHANICAL (15000):	**$ 996,316**
16-Electrical	30	HEI Electrical and I&C (Alt. No. 3)	LS	1	$ 4,814,150	$ 4,814,150	0%	$ -	$ -	$ 4,814,150
				MATERIAL SUBTOTAL:		$ 4,814,150	LABOR SUBTOTAL:		$ -	
									SUBTOTAL ELECTRICAL (16000):	**$ 4,814,150**
					MATERIAL TOTAL:	**$8,005,603.39**		**LABOR TOTAL:**	**$ 2,401,499.30**	
									Subtotal:	$ 10,407,103
									Contractor's Overhead & Profit (20%):	$ 2,081,421
									Bonds & Insurance (2%):	$ 208,142
									Subtotal:	$ 12,696,665
									Contingency 40% @Preliminary Design:	$ 5,078,666
									Total Estimated Cost:	**$ 17,775,331**

Appendix 2.8:

Present Worth Calculations

Prepared by

AECOM

SARWWTP FILTER BUILDING IMPROVMENTS
BASIS OF PRESENT WORTH CALCULATIONS

Project:	**SAR WWTP Filter Improvements Project**	AECOM
AECOM Job No.:	**60213591**	400 West 15th Street, Suite 500
Date:	**6/13/11**	Austin, Texas 78701
Prepared By:	**Kit Perkins**	Phone: (512) 472-4519
File Name:	**Present Worth**	Fax: (512) 472-7519
Design Stage:	**Preliminary**	

Objective:

Summarize the basis and assumptions for the present worth calcs for the SAR WWTP Filter Improvements Project.

General Assumptions:

kWh Cost:	$0.11
Maintenance Hour Rate:	$27.11

Initial Cost Assumptions:

Filter Rehabilitation Initial Cost:	$ 17,780,000
Disk Filter Installation Initial Cost (4 filters):	$ 17,670,000
Disk Filter Installation Initial Cost (6 filters):	$ 23,960,000

Assumptions for Filter Rehabilitation Alternative:

No media replacement for the deep bed filters is assumed for the filter rehabilitation alternative.

Backwash Pump		Mudwell Pump		Blower Pump	
Backwash Pump HP:	150	Mudwell Pump HP:	50	Blower Pump HP:	200
Backwash Volume per Backwash (gal):	225,000			Backwash Air Volume per Backwash (scfm):	110,250
Backwash Vol/day (1 bw/filter, 12 filters):	2,700,000			Backwash Vol/day (1 bw/filter, 12 filters):	1,323,000
Backwash Water/Year:	985,500,000			Backwash Air/Year (scfm):	482,895,000
Backwash Pump Capacity (gpm):	11,000	Mudwell Pump Capacity (gpm):	4,350	Blower Capacity (scfm):	3,500
Backwash Operating Hrs:	1,493	Mudwell Operating Hrs:	3,776	Blower Operating Hrs:	2299.5
Annual BW Pump Power (kWh):	167,020	Annual Mudwell Pump Power (kWh):	140,783	Annual Blower Pump Power (kWh):	342,947

No annual maintenance cost for the deep bed sand filters is assumed.

Energy

Item	Interval	kWh	Cost	Total
Backwash Solid Waste Pump Energy (kWh):	Annual	167,020	$0.11	$18,372
Mudwell Pump Energy (kWh):	Annual	140,783	$0.11	$15,486
Blower Pump Energy (kWh):	Annual	342,947	$0.11	$37,724
Contingency (40%)	Annual	260,300	$0.11	$28,633
Total Energy (kWh):	**Annual**	**911,050**	**$0.11**	**$100,216**

Chemicals

Item	Cost (lb)	Dose (mg/L)	Liters / Day	Pounds / Day	Annual Cost
Chlorine (Mudwell)	$ 0.23	5.0	10,206,000	113	$9,445
Chlorine (Filtered Water)	$ 0.23	2.5	151,200,000	833	$69,960
Sulfur Dioxide (Filtered Water)	$ 0.30	1.0	151,200,000	333	$36,501

*Based on 40MGD Effluent

Chloine for backwash water not required

Assumptions for Disk Filter Installation (4 filters):

Number of Disk Filters: 4

Mudwell Pump

Mudwell Pump HP:	50
Backwash Volume per Day / (gal):	546,120
Backwash Water/Year:	199,333,800
Mudwell Pump Capacity (gpm):	4,350
Mudwell Operating Hrs:	764
Annual Mudwell Pump Power (kWh):	28,476

*Backwash Solid Waste Pump Energy

and disk drive motor energy provided by the manufacturer.

Maintenance

Item	Interval (YR)	Hours	Material	Total
Main V-Ring Seal	10	64	$16,048	$17,783
Filter Media Cloths	7	288	$309,808	$317,616

Energy

Item	Interval	Hours	Material	Total	
Disk Drive Motor Energy (kWh):	Annual	9,215	$0.11	$1,014	
Backwash Solid Waste Pump Energy (kWh):	Annual	84,908	$0.11	$9,340	*Adjusted for a 7.5hp Motor
Mudwell Pump Energy (kWh):	Annual	28,476	$0.11	$3,132	
Contingency (40%)	Annual	49,039	$0.11	$5,394	
Total Energy (kWh):	**Annual**	**171,638**	**$0.11**	**$18,880**	

Chemicals

Item	Cost (lb)	Dose (mg/L)	Liters / Day	Pounds / Day	Annual Cost	
Chlorine (Mudwell)	$ 0.23	5.0	2,064,334	23	$1,910	
Chlorine (Filtered Water)	$ 0.23	2.5	151,200,000	833	$69,960	
Sulfur Dioxide (Filtered Water)	$ 0.30	1.0	151,200,000	333	$36,501	*Based on 40MGD Effluent

Chloine for backwash water not required

Assumptions for Disk Filter Installation (6 filters):

Number of Disk Filters: 6

Mudwell Pump

Mudwell Pump HP:	50
Backwash Volume per Day / (gal):	819,180
Backwash Water/Year:	299,000,700
Mudwell Pump Capacity (gpm):	4,350
Mudwell Operating Hrs:	1,146
Annual Mudwell Pump Power (kWh):	42,714

*Backwash Solid Waste Pump Energy

and disk drive motor energy provided by the manufacturer.

Maintenance

Item	Interval (YR)	Hours	Material	Total
Main V-Ring Seal	10	96	$21,397	$24,000
Filter Media Cloths	7	432	$413,077	$424,789

Energy

Item	Interval	Hours	Material	Total	
Disk Drive Motor Energy (kWh):	Annual	9,215	$0.11	$1,014	
Backwash Solid Waste Pump Energy (kWh):	Annual	84,908	$0.11	$9,340	*Adjusted for a 7.5hp Motor
Mudwell Pump Energy (kWh):	Annual	42,714	$0.11	$4,698	
Contingency (40%)	Annual	54,734	$0.11	$6,021	
Total Energy (kWh):	**Annual**	**191,570**	**$0.11**	**$21,073**	

Chemicals

Item	Cost (lb)	Dose (mg/L)	Liters / Day	Pounds / Day	Annual Cost	
Chlorine (Mudwell)	$ 0.23	5.0	3,096,500	34	$2,865	
Chlorine (Filtered Water)	$ 0.23	2.5	151,200,000	833	$69,960	
Sulfur Dioxide (Filtered Water)	$ 0.30	1.0	151,200,000	333	$36,501	*Based on 40MGD Effluent

Chloine for backwash water not required

SARWWTP FILTER BUILDING IMPROVEMENTS
20-YEAR PRESENT WORTH SUMMARY

Project:	**SAR WWTP Filter Improvements Project**	AECOM	
AECOM Job No.:	**60213591**	400 West 15th Street, Suite 500	
Date:	**6/13/11**	Austin, Texas 78701	
Prepared By:	**Kit Perkins**	Phone: (512) 472-4519	
File Name:	**Present Worth Evl.xlsc**	Fax: (512) 472-7519	
Design Stage:	**Preliminary**		

Objective:
Summarize the estimated present worth for the alternatives for the SAR WWTP Filter Improvements Project for a 20-year duration.

Assumptions:

Inflation Rate:	2.5%
Interest Rate:	4.5%

FILTER REHABILITATION ALTERNATIVE

Item	Year:	Capital Cost:	Energy Cost:	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	
	0	$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	$ 17,996,121
	1	$ -	$ 102,721	$ 9,681	$ 71,709	$ 37,413	$ 211,985
	2	$ -	$ 105,289	$ 9,923	$ 73,502	$ 38,349	$ 207,927
	3	$ -	$ 107,921	$ 10,171	$ 75,339	$ 39,307	$ 203,948
	4	$ -	$ 110,619	$ 10,425	$ 77,223	$ 40,290	$ 200,045
	5	$ -	$ 113,385	$ 10,686	$ 79,153	$ 41,297	$ 196,216
	6	$ -	$ 116,219	$ 10,953	$ 81,132	$ 42,330	$ 192,461
	7	$ -	$ 119,125	$ 11,227	$ 83,160	$ 43,388	$ 188,777
	8	$ -	$ 122,103	$ 11,507	$ 85,239	$ 44,473	$ 185,164
	9	$ -	$ 125,155	$ 11,795	$ 87,370	$ 45,585	$ 181,620
	10	$ -	$ 128,284	$ 12,090	$ 89,555	$ 46,724	$ 178,144
	11	$ -	$ 131,491	$ 12,392	$ 91,793	$ 47,892	$ 174,735
	12	$ -	$ 134,779	$ 12,702	$ 94,088	$ 49,090	$ 171,391
	13	$ -	$ 138,148	$ 13,019	$ 96,440	$ 50,317	$ 168,111
	14	$ -	$ 141,602	$ 13,345	$ 98,851	$ 51,575	$ 164,893
	15	$ -	$ 145,142	$ 13,679	$ 101,323	$ 52,864	$ 161,737
	16	$ -	$ 148,771	$ 14,021	$ 103,856	$ 54,186	$ 158,642
	17	$ -	$ 152,490	$ 14,371	$ 106,452	$ 55,540	$ 155,606
	18	$ -	$ 156,302	$ 14,730	$ 109,114	$ 56,929	$ 152,628
	19	$ -	$ 160,210	$ 15,099	$ 111,841	$ 58,352	$ 149,706
	20	$ -	$ 164,215	$ 15,476	$ 114,637	$ 59,811	$ 146,841
	Total						$ 21,546,698

DISK FILTERS ALTERNATIVE (4 Filters)

Item	Year:	Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,670,000	$ 18,880	$ 17,783	$ 317,616	$ 1,910	$ 69,960	$ 36,501	
	0	$ 17,670,000	$ 18,880	$ -	$ -	$ 1,910	$ 69,960	$ 36,501	$ 17,797,251
	1	$ -	$ 19,352	$ -	$ -	$ 1,958	$ 71,709	$ 37,413	$ 124,816
	2	$ -	$ 19,836	$ -	$ -	$ 2,007	$ 73,502	$ 38,349	$ 122,427
	3	$ -	$ 20,332	$ -	$ -	$ 2,057	$ 75,339	$ 39,307	$ 120,084
	4	$ -	$ 20,840	$ -	$ -	$ 2,109	$ 77,223	$ 40,290	$ 117,786
	5	$ -	$ 21,361	$ -	$ -	$ 2,161	$ 79,153	$ 41,297	$ 115,531
	6	$ -	$ 21,895	$ -	$ -	$ 2,215	$ 81,132	$ 42,330	$ 113,320
	7	$ -	$ 22,443	$ -	$ 377,545	$ 2,271	$ 83,160	$ 43,388	$ 388,582
	8	$ -	$ 23,004	$ -	$ -	$ 2,328	$ 85,239	$ 44,473	$ 109,024
	9	$ -	$ 23,579	$ -	$ -	$ 2,386	$ 87,370	$ 45,585	$ 106,937
	10	$ -	$ 24,168	$ 22,764	$ -	$ 2,445	$ 89,555	$ 46,724	$ 119,549
	11	$ -	$ 24,772	$ -	$ -	$ 2,507	$ 91,793	$ 47,892	$ 102,883
	12	$ -	$ 25,392	$ -	$ -	$ 2,569	$ 94,088	$ 49,090	$ 100,914
	13	$ -	$ 26,027	$ -	$ -	$ 2,633	$ 96,440	$ 50,317	$ 98,983
	14	$ -	$ 26,677	$ -	$ 448,783	$ 2,699	$ 98,851	$ 51,575	$ 339,419
	15	$ -	$ 27,344	$ -	$ -	$ 2,767	$ 101,323	$ 52,864	$ 95,230
	16	$ -	$ 28,028	$ -	$ -	$ 2,836	$ 103,856	$ 54,186	$ 93,408
	17	$ -	$ 28,728	$ -	$ -	$ 2,907	$ 106,452	$ 55,540	$ 91,620
	18	$ -	$ 29,447	$ -	$ -	$ 2,979	$ 109,114	$ 56,929	$ 89,867
	19	$ -	$ 30,183	$ -	$ -	$ 3,054	$ 111,841	$ 58,352	$ 88,147
	20	$ -	$ 30,937	$ 29,140	$ -	$ 3,130	$ 114,637	$ 59,811	$ 98,542
	Total								$ 20,434,321

DISK FILTERS ALTERNATIVE (6 Filters)

Item		Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 23,960,000	$ 21,073	$ 24,000	$ 424,789	$ 2,865	$ 69,960	$ 36,501	
Year	0	$ 23,960,000	$ 21,073	$ -	$ -	$ 2,865	$ 69,960	$ 36,501	$ 24,090,399
	1	$ -	$ 21,600	$ -	$ -	$ 2,937	$ 71,709	$ 37,413	$ 127,903
	2	$ -	$ 22,140	$ -	$ -	$ 3,011	$ 73,502	$ 38,349	$ 125,455
	3	$ -	$ 22,693	$ -	$ -	$ 3,086	$ 75,339	$ 39,307	$ 123,054
	4	$ -	$ 23,260	$ -	$ -	$ 3,163	$ 77,223	$ 40,290	$ 120,699
	5	$ -	$ 23,842	$ -	$ -	$ 3,242	$ 79,153	$ 41,297	$ 118,389
	6	$ -	$ 24,438	$ -	$ -	$ 3,323	$ 81,132	$ 42,330	$ 116,123
	7	$ -	$ 25,049	$ -	$ 504,940	$ 3,406	$ 83,160	$ 43,388	$ 484,945
	8	$ -	$ 25,675	$ -	$ -	$ 3,491	$ 85,239	$ 44,473	$ 111,721
	9	$ -	$ 26,317	$ -	$ -	$ 3,579	$ 87,370	$ 45,585	$ 109,583
	10	$ -	$ 26,975	$ 30,721	$ -	$ 3,668	$ 89,555	$ 46,724	$ 127,268
	11	$ -	$ 27,649	$ -	$ -	$ 3,760	$ 91,793	$ 47,892	$ 105,428
	12	$ -	$ 28,341	$ -	$ -	$ 3,854	$ 94,088	$ 49,090	$ 103,411
	13	$ -	$ 29,049	$ -	$ -	$ 3,950	$ 96,440	$ 50,317	$ 101,431
	14	$ -	$ 29,775	$ -	$ 600,216	$ 4,049	$ 98,851	$ 51,575	$ 423,590
	15	$ -	$ 30,520	$ -	$ -	$ 4,150	$ 101,323	$ 52,864	$ 97,586
	16	$ -	$ 31,283	$ -	$ -	$ 4,254	$ 103,856	$ 54,186	$ 95,718
	17	$ -	$ 32,065	$ -	$ -	$ 4,360	$ 106,452	$ 55,540	$ 93,886
	18	$ -	$ 32,866	$ -	$ -	$ 4,469	$ 109,114	$ 56,929	$ 92,090
	19	$ -	$ 33,688	$ -	$ -	$ 4,581	$ 111,841	$ 58,352	$ 90,327
	20	$ -	$ 34,530	$ 39,326	$ -	$ 4,695	$ 114,637	$ 59,811	$ 104,905
	Total								$ 26,963,913

SARWWTP FILTER BUILDING IMPROVMENTS
30-YEAR PRESENT WORTH SUMMARY

Project: **SAR WWTP Filter Improvements Project**
AECOM Job No.: **60213591**
Date: **3/12/12**
Prepared By: **Kit Perkins/Nathan Fitzhugh**
File Name: **Present Worth Evl03122012-30yr.xlsc**
Design Stage: **Preliminary**

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

Objective:

Summarize the estimated present worth for the alternatives for the SAR WWTP Filter Improvements Project for a 30-year duration.

Assumptions:
Inflation Rate: 2.5%
Interest Rate: 4.5%

FILTER REHABILITATION ALTERNATIVE

Item		Capital Cost:	Energy Cost:	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	
Year	0	$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	$ 17,996,121
	1	$ -	$ 102,721	$ 9,681	$ 71,709	$ 37,413	$ 211,985
	2	$ -	$ 105,289	$ 9,923	$ 73,502	$ 38,349	$ 207,927
	3	$ -	$ 107,921	$ 10,171	$ 75,339	$ 39,307	$ 203,948
	4	$ -	$ 110,619	$ 10,425	$ 77,223	$ 40,290	$ 200,045
	5	$ -	$ 113,385	$ 10,686	$ 79,153	$ 41,297	$ 196,216
	6	$ -	$ 116,219	$ 10,953	$ 81,132	$ 42,330	$ 192,461
	7	$ -	$ 119,125	$ 11,227	$ 83,160	$ 43,388	$ 188,777
	8	$ -	$ 122,103	$ 11,507	$ 85,239	$ 44,473	$ 185,164
	9	$ -	$ 125,155	$ 11,795	$ 87,370	$ 45,585	$ 181,620
	10	$ -	$ 128,284	$ 12,090	$ 89,555	$ 46,724	$ 178,144
	11	$ -	$ 131,491	$ 12,392	$ 91,793	$ 47,892	$ 174,735
	12	$ -	$ 134,779	$ 12,702	$ 94,088	$ 49,090	$ 171,391
	13	$ -	$ 138,148	$ 13,019	$ 96,440	$ 50,317	$ 168,111
	14	$ -	$ 141,602	$ 13,345	$ 98,851	$ 51,575	$ 164,893
	15	$ -	$ 145,142	$ 13,679	$ 101,323	$ 52,864	$ 161,737
	16	$ -	$ 148,771	$ 14,021	$ 103,856	$ 54,186	$ 158,642
	17	$ -	$ 152,490	$ 14,371	$ 106,452	$ 55,540	$ 155,606
	18	$ -	$ 156,302	$ 14,730	$ 109,114	$ 56,929	$ 152,628
	19	$ -	$ 160,210	$ 15,099	$ 111,841	$ 58,352	$ 149,706
	20	$ -	$ 164,215	$ 15,476	$ 114,637	$ 59,811	$ 146,841
	21	$ -	$ 168,320	$ 15,863	$ 117,503	$ 61,306	$ 144,031
	22	$ -	$ 172,528	$ 16,260	$ 120,441	$ 62,839	$ 141,274
	23	$ -	$ 176,841	$ 16,666	$ 123,452	$ 64,410	$ 138,571
	24	$ -	$ 181,262	$ 17,083	$ 126,538	$ 66,020	$ 135,918
	25	$ -	$ 185,794	$ 17,510	$ 129,702	$ 67,670	$ 133,317
	26	$ -	$ 190,439	$ 17,947	$ 132,944	$ 69,362	$ 130,766
	27	$ -	$ 195,200	$ 18,396	$ 136,268	$ 71,096	$ 128,263
	28	$ -	$ 200,080	$ 18,856	$ 139,675	$ 72,874	$ 125,808
	29	$ -	$ 205,082	$ 19,327	$ 143,166	$ 74,696	$ 123,400
	30	$ -	$ 210,209	$ 19,811	$ 146,746	$ 76,563	$ 121,039
	Total						$ 22,869,085

DISK FILTERS ALTERNATIVE (4 Filters)

Item		Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,670,000	$ 18,880	$ 17,783	$ 317,616	$ 1,910	$ 69,960	$ 36,501	
Year	0	$ 17,670,000	$ 18,880	$ -	$ -	$ 1,910	$ 69,960	$ 36,501	$ 17,797,251
	1	$ -	$ 19,352	$ -	$ -	$ 1,958	$ 71,709	$ 37,413	$ 124,816
	2	$ -	$ 19,836	$ -	$ -	$ 2,007	$ 73,502	$ 38,349	$ 122,427
	3	$ -	$ 20,332	$ -	$ -	$ 2,057	$ 75,339	$ 39,307	$ 120,084
	4	$ -	$ 20,840	$ -	$ -	$ 2,109	$ 77,223	$ 40,290	$ 117,786
	5	$ -	$ 21,361	$ -	$ -	$ 2,161	$ 79,153	$ 41,297	$ 115,531
	6	$ -	$ 21,895	$ -	$ -	$ 2,215	$ 81,132	$ 42,330	$ 113,320
	7	$ -	$ 22,443	$ -	$ 377,545	$ 2,271	$ 83,160	$ 43,388	$ 388,582
	8	$ -	$ 23,004	$ -	$ -	$ 2,328	$ 85,239	$ 44,473	$ 109,024
	9	$ -	$ 23,579	$ -	$ -	$ 2,386	$ 87,370	$ 45,585	$ 106,937
	10	$ -	$ 24,168	$ 22,764	$ -	$ 2,445	$ 89,555	$ 46,724	$ 119,549
	11	$ -	$ 24,772	$ -	$ -	$ 2,507	$ 91,793	$ 47,892	$ 102,883
	12	$ -	$ 25,392	$ -	$ -	$ 2,569	$ 94,088	$ 49,090	$ 100,914
	13	$ -	$ 26,027	$ -	$ -	$ 2,633	$ 96,440	$ 50,317	$ 98,983
	14	$ -	$ 26,677	$ -	$ 448,783	$ 2,699	$ 98,851	$ 51,575	$ 339,419
	15	$ -	$ 27,344	$ -	$ -	$ 2,767	$ 101,323	$ 52,864	$ 95,230
	16	$ -	$ 28,028	$ -	$ -	$ 2,836	$ 103,856	$ 54,186	$ 93,408
	17	$ -	$ 28,728	$ -	$ -	$ 2,907	$ 106,452	$ 55,540	$ 91,620
	18	$ -	$ 29,447	$ -	$ -	$ 2,979	$ 109,114	$ 56,929	$ 89,867
	19	$ -	$ 30,183	$ -	$ -	$ 3,054	$ 111,841	$ 58,352	$ 88,147
	20	$ -	$ 30,937	$ 29,140	$ -	$ 3,130	$ 114,637	$ 59,811	$ 98,542
	21	$ -	$ 31,711	$ -	$ 533,462	$ 3,209	$ 117,503	$ 61,306	$ 296,476
	22	$ -	$ 32,504	$ -	$ -	$ 3,289	$ 120,441	$ 62,839	$ 83,182
	23	$ -	$ 33,316	$ -	$ -	$ 3,371	$ 123,452	$ 64,410	$ 81,590
	24	$ -	$ 34,149	$ -	$ -	$ 3,455	$ 126,538	$ 66,020	$ 80,028
	25	$ -	$ 35,003	$ -	$ -	$ 3,542	$ 129,702	$ 67,670	$ 78,497
	26	$ -	$ 35,878	$ -	$ -	$ 3,630	$ 132,944	$ 69,362	$ 76,994
	27	$ -	$ 36,775	$ -	$ -	$ 3,721	$ 136,268	$ 71,096	$ 75,521
	28	$ -	$ 37,694	$ -	$ 634,118	$ 3,814	$ 139,675	$ 72,874	$ 258,966
	29	$ -	$ 38,637	$ -	$ -	$ 3,909	$ 143,166	$ 74,696	$ 72,658
	30	$ -	$ 39,602	$ 37,301	$ -	$ 4,007	$ 146,746	$ 76,563	$ 81,226
	Total								$ 21,619,458

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DISK FILTERS ALTERNATIVE (6 Filters)

Item		Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 23,960,000	$ 21,073	$ 24,000	$ 424,789	$ 2,865	$ 69,960	$ 36,501	
Year	0	$ 23,960,000	$ 21,073	$ -	$ -	$ 2,865	$ 69,960	$ 36,501	$ 24,090,399
	1	$ -	$ 21,600	$ -	$ -	$ 2,937	$ 71,709	$ 37,413	$ 127,903
	2	$ -	$ 22,140	$ -	$ -	$ 3,011	$ 73,502	$ 38,349	$ 125,455
	3	$ -	$ 22,693	$ -	$ -	$ 3,086	$ 75,339	$ 39,307	$ 123,054
	4	$ -	$ 23,260	$ -	$ -	$ 3,163	$ 77,223	$ 40,290	$ 120,699
	5	$ -	$ 23,842	$ -	$ -	$ 3,242	$ 79,153	$ 41,297	$ 118,389
	6	$ -	$ 24,438	$ -	$ -	$ 3,323	$ 81,132	$ 42,330	$ 116,123
	7	$ -	$ 25,049	$ -	$ 504,940	$ 3,406	$ 83,160	$ 43,388	$ 484,945
	8	$ -	$ 25,675	$ -	$ -	$ 3,491	$ 85,239	$ 44,473	$ 111,721
	9	$ -	$ 26,317	$ -	$ -	$ 3,579	$ 87,370	$ 45,585	$ 109,583
	10	$ -	$ 26,975	$ 30,721	$ -	$ 3,668	$ 89,555	$ 46,724	$ 127,268
	11	$ -	$ 27,649	$ -	$ -	$ 3,760	$ 91,793	$ 47,892	$ 105,428
	12	$ -	$ 28,341	$ -	$ -	$ 3,854	$ 94,088	$ 49,090	$ 103,411
	13	$ -	$ 29,049	$ -	$ -	$ 3,950	$ 96,440	$ 50,317	$ 101,431
	14	$ -	$ 29,775	$ -	$ 600,216	$ 4,049	$ 98,851	$ 51,575	$ 423,590
	15	$ -	$ 30,520	$ -	$ -	$ 4,150	$ 101,323	$ 52,864	$ 97,586
	16	$ -	$ 31,283	$ -	$ -	$ 4,254	$ 103,856	$ 54,186	$ 95,718
	17	$ -	$ 32,065	$ -	$ -	$ 4,360	$ 106,452	$ 55,540	$ 93,886
	18	$ -	$ 32,866	$ -	$ -	$ 4,469	$ 109,114	$ 56,929	$ 92,090
	19	$ -	$ 33,688	$ -	$ -	$ 4,581	$ 111,841	$ 58,352	$ 90,327
	20	$ -	$ 34,530	$ 39,326	$ -	$ 4,695	$ 114,637	$ 59,811	$ 104,905
	21	$ -	$ 35,393	$ -	$ 713,468	$ 4,813	$ 117,503	$ 61,306	$ 369,998
	22	$ -	$ 36,278	$ -	$ -	$ 4,933	$ 120,441	$ 62,839	$ 85,239
	23	$ -	$ 37,185	$ -	$ -	$ 5,056	$ 123,452	$ 64,410	$ 83,608
	24	$ -	$ 38,115	$ -	$ -	$ 5,183	$ 126,538	$ 66,020	$ 82,008
	25	$ -	$ 39,068	$ -	$ -	$ 5,312	$ 129,702	$ 67,670	$ 80,438
	26	$ -	$ 40,044	$ -	$ -	$ 5,445	$ 132,944	$ 69,362	$ 78,899
	27	$ -	$ 41,046	$ -	$ -	$ 5,581	$ 136,268	$ 71,096	$ 77,389
	28	$ -	$ 42,072	$ -	$ 848,089	$ 5,721	$ 139,675	$ 72,874	$ 323,186
	29	$ -	$ 43,123	$ -	$ -	$ 5,864	$ 143,166	$ 74,696	$ 74,455
	30	$ -	$ 44,202	$ 50,341	$ -	$ 6,011	$ 146,746	$ 76,563	$ 86,471
	Total								$ 28,305,604

AECOM
400 West 15th Street, Suite 500, Austin, Texas 78701
T 512.472.4519 F 512.472.7519 www.aecom.com

City of Austin
South Austin Regional Waste Water Treatment Plant Filter Improvements

Technical Memorandum No. 3
Filter System Process Evaluation

To: Chris Graf, P.E., Austin Water Utility

From: Shelby Eckols, P.E. (AECOM)

Prepared By: Abu Alam, Sc.D., P.E. (AECOM)
Nathan Fitzhugh, EIT (AECOM)
Neil Higa, P.E. (AECOM)
Gary Hunter (Black & Veatch)

SHELBY G. ECKOLS
41485

Date: March 27, 2012

COA C.I.P. 3333.015
AECOM PROJECT ID. 60213591

3/29/12

3.1 Introduction

The Filter Building facility at the South Austin Regional Wastewater Treatment Plant (SARWWTP) was constructed in 1988 as part of the Train B Expansion. The Filter Building is located at the Northeast side of the treatment plant between Trains A and C, and the filtration system is configured as 12 single-media, intermittently backwashed, deep-bed filters. There have been multiple modifications to the Filter Building throughout its operating life, including modification to the electrical duct banks entering the building, and additional exterior pipe modifications made during the Train C expansion to address hydraulic issues. However, no modifications, replacements, or rehabilitation of the filters, media, major equipment, or filtration system cells have been undertaken since the filters were constructed.

3.2 Scope of Work and Objectives

The objectives of this Technical Memorandum No. 3 on the Filter System Process Evaluation are to determine the most cost-effective, and appropriate filtration technology that will provide SARWWTP with the ability to consistently meet desired effluent quality of the plant as determined by the TCEQ permit requirements, and discuss and present the following:

1. Evaluation of the current filtration process;
2. Consideration of future alternative filtration processes;
3. Overall effectiveness of the existing facility; and
4. Recommendations that will satisfy the future needs of the SARWWTP to meet the required effluent quality.

Although the intent of this project is to rehabilitate the existing filters, evaluation of applicable alternative filtration methods and technologies is also included. Per AECOM Scope of Work, City of Austin has assigned the evaluation of current wastewater effluent filtration technologies to be conducted jointly by AECOM and Black & Veatch as a part of the City's contract to evaluate and upgrade the filters at the SAR WWTP and the Walnut Creek WWTP. AECOM participated in the joint evaluation of the filtration technologies and provided AECOM material and input to Black & Veatch for the preparation of a Technical Memorandum of current Filtration Technologies for wastewater effluent filtration. Black & Veatch has incorporated AECOM produced material and input in the preparation of a Technical Memorandum (TM) on Filtration Technology applicable to wastewater effluent filtration. This assessment is located in Appendix 3.3, in the Process Technical Memorandum entitled "Alternative Filtration Technologies".

AECOM and Black & Veatch jointly evaluated Effluent Filtration Technology including the following:

1. Particle Filtration;
2. Microfiltration;
3. Ultrafiltration;
4. Nanofiltration; and
5. Reverse Osmosis.

Particle filtration covers the range of micro particles (from about 1 micron to about 50 micron) to macro particles (from about 50 micron to about 1,000 micron). Conventional granular media filtration falls in the 100 micron to 300 micron particle range. Single media (sand or anthracite or granular activated carbon), dual media (anthracite over sand or granular activated carbon over sand), and multi-media (anthracite over sand over garnet or granular activated carbon over sand over garnet) all fall within the macro particle filtration range. Newer surface filtration technologies, such as the Disc Filters and other cloth media filters use synthetic polyester membranes and operate in the larger pore opening microfiltration range (10 micron to 20 micron).

Microfiltration (MF) is normally used in the macro molecular range (from about 0.5 micron to about 1 micron) to the lower end of the micro particle range (from about 1 micron to about 3 micron). Microfiltration uses synthetic polyester or other types of membranes to filter out the smaller particles. Higher operating pressures are required for use of microfiltration membranes as compared to conventional granular media or cloth media filtration. Memcor, Koch and other manufacturers supply this type of membranes.

Ultrafiltration (UF) is normally used in the molecular to macro molecular range (from about 0.03 micron to about 0.1 micron). Because ultrafiltration operates to remove molecular particles, higher operating pressures are normally required for this type of pressure filtration. Hollow fiber ultrafiltration membranes with larger pore openings are used by some manufacturers. Hollow fiber membranes create a vacuum induced filtration through the larger pore openings and require smaller differential pressures as compared to pressures needed to filter through smaller pore openings in other ultrafiltration membranes. Submerged ultrafiltration membranes are sometimes used for filtration of mixed liquor suspended solids (MLSS) and are used in place of the normal sedimentation/clarification process normally used in secondary treatment. Zenon, Kubota, Koch, Hydranautics and other manufacturers supply these types of Ultrafiltration membranes.

Nanofiltration is normally used in the lower end of the ionic range (about 0.001 micron) to the upper end of the molecular range (about 0.008 micron). Nanofiltration requires higher differential pressures because of filtration through very small pore openings. Nanofiltration is not used for clarified effluent filtration.

Reverse Osmosis membranes are used in the lower end of the ionic range (about 0.0001 micron to 0.001 micron). Reverse Osmosis membranes are primarily used in brackish water filtration and in desalination of sea water. Reverse Osmosis membranes require significantly higher operating pressures are not used for clarified effluent filtration.

The AECOM & Black & Veatch Team also evaluated the following conventional effluent filtration technologies:

1. Traveling Bridge Filters;
2. Upflow Filters
3. Compressible Media Filters;
4. Cloth Media Filters;
5. Stainless Steel Media (NOVA) Filters;
6. Tubular Membrane Filters;
7. Submersible Hollow Membrane Filters; and
8. Submersible Plate Membrane Filters.

AECOM and Black & Veatch jointly identified and evaluated the advantages and disadvantages of each of these effluent filtration technologies. Results of this effluent filtration evaluation process considered the following criteria:

1. Experience of the process at the design flows for SAR and Walnut Creek;
2. Need for modification of the existing structures to incorporate the effluent filtration process;
3. Ability to optimize existing facilities to incorporate the filtration technology;
4. Flexibility for expansion of the existing filtration facilities to incorporate technology;
5. Flexibility of the filtration technology to meet future regulations;
6. Ability of filtration technology for energy optimization; and
7. Reliability and complexity of filtration technology.

Based on the results of this filtration technology evaluation process, Cloth Media Filtration was determined to be suitable for use at the SAR WWTP and Granular Media filtration was selected for use at the Walnut Creek WWTP.

This Technical Memorandum No. 3 for the Filter System Process Evaluation focuses on appropriate filtration processes applicable for the SARWWTP. This evaluation includes Granular Media Deep Bed Filtration and Cloth Media Surface Filtration. The scope of services covered in this includes the following tasks:

1. Meeting with SAR WWTP operations and maintenance personnel to discuss filtration system issues, goals and observations;
2. Evaluating the existing filtration process in comparison to applicable current filtration technologies. An evaluation of Filtration Technologies performed in coordination with the evaluation being performed at the Walnut Creek WWTP by Black & Veatch will result in one Technical Memorandum for both Projects;
3. Based on the Current Filtration Technologies TM, identify specific filtration technologies for use at the SARWWTP. This TM reviewed the application of the selected filtration technologies to the SARWWTP and defines modifications required to implement the selected technology. A workshop with the COA to review the findings and recommendations will be carried out.
4. This TM will determine if filter cells must be removed from service, and based on the filtration technology selected during the workshop, internal modifications of the filters required to implement the new filtration process will be identified. This evaluation will consist of an internal evaluation of each filter cell and will include the following sub-tasks:

    i. Operate selected filter cells through a full cycle of operation to observe current operational procedures, practices and characteristics; durations of backwash steps (air scour, combined air/water backwash, and water alone backwash); uniformity of air, air/water and water flow distributions over the filter beds; clarity of backwash water over different parts of the filter beds; effectiveness of the backwash operations; height of water levels over the two separate filter beds in each filter and any differences between these heights; water level (head) variations with time; changes in head losses through the filter beds during the filtration cycle (from end of a backwash to beginning of next backwash); and any noticeable variations or non-uniformity in flow across the filter cell.

ii. If alternative filtration technology is selected, define structural and mechanical modifications necessary to accommodate the selected filtration process.
iii. If existing filtration technology is selected, evaluate filter media and determine if media replacement is required. The underdrain system of one of the existing out-of-service filter will be inspected and evaluated. It is anticipated that coordination with plant personnel will identify a means to isolate and access this filter underdrain for inspection and evaluation. Evaluation will determine effectiveness of the existing underdrain system and will determine necessary modifications and improvements, if any, for reliable and effective filtration, uniform flow distribution over the entire filter bed, and flow transfer and delivery to the clearwells.

3.3 Existing Conditions and Issues of Concern

The following lists some of the known issues in need of correction, or causing concern with operations and maintenance personnel:

1. The current operating procedure for the SARWWTP is to use the existing filters consistently to meet the desired effluent quality of the plant and to meet the permit requirements established by the TCEQ. The SARWWTP filters must be fully operational and provide effective filtration treatment to meet the effluent discharge limits at all times;
2. SARWWTP operations staff have indicated general satisfaction with the performance of the existing Deep Bed filters; however, the system is over 20 years old and has not had any major rehabilitation since constructed;
3. SARWWTP maintenance staff has performed routine maintenance and repair over the life span of these filters, but recently these repairs have been inadequate to maintain an acceptable level of performance;
4. Filter Cell No. 1 has been out of service for an extended period of time and is unable to be repaired, because the filter cell cannot be totally isolated without taking the Filter Building out of service;
5. Multiple other filters (Nos. 2, 3 and 11) are experiencing operational problems that impact their reliability;
6. One side of Filter Cell No. 11 has lost approximately 42" of the designed 48" of filter media (>87 percent) and is now taken out of operation. Reason(s) for this large filter media loss needs to be determined. The Underdrain System of this filter needs to be inspected by dewatering the filter, removing the remaining media, and checking the condition of the pre-cast filter bottom and the air/water backwash nozzles in the underdrain system;
7. Growth of algae on the walls of the filter cells and on parts of the media surface; and
8. SARWWTP Filters were designed to provide an averaged filtration capacity of 40 MGD and a peak filtration capacity of 80 MGD. The Plant itself was rerated and permitted treatment capacity for the WWTP was increased after the SARWWTP Filters were designed and built. As a result, filter capacity is now below the plants permitted treatment capacity of 75 MGD (average daily flow).

3.4 Review of Original Filter Design Criteria

The SAR WWTP has an Effluent Filtration System consisting of 12 individual Semi-Continuous Operation Granular Media (sand) Filters. Each Filter has two 12' wide x 36' long filter beds separated by an Influent/Effluent Gullet. Design details of the filters are as follows:

Type	Deep Bed single media
Media	Coarse sand
Bed Depth, inches	48
Effective size, mm	1.9 – 2.1
Maximum Uniformity Coefficient	1.6

SAR Effluent Filters are designed for the following loading rates with one Filter out of service:

Loading rate	**gpm/ft^2**
Average	2.9
Maximum	5.8

Design Flow Rates for the Filters with one filter out of service are as follows:

Flow Rate	**mgd**
Average	40
Peak	80

Designed filter backwash rates are as follows:

Method	**Minimum**	**Maximum**
Air Scour (wash), scfm/ft^2	2	4
Combined Backwash		
- Air backwash, scfm/ft^2	2	4
- Water backwash, gpm/ft^2	6	12
Water backwash (filter to waste), gpm/ft^2	6	12

3.5 Filter Backwash Operation As Designed

SAR Filters were designed for either automatic, semi-automatic, or manual backwash of the filters. When an operating filter gets dirty and needs cleaning for restoring its filtering capacity, it is taken out of operation. In all three modes of filter backwashing, the influent valve to the filter is first closed and the water level in the filter is lowered to 6" above the filter bed by draining down the filter. The effluent valve is then closed and the backwash water discharge valve to the Mud Well is opened. This allows the dirty backwash water from the Filter to discharge and collect into the Mud Well.

3.5.1 Air Scour Alone

Initiation of filter backwash operations starts with air scour. One of the two Blowers is started and air is supplied to the underside of filter for scouring the bed. Air scour of the filter bed as designed is provided as follows:

Average air flow, scfm/ft^2	2
Maximum air flow, scfm/ft^2	4
Duration, minutes	3 to 5

3.5.2 Combined Air and Water Backwash

One of the two vertical turbine pumps is then started and the washwater inlet valve is opened to allow discharge of washwater into the Filter Underdrain Plenum for combined air and water backwash of the filter media. Combined air and water backwash rates of the filter bed as designed are provided below:

Average air flow, scfm/ft^2	2
Maximum air flow, scfm/ft^2	4
Average water flow, gpm/ft^2	6
Maximum water flow, gpm/ft^2	12
Duration, minutes	3 to 5

3.5.3 Water Backwash (Filter to Waste)

After combined air and water backwash, the operating blower is shut off to stop airflow to the filter bed. Water backwash is continued for filter to waste operation to clean the filter bed of any remaining solids and particulates. Details of design water alone backwash is as given below:

Minimum water flow, gpm/ft^2	6
Maximum water flow, gpm/ft^2	12
Minimum duration, minutes	8
Average duration, minutes	10
Maximum duration, minutes	12

After completion of water backwash (filter to waste) operation, the filter is put back into service for normal operation.

3.6 Work Performed in the Field

AECOM engineers have carried out several on-site inspections of the SAR Filters as a part of the investigations for evaluation of the existing Deep Bed sand filters. SAR Filters O&M Manual describes the filter backwashing requirements. Current manual backwashing differs from the backwashing requirements prescribed in the O&M Manual. These included the following:

1. Observations of the current practices of filter backwashing carried out by the plant operators;
2. Inspection of the existing valves, operators for Filter Backwash water discharge and sluice gates for discharge of filtered water from the Splitter box into the two clear wells;
3. Inspection of pipes, couplings, valves, operators, effluent slide gates, pumps, blowers and other equipment in the Upper Pipe Gallery;
4. Inspection of the two Aeration Blowers installed in a room above the Mudwell Pump Room;
5. Inspection of pipes, couplings, valves, operators, mud well pumps in the Lower Pipe Gallery; and
6. Inspection of the flow control gates in Junction Box Nos. 5, 6 and 9.

3.7 Observations of Backwashing of Existing Filters

AECOM engineers observed filter backwash operations and practices at the SARWWTP on April 25, 2010. Backwashing of two filters (No. 4 and No. 5) by the plant operators were observed. Based on this observation, following issues were noted by AECOM:

1. Filter backwash is currently done manually. This manual operation is necessary because the automatic and semi-automatic methods of backwash are not functional because of the condition of the existing valves, valve operators, flow meters, and electrical and I&C system. Refer to TM 2 for details;
2. A Filter requiring backwash is identified and selected for backwash using a hand operated selector switch;
3. Backwash consisted of air scour for about 10+ minutes, followed by combined air/water backwash for another 10+ minutes, and finally water wash for about 10+ minutes. The Operator started and stopped each backwash step manually;
4. Duration of manual backwash periods for air scour, combined air-water backwash, and filter-to-waste backwash varied by the operator based upon observation of clarity of backwash water, and durations were not consistent and uniform for all filters;

5. Observed durations of backwash were inconsistent with design durations prescribed in the SAR O&M Manual. Observed backwash durations are inconsistent with design durations due to operator interpretation of cleaning required for each filter;
6. Air flow and water flow through the filter beds appeared to be non-uniform with parts of the bed receiving more air and water while other parts received lesser amounts;
7. Even after completion of filter backwash, cloudy water was observed to rise through parts of the filter bed during the filter-to-waste operation;
8. The air flow rate indicator for air scour showed that actual air flow rates varied from about 4.92 scfm/ft^2 to about 5.20 scfm/ft^2. These rates are not consistent with Filter Design Criteria.
9. Backwash water flow rates were noted to vary from filter to filter and ranged between 8.82 gpm/ft^2 to 9.26 gpm/ft^2;
10. Filter bed expansions during backwash of the two filters were considerably larger than the specified maximum 15 percent allowed for non-stratified filters. Unstratified filters beds are first scoured with air so that particles can abrade against each other to remove organic solids that get attached to the particles during the filtration process. Good particle abrasion requires that the filter bed is either not expanded or expanded very little. Following air scour, the filter bed is backwashed with combined air and water without fluidizing the filter bed, because fluidization causes stratification (with larger particles settling at the bottom and smaller particles settling at the top) of the filter bed.

    To prevent stratification, the filter bed is drained immediately before backwashing. Normally water level on top of the filter bed is lowered to about 6 inches above the bed (as per SAR Filters O&M Manual by TCB, pp V-5) and then combined air and water backwash is initiated. Common practice is to allow 10 percent expansion of the bed. Expansion of 15 percent is the maximum at which point the filter bed starts stratifying.

    To assure unstratified condition in the filter bed maximum expansion of filter bed is limited to less than 15 percent. Expansion beyond 15 percent of the bed depth leads to bed fluidization and subsequent stratification at the completion of backwash. (Reference is WEF MOP 8, 2010 Edition, Vol. No. 2, pp 16-33.)

    Filter bed expansion recorded during air scour and combined air-water backwash ranged between 60% and 75%. Expansion was based on observation of top level of media during backwash. Media was observed to flow over the effluent launder weirs.
11. Due to excessive bed expansion, it is likely that the filter beds are now operating as stratified beds with finer sand particles settled at the top and coarser particles settled at the bottom;
12. Results of sampling of sand media at different depths and analysis conducted by the City at one of the filters confirmed that the filter bed is stratified;
13. Head losses through the two separate filter beds in some of the filters appear to be significantly different from each other, even after backwashing. This indicates that some of the filters may be partially clogged or obstructing the passage of water flow; and
14. One of the two beds in Filter No. 11 has lost about 42 inches of filter media out of the total depth of 48 inches (over 85 percent of the total bed depth). This indicates that there may be integrity issues with the filter bottom slab and/or with the plastic nozzles.

3.8 Clarified Secondary Effluent Filtration

Clarified secondary effluent contains suspended and colloidal solids and other particulates. The filtration process is extensively used for supplemental removal of solids and associated organic matter from biologically treated effluent. Removal of other constituents by filtration of secondary effluent, such as nutrients (ammonia, nitrate and phosphorous) and inorganic solids is also practiced. Many different filtration technologies are now available and used for secondary effluent filtration to remove remaining solids, colloids and other particulates. The basic principle of filtration is the same in all processes regardless of the technology selected and used. The technologies currently applied include Depth Filtration using different types of granular media such as sand, anthracite, granular activated carbon (GAC); Surface Filtration using synthetic cloth media, woven stainless steel fabric; and Compressible Media Filters. Disc Filters supplied by a number of manufacturers, and Diamond Filters with Traveling Bridge mechanisms for backwash fall into the Surface Filtration Technology. As mentioned in Section 1.2

above, a Technical Memorandum on Filtration Technology is being prepared by Black & Veatch with input from AECOM. The Filtration Technology TM will identify current filtration technologies used in wastewater effluent filtration and evaluate these technologies to determine their possible application at the SAR and at Walnut Creek WWTPs.

This TM No. 3 for SARWWTP addresses Granular Media Filtration and Disc Filtration processes applicable to the SAR WWTP Filters. Granular Media Filtration is a proven technology and has been extensively used over the past 100 years. Disc Filtration is a relatively new technology (in use for less than 15 years and has been tested and proven at numerous installations) is currently being used for upgrading existing granular media filtration systems because of its many advantages.

Different types of applicable granular media filtration systems are discussed and evaluated to illustrate why the existing single granular media deep bed filters at the SARWWTP is still an appropriate filtration process for treating secondary effluent.

3.9 Normal Downflow Filter Operation at SAR WWTP

SAR Filters are designed for 'Variable Declining Rate Filtration'. Chlorinated secondary effluent is delivered to two Filter Bays, each bay consisting of six filters. Each filter has two separate filter beds, and inflow is uniformly distributed to each filter bed through a central gullet and over two sharp crested weirs. A constant water level is maintained on the filters by effluent weirs at the outlets of the two Clearwells. Thus, all of the operating filters have the same water level, but inflow to a filter is determined by the condition of the filter bed. A clean filter bed gets more flow, while a dirtier filter bed gets less flow determined by the headloss through the filters. As the filtration continues, the cleanest filter gets the most flow, while the dirtiest filter gets the least flow. This creates the variable declining rate flow condition. Once the dirtiest filter reaches the maximum headloss set point or maximum hours of operation (usually 24 hours), it is taken out of operation, backwashed and put back to service as a cleaned filter.

As the effluent is filtered, suspended solids (SS) and associated Biochemical Oxygen Demand (BOD) is removed by the filter media. Filtered effluent enters through the Filter Underdrain Plenum into one of two Filtered Effluent Pipes and discharges into a Splitter Box for discharge into the two Clearwells.

The two Clearwells overflow into two Filtered Water Effluent Channels which in turn discharge into an 84" diameter pipe. The 84" Filtered Effluent Pipe connects to Effluent Junction Box No. 6 for discharge into the Lower Colorado River.

3.10 Applicable Wastewater Effluent Filtration Technologies

The full Filtration Spectrum and various filtration technologies currently available for use in effluent filtration are presented in the Filtration Technology Memorandum now under preparation by Black & Veatch as per their agreement with the City of Austin. In this TM No. 3 Filtration Technologies applicable to the SARWWTP are identified and discussed.

Filtration of secondary treated effluent is normally carried out as an advanced treatment process for removal of organic and inorganic solids that remain in the colloidal and suspended forms. Filtration is typically carried out to meet the limits specified in the treatment plant's effluent discharge permit. If the plant's effluent discharge permit requires phosphorous limits in addition to solids removal, deep bed granular media filtration with or without chemical pretreatment may be used to remove phosphorous from secondary effluent. Necessity of chemical pretreatment would depend on the effluent limits for phosphorous.

Filtration processes commonly used for treating secondary effluent are categorized as follows:

I. Downflow Depth Filtration

a. Rapid Sand or other Granular Media Filtration;

    b. Traveling Bridge Filters; and
    c. Deep Bed Filters

II. Upflow Granular Media Filtration

    a. Intermittent Backwash Granular Media Filtration;
    b. Continuous Backwash Granular Media Filtration.

III. Surface Filtration;

    a. Cloth Media Disc Filtration; and
    b. Pleated Surface Disc Filtration;

IV. Membrane Filtration

    a. Microfiltration; and
    b. Ultrafiltration.

Not all of the available filtration processes listed above are applicable to secondary effluent filtration at the SARWWTP. Upflow Granular Media Filtration has been used extensively in the United States. There are numerous installations of Upflow Granular Media Filters in Florida. But these applications for wastewater filtration are mostly located in smaller treatment plants (less than 10 mgd). The Upflow Granular Media Filters is not recommended to be used at the SARWWTP because of its large capacity need and limitations of available space.

Membrane Filtration using either MF or UF membranes are not normally used for effluent filtration because of higher capital costs and significantly higher Operations and Maintenance needs. Therefore, these technologies are discarded from further consideration at SARWWTP.

Granular Media Filtration using a Traveling Bridge for filter back wash has some advantages but is typically used in smaller WWTPs. The large design treatment capacity of the existing SAR Filters, their sizes, and their layout do not readily permit use of Traveling Bridge Filters. Therefore, Granular Media Filtration using Traveling Bridge for backwash is also removed for further consideration.

Granular media filtration technologies applicable to the SARWWTP are discussed below.

3.11 Downflow Depth Filtration Systems

I. **Rapid sand or other granular media filters** have been used extensively for effluent filtration. **Conventional Filters** commonly used in this type of filtration process are:

    a. Single granular media (either a sand bed or an anthracite bed or an Activated Carbon bed);
    b. Dual media (a coarser anthracite bed over a finer sand bed or a coarser granular activated carbon (GAC) bed over a finer sand bed); and
    c. Multi-media (a coarser anthracite bed over a finer sand bed over a heavier garnet bed; a coarser GAC bed over a bed of finer sand placed over a bed of heavier garnet; or a coarse bed of GAC over a bed of finer sand over a bed of heavier garnet).

Figure 3.11.1 illustrates the schematic of the single granular media filter. Figure 3.11.2 illustrates the schematic of the Dual Granular Media Filter.

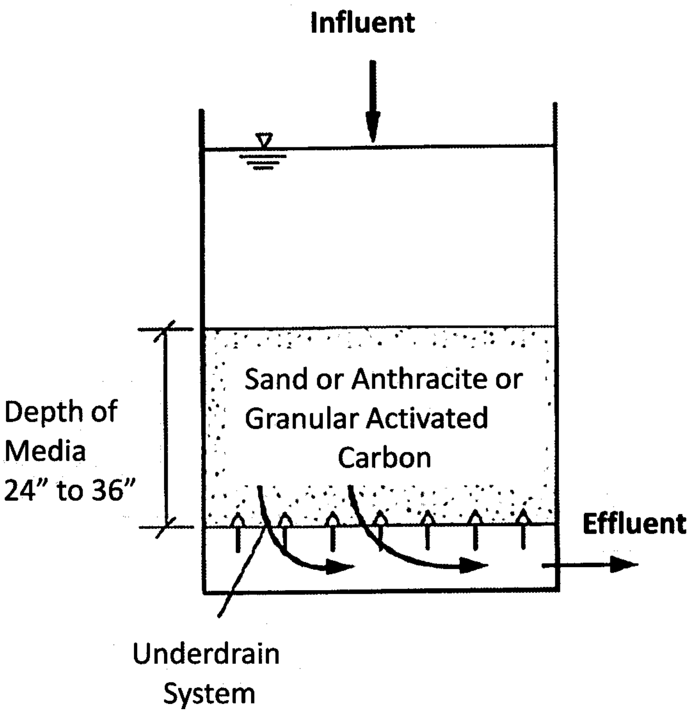


Figure 3.11.1 Schematic of the Single Granular Media Filter

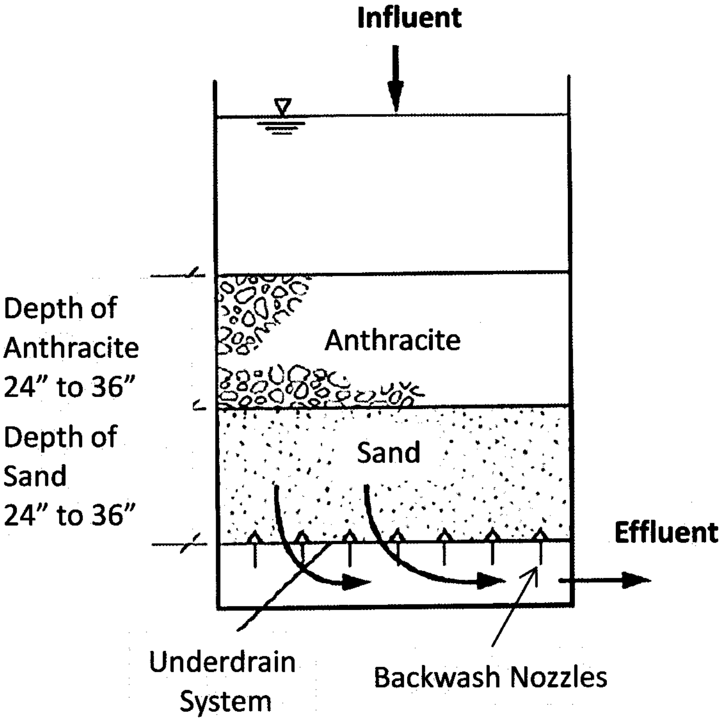


Figure 3.11.2 Schematic of the Dual Granular Media Filter

II. **Deep Bed Filters** - Experience with use of **Conventional Filters** for effluent filtration has led to the development and use of **Deep Bed Filters.** A deep bed allows penetration of suspended solids to be removed deep into the filter bed. Deeper penetration of solids provides higher capacity to store solids, and gives longer filter runs before backwashing is needed. Deep Bed filters are preferred for effluent filtration because of their superior performance and ease of operation and maintenance.

Deep Bed Filters use a single coarser granular media (either sand, anthracite, or GAC) ranging in depth from 48" to 72". These filters are designed to operate either as an **unstratified filter bed** or as a **stratified filter bed**. Use of larger size media in **Deep Bed** filters allow deeper penetration of colloidal and suspended solids into the filter bed, gives larger capacity to remove and store solids, and extends the length of the filter run. Maximum storage of solids, longer filter runs and better effluent quality is achieved when the **Deep Bed** filters are operated as **unstratified bed** filters.

Figure 3.11.3 illustrates the schematic of the Deep Bed Granular Media Filter.

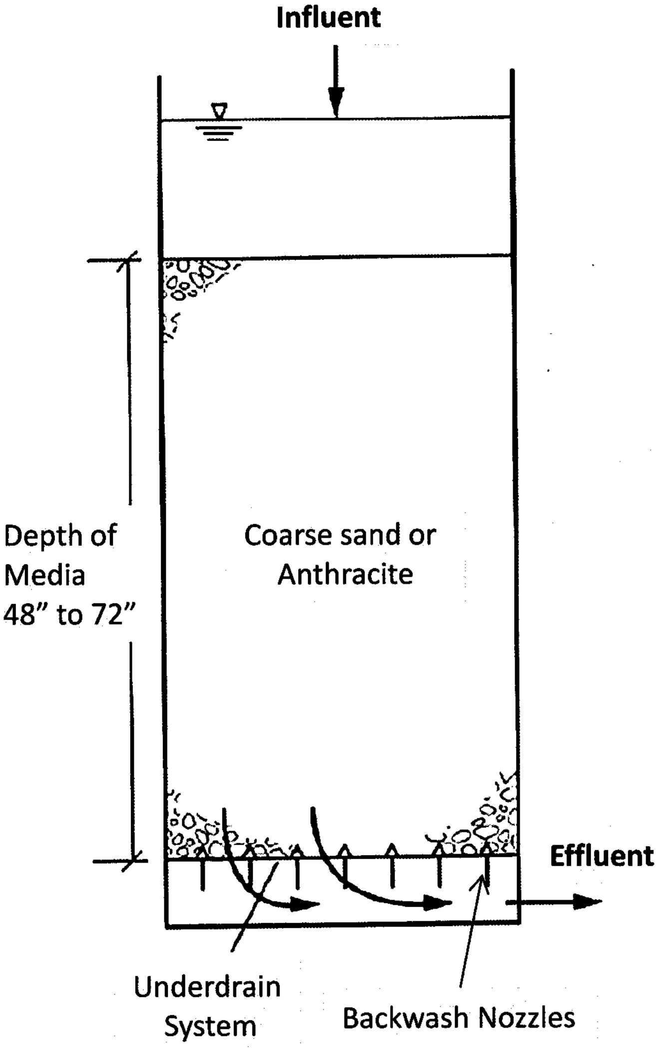


Figure 3.11.3 Schematic of the Deep Bed Granular Media Filter

To assure that the filter bed remains unstratified, the media is not fluidized during backwash. Maximum expansion of the **unstratified bed** is limited to about 15 percent of the bed depth to assure that the bed remains unstratified.

Considerable amount of solids are removed from the effluent during filtration, and these solids get attached to the media as the filtration continues. As solids build up continues, head loss in the filter increases. Once the head loss through the filter reaches a preset limit, the filter bed is backwashed to remove the accumulated solids, and to clean and prepare the filter bed for another run.

The attachment between the granular media and biological solids is relatively strong. To detach the accumulated solids from the filter media it is necessary to use air for scouring the filter bed. Normally for backwashing of the filter bed air scour is used first followed by a combined air and water backwash to clean the Deep Bed filters. Finally, a water backwash is used (filter to waste) to remove any remaining solids in the bed.

As mentioned above, the **Deep Bed Filters** can also be used as **stratified bed** filters by completely fluidizing the filter media during backwash. When the granular media is allowed to settle after fluidization, the smaller particles in the granular media settles at the top of the bed while the largest particles settle at the very bottom of the bed. In a **stratified filter bed** solids removal and attachment takes place primarily at the top of the bed where the finer media rests. Solids do not penetrate deep into the lower portion of the filter bed. A significant portion of the filter depth in a stratified media is therefore not effective for solids removal. Build up of headloss is higher and faster in a stratified media. This requires more frequent backwashing and cleaning of the stratified filters. Another issue in stratified bed filters is the potential for formation of localized carbonate layers near the top of the bed where the solids are removed. Solids and organic matter remaining in filter bed due to inadequate backwash and insufficient cleaning of the bed create conditions that allow formation of carbonate in the media causing encrustation. This is particularly true for alkaline effluent as it is in the case of SAR filters. Most municipal wastewater is alkaline. Because of the mostly limestone formations in the Austin area the raw water is alkaline and the wastewater is also expected to be alkaline. Formation of localized carbonate layers prevents effective backwashing and cleaning of the filters. To avoid this carbonate formation, it is preferable to operate the Deep Bed filters as unstratified filters, allowing deeper penetration and dispersion of the solids into the filter media.

III. Comparison of Granular Media Filters for Application at SARWWTP

Granular Media Filtration systems that applicable at the SAWWWTP are as follows:

a. Single Fine Media;
b. Single Coarse Media;
c. Dual Media; and
d. Multi-Media.

Advantages and disadvantages of these four filtration processes are compared in Table 3.11.1.

As seen from the comparison presented in Table 3.11.1, among the granular media filtration technologies, the Single Coarse Media Unstratified Filter currently used at the SARWWTP is the appropriate granular media for effluent filtration providing low headloss, high solids storage capacity and long filter runs. At the SAR WWTP the average filtration capacity of the existing 11 filters (with one unit out of service) at 2.9 gpm/ft^2 is about 40 mgd and the peak filtration capacity at 5.8 gpm/ft^2 is about 80 mgd. The design average and design peak flow filtration capacities with all12 filters in operation are higher than these values. In the future, increase over the design 40 mgd average and

80 mgd peak filtration capacities for 11 filters, if needed, would require construction of a new Filter Building and other appurtenant facilities.

Table 3.11.1 Comparison of Different Granular Media Filters

Filtration System	Filtration Capacity gpm/ft^2	Backwash Type	Backwash Rate gpm/ft^2	Headloss Buildup	Solids Storage Capacity	Filter Run Length
Single Fine Media Fluidized & Stratified	3 - 6	Intermittent	12 - 15	High	Low	Short
Single Coarse Media Non-fluidized & Unstratified	3 - 6	Intermittent	8 - 12	Lower	High	Long
Dual Media Fluidized & Stratified	3 - 6	Intermittent	18 - 30	Medium	Medium	Medium
Multi-Media Fluidized & Stratified	3 - 6	Intermittent	18 - 30	Medium	Medium	Medium

The existing Deep Bed Filters at the SARWWTP have provided effluent filtration for almost 25 years. These filters have provided reliable service and operations for many years. Plant operators are very familiar with these filters, the filtration process and their operations. Operators like the relatively simple operations of these filters. Only in recent years, some of the Deep Bed filters have been facing operating difficulties, possibly due to age, deterioration of filter bottom and filter bed. Characteristics of filtered effluent from a few of the filters indicated higher TSS concentrations and higher turbidities.

Continued use of these Deep Bed filters will require the following:

1. Inspection, repair and/or replacement of the existing filter under drain system;
2. Removal and replacement of the existing filter sand media;
3. Repair, modifications and replacement of the existing mechanical, electrical, and Instrumentation equipment and controls; and
4. Modifications, repair, sand blasting and recoating of the existing pipes, valves and fittings.

Details of these steps and associated estimated Probable Construction Costs are presented in Technical Memorandum No. 2.

3.12 Surface Filtration

Surface Filtration includes both Cloth Media Disc and Pleated Media Disc Filters. Use of pleated media provides additional surface area and slightly larger size of pore opening (20 to 35 microns) in the media. Higher filtration capacity is claimed by the manufacturer of these types of pleated surface filters with larger pore openings.

Cloth Media Disc Filters use cloth pile which has smaller nominal openings (10 microns). Figure 3.12.1 illustrates the Flow and Operations Schematic of a Cloth Media Disc Filter.

Surface Filters use either woven nylon or a polyester fabric or a square mesh stainless steel fabric or a pleated surface disc. In this type of filter, TSS and colloidal solids removal takes place on the surface of the filter fabric. These filters have been introduced for wastewater effluent filtration within the last 10 to 15 years. They have significant advantages over conventional granular media filters for the following reasons:

i. Smaller foot print and less space requirements;
ii. Higher filtration capacity;
iii. Better effluent quality;
iv. Reduced backwash requirements;
v. Reduced head requirements;
vi. Lower washwater use; and
vii. Simplified filter operation.

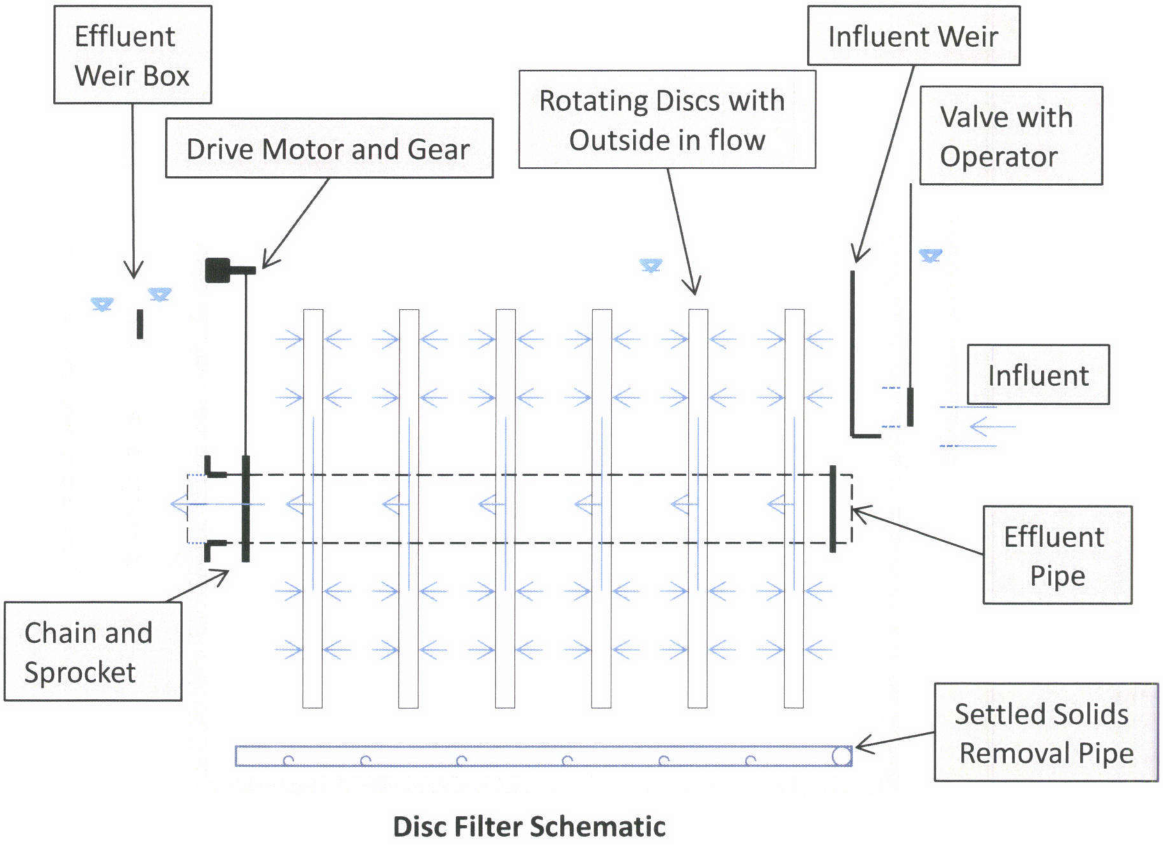


Figure 3.12.1 Cloth Media Disc Filter Schematic

A number of manufacturers supply **Surface Filters**. These can either be fully submerged or partially submerged. Disc Filters use a filtration rate ranging between 3 gpm/ft^2 to 8 gpm/ft^2. Higher filtration rates of up to 20 gpm/ft2 have been reported for some Disc Filters (Metcalf& Eddy, 2003), with larger pore openings media. The direction of flow and filtration can be either outside in or inside out. Disc Filters with outside to inside flow configuration are easier to maintain as compared to inside to outside flow configuration.

Cloth or polyester fabrics have a nominal pore opening of about 10 micron, while stainless steel mesh uses a higher pore opening in the 10 to 100 micron range. Disc Filters operate with rotating discs. For large capacity effluent filtration a Diamond Configuration of the frame with stationary cloth filters is used. A slowly moving Traveling Bridge is used in the Diamond Configuration for backwashing and cleaning the filter cloth using a vacuum pump.

Space requirement for **Surface Filters** is about 25 percent or less as compared to the **Conventional Granular Media Filters**. A very small portion of the filter is backwashed either continuously or intermittently using a vacuum type system.

Headloss through the clean filter cloth used in Surface Filters normally ranges between 2 inches to 4 inches and maximum headloss through the cloth media filter is usually less than 12 inches. Total head required for operation of the Disc Filters including losses for influent and effluent weirs, and control valves range between 2.0 ft to 2.5 ft and is considerably less than that required for granular media filters.

Filtered water is used for backwashing Surface Filters. Typical backwash water use in Surface Filters varies between 2 percent to 5 percent of the total filtered water produced. Due to application of vacuum backwash, quantity of backwash water needed is small relative to intermittent backwash granular media filters. As a result, normally a separate Clearwater Well for storing and supplying backwash water is not needed or used in Disc Filters.

Filter operations and controls are relatively simple. Normally a PLC is used for automatic operations of the Surface Filters. Finally, Disc Filters provide excellent treatment with effluent turbidity less than 1 NTU (Metcalf & Eddy 2003, Figure 11-31(b), pp 1103) even with highly variable influent characteristics (both TSS and turbidity).

3.13 Advantages of Cloth Media Surface Filtration over Deep Bed Granular Media Filtration

Potential use of the Cloth Media Filters at the SARWWTP has significant advantages, including the following:

1. **Increased Capacity** – Conversion of four of the twelve existing filters into Disc Filters would provide an average filtration capacity of 48 mgd and a peak filtration capacity of 96 mgd. If additional capacity is required in the future, conversion of six of the existing twelve filters in one bay would provide an average filtration capacity of 72 mgd and a peak filtration capacity of 144 mgd. Further, if required, the second bay of existing filters can also be converted into disc filters to provide additional filtration capacity.

2. **Reduced Backwash Water Use** - Backwash water pumping rates would be reduced significantly from the current operations and backwashing needs of the existing granular media filters. Existing backwash water pumps would not be required as the Disc filters would be backwashed intermittently using smaller vacuum pumps. The total quantity of backwash water used would also be reduced significantly.

3. **Air Scour Not Required** - Air scour would not be required for Disc Filters and the existing blowers would not be needed.

4. **Reduced Power use** - Elimination of the large Backwash Water Pumps and the Aeration Blowers would reduce power usage significantly.

5. **Reduced Operation and Maintenance (O&M)** – O&M of the Disc Filters would be simplified and automated using a PLC. Operators can use an Interface to monitor, adjust and/or override PLC operations.

6. **Better Effluent Quality** – Quality of effluent from Cloth Media Disc Filters is much better with turbidity at or below 1 NTU even with highly variable influent characteristics. In comparison

effluent turbidity from Granular Media Filters, effluent turbidity would fall in the range of 3 to 6 NTU (Metcalf & Eddy, 2003, Figure 11-18, pp 1079) and vary with influent characteristics.

7. **Better Fit in Existing Layout** – Cloth Media Disc Filters would fit perfectly within the existing Filter Bed layout of the SAR Filter Plant.

8. **Reduced Hydraulic Head** – Cloth Media Filters retrofitted into the existing SAR Filters would require much lower hydraulic head (about 2.0 to 2.5 ft including head losses for weirs and flow control valves) as compared to the hydraulic head (4.0 ft to 12.0 ft) needed for Deep Bed Granular Media Filters. Due to lower head requirements, hydraulics of the Cloth Media Disc Filters would improve filtration system.

9. **Comparable Costs for Major Upgrading** – Usually Disc Filters require more capital expenditure. However, costs may be comparable if major structural modifications such as filter underdrain replacement, replacement of filter media, replacement of equipment and process controls are required. Many older Granular Media Filters requiring major modifications and upgrading at the end of their service life have been modified and converted to Cloth Media Disc Filters because of cost advantages in a smaller foot print plant for the same design capacity.

3.14 Disadvantages of the Cloth Media Disc Filters

Potential disadvantages of the Cloth Media Disc Filters are as follows:

1. **Periodic Replacement of Media Required** - Cloth Media used in Disc Filters usually gives a service life ranging from 7 to 10 years. In comparison, Deep Bed Granular Media Filters provide longer service life (20 to 30 years).

2. **Potential for Rips and Tears in Media** - Accidental rips and tears of the cloth media may allow breakthrough of solids and turbidity.

3. **Monitoring of Effluent Quality** – Continuous monitoring of effluent TSS concentrations and turbidity is necessary for assuring reliability more so in Cloth Media Disc Filters than in Deep Bed Granular Media Filters.

4. **Higher Capital Costs** – Capital costs of Cloth Media Disc Filters are usually higher than Granular Media Filters when both systems are built new.

3.15 SAR Filters Modifications for Retrofitting New Disc Filters

Existing Deep Bed Granular Filters at the SARWWTP can be readily modified to retrofit Cloth Media Disc Filters. Retrofitting four (4) of the six (6) existing Granular Media Filters on the East Filter Bay (Filter Nos. 3, 4, 5, and 6) would provide an average filtration capacity of 48 mgd at the filtration rate of 3.0 gpm/ft^2 and a peak filtration capacity of 96 mgd at a filtration rate of 6.0 gpm/ft^2. If necessary, filtration rates for the Cloth Media Filters can be easily increased to 3.125 gpm/ft^2 for obtaining an average flow capacity of 50 mgd and to 6.25 gpm/ft^2 for obtaining a peak flow capacity of 100 mgd. These average and peak filtration capacities exceed the design average and peak filtration capacities of the existing eleven (11) Deep Bed Sand Filters.

If needed in the future, the remaining two Granular Media Filters (No. 1 and 2) on the East Filter Bay can also be retrofitted with new Disc Filters to provide additional filtration capacities of 24 mgd average and 48 mgd peak flow. Conversion and retrofitting of all six existing filters on the East Filter Bay would give an average filtration capacity of 72 mgd and a peak filtration capacity of 144 mgd with all units operating. With one unit in standby mode, the average design capacity would be reduced to 69 mgd and the peak design capacity would be 138 mgd.

A Preliminary Process Flow Schematic for retrofitting new Cloth Media Disc Filters within existing Filters No. 3, 4, 5 and 6 is illustrated in Exhibit 3.1. Only lines shown in bold on the Process Flow Schematic are required for the new Disc Filters. All existing equipment, air lines, pipes, valves and fittings shown as screened would not be needed after installation of the Disc Filters. A plan and sections showing four (4) Disc Filters retrofitted inside one of the existing Granular Media Filters are shown respectively in Exhibits 3.2, 3.3 and 3.4.

As seen from the Process Flow Schematic, many of the existing equipment (pumps, blowers, etc), low pressure air pipes and fittings, filter effluent and backwash water pipes, valves and other appurtenances would no longer be needed after the Disc Filters are installed. Only the influent pipe to East Filter Bay would be used for feeding the Disc Filters. All six filters on the West Filter Bay would be abandoned in place together with all air pipes and fittings, influent and effluent pipes and fittings, and backwash water pipes and fittings. These pipes and fittings can be easily dewatered, and then left in place blind-flanged and isolated for possible future use.

New Mudwell pumps are required to transfer backwash water to the treatment trains. It is anticipated three (3) 3,500-GPM pumps will be required and will be installed to connect to the existing piping. These new pumps will be powered by new 100 horsepower, high-efficiency electric motors.

3.15.1 SAR Filters Electrical Modifications for Retrofitting New Disc Filters

The power distribution, instrumentation, and control systems design concepts to support the disc filter process system technology will be generally similar in architecture to those proposed for the conventional media filter technology as discussed in TM2 with the appropriate system modifications to address the specific needs of the disc filter process system technology. In particular, modifications to the infrastructure of the existing power distribution system are necessary to facilitate reliable service and one that is synchronized with the life cycle of the proposed process system. Provisions will be made to address the power quality issues resulting from the anticipated application of variable frequency drives for the disc filters.

Consideration will also be given to the application of adjustable speed drives that do not employ variable frequency drives. It is anticipated that the sizing/arrangement of the related distribution equipment will be more closely examined during later phases of the project. With the anticipated deletion of the backwash pumps and air scour blowers from the existing power distribution system related with the selection of the disc filter system technology, consideration will also be given to the need for a motor control center lineup in the filter building. Where applicable, the concerns discussed in TM2 associated with the routing of raceway systems in the filter building remain valid for the disc filter system technology.

In summary, the power distribution equipment located in the Mezzanine Electrical Room will be replaced with new equipment sized to support the power demands of the four new cloth media disc filters in existing Filter Nos. 3, 4, 5, and 6. The new equipment will be designed to accommodate a future capacity increase when existing Filter Nos. 1 and 2 are converted to cloth media disc filters. The cost of their equipment replacement is defined in Appendix 2.5 of TM No. 2, in the cost tables under Conceptual Electrical and I&C Construction Cost Opinion, Power Distribution System. The replacement of this power distribution equipment will also impact auxiliary equipment and this cost has been identified and included in the construction cost estimate.

3.15.2 SAR Filters Instrumentation/Controls Modification for Retrofitting New Disc Filters

As stated in TM No. 2, the existing instrumentation is older technology and in need of repair. The I/C architecture proposed for TM No. 2 will be used for retrofitting the new disc filters. This will consist of a central PLC located in the Mezzanine Electrical Room and connected to the plant-wide SCADA system. Each cloth media disc filter unit will be provided with a vendor supplied or instrumentation and control system contractor supplied control panel. Each control panel will be interlocked with the central PLC. The central PLC will also provide remote control for the auxiliary equipment. Final details of the control concepts will be resolved during final design. The I/C equipment and wiring cost has been defined in the construction cost estimate, and it is anticipated the final design control concepts will be achieved within this probable cost.

3.15.3 SAR Filters Structural Modifications for Retrofitting New Disc Filters

The structural modifications required to retrofit Filters No. 3 through No. 6 (or Filters No. 1 through No. 6; Option 2) with a disk filter system based upon the preliminary layout provided by AECOM include:

1. Demolition of the existing concrete elements that form the gullets in each bay noted above.
2. Addition of concrete columns in the clearwells below those areas to provide added support for the anticipated increased loads of the new system.
3. Construction of new concrete walls and slabs in each filter well in a direction that is 90 degrees to the existing filter well layout.
4. Cutting holes in the existing concrete walls that remain between the existing filter cells, to accommodate the new effluent channel that is part of the construction noted in item 3 above.
5. Complete repair of the existing expansion joint that divides the filter cells into two sections.
6. Construction of new grated walkways for maintenance/observation purposes.

Additionally, a canopy system for the disc filter system constructed of steel (gable or bowstring) trusses and decking supported by steel beams and columns is proposed for the facility; the columns would be connected to the existing concrete structure around the perimeter.

3.16 Design Criteria for Cloth Media Disc Filters

Several manufacturers supply Cloth Media Disc Filters and design criteria and specifications vary with manufacturer. Some units are fully submerged, while others are partially submerged. In some units, the flow regime is from outside to inside while in other units flow is from inside to outside. Units that are fully submerged with influent going from outside to inside usually provides more reliable performance and require less maintenance. Units may rotate continuously or intermittently when backwash is required. Intermittent rotation tends to reduce wear and tear of drive mechanism and give longer life.

Typical values and design parameters used for Cloth Media Disc Filters together with pertinent observations are presented in Table 3.16.1. This information will facilitate the sizing of new Disc Filters should the City of Austin select this filtration technology to replace the existing Deep Bed Sand Media Filters at the SARWWTP.

Table 3.16.1 Typical Design Criteria for Cloth Media Disc Filters

Type of Disc Filter	Design Information and Units	Typical Values	Observations
1. Rotating Multi-Disc	Not Applicable	12 Units per Filter Drive	Chain and Sprocket
2. Diameter of Disc	ft	3 to 6	May Vary with supplier
3. Disc Rotation	Revs/min	1 to 2	Only during backwash
4. Flow Type	Outside to Inside	Not Applicable	Varies with supplier
5. Media Type	Synthetic Pile Fabric	Not Applicable	Resistant to chlorine

6. Nominal Size of Pore Openings	Microns	10	Other Pore openings may be available
7. Hydraulic loading Rate	gals/min/ft^2	3 to 8	Varies with influent characteristics
8. Backwash Type	Filtered Water with Vacuum Pump	2 Vacuum Slots per Disc, 24 Slots per unit	some suppliers use spray nozzles
9. Headloss through Pile Cloth Media	Inches	2 to 12	Varies with solids accumulation on pile cloth media
10. Disc Submergence	Fully submerged	100 percent	Some manufacturers use partially submerged units
11. Backwash Quantity	Percent of production	2 to 5	Varies with influent quality and supplier

Retrofitting of Disc Filters inside the existing filters at the SARWWTP would require some structural modifications to the existing filters. Mechanical and structural arrangements and details of this retrofit are presented in the Exhibits.

3.17 Engineers Opinion of Probable Construction Cost

This section presents the Probable Construction Costs and estimated annual operating costs for one of the two feasible alternatives suitable for use at the existing Filters at the SAR WWTP. The estimated Probable Construction Costs for Alternative 1 - Modifications and upgrading the existing Deep Bed Sand Filters are presented in Technical Memorandum No. 2. The estimated Probable Construction Costs for Alternative 2 - Installation of the Cloth Media Disc Filters are presented in this Technical Memorandum No. 3.

Details of the alternative to install the Cloth Media Disc Filters in some of the existing filter cells are discussed in the following section.

3.17.1 Alternative 2 - Installation of Cloth Media Disc Filters to replace existing Deep Bed Filters

Modifications to the existing Deep Bed Sand Filters to retrofit new Cloth Media Disc Filters would include:

1. Structural modifications of four of the twelve existing Deep Bed Filters (Nos. 3, 4, 5 and 6) to provide the same capacity as the twelve existing filters;
2. Demolition and removal of the influent and washwater gullets in these four filters;
3. Building a new concrete effluent channel through the middle of these four filters;
4. Installation of a blind flanged wall pipe in the existing wall between existing Filter No. 2 and 3 for possible future connection/conversion of existing Filters No. 1 and 2;
5. Removal of part of the existing concrete wall between existing Filter No. 6 and the existing Flow Splitter Box for the two Clearwells;
6. Relocation of one of the two existing slide gates on the inlets to the two Clearwells;
7. Building four (4) new influent channels inside the four filters at the locations of the existing influent and washwater gullets;
8. Installation of gratings over the new influent channels for access to suction pipes and influent valves;
9. Building four new filter cells in each of the four existing Deep Bed Filters for installation of sixteen (16) new Disc Filters units, together with their filtered effluent discharge pipes and their drive units;
10. Installation of influent valves including hand wheels operator in each Disc Filter for isolation of units;

11. Installation of influent and effluent weirs for level control in the individual filter cells;
12. Installation of sixteen (16) new Backwash Pumps (one for each Disc Filter), together with their associated valves and controls;
13. Installation of settled solids extraction manifolds in each Disc Filter cell;
14. Installation of backwash water discharge pipes from each pump to a discharge manifold;
15. Installation of pressure transducers for level indication and floats for high-high level alarm in each filter cell; and
16. Installation of sixteen (16) new Filter Control Panels. Control Panels would include motor starters, VFD for pump, all instruments and control systems and Ethernet connections to the Main Control Panel for data transmission to the Plant's SCADA system;
17. New electrical supply facilities and motor control center;
18. New instrumentation and control system specific to operation of Disc Filters.

AECOM has developed Probable Construction Costs estimate for the above mentioned tasks for two separate Options. Option 1 includes modifications to four (4) of the twelve (12) existing Deep Bed Filters (Nos. 3, 4, 5,and 6) to install and retrofit sixteen (16) new Disc Filter Units to provide an average treatment capacity of 48 mgd and a peak treatment capacity of 96 mgd. Estimates of Probable Construction Costs for retrofitting 16 disc filters in existing four (4) existing filters is presented in table 3.17.1. The Probable Construction Costs estimate for modifications of the four (4) existing Deep Bed Filters to retrofit sixteen (16) Disc Filter Units is $17.67 million. Refer to Appendix 3.1 for more in-depth cost breakdowns.

Table 3.17.1 Summary of Cost Estimates for Retrofitting Sixteen Disc Filters in Four Existing Deep Bed Sand Filters

Divisions	Details	Estimated Costs
Division 2 – Site Work	Misc. Site Work and Demolition	$180,000
Division 3 - Concrete	New Partition & Channel Walls and Slabs	$489,000
Division 5 – Metals	Aluminum Gratings and Supports	$98,800
Division 9 - Finishes	Sand Blasting and Re-Coating of Influent Pipe & Fittings only	$66,000
Division 10 Specialties	New Disc Filter Equipment and New Roof Structure	$5,965,200
Division 11 - Equipment	Mudwell Pumps, Motors, Valve Operators, Crane and Hoist	$378,900
Division 15 - Mechanical	Pipes, Valves and fittings	$683,800
Division 16 - Electrical	Electrical and I&C Equipment	$2,481,700
Sub-Total 1		**$10,343,400**
Contractor's Overhead & Profit (20%)		$2,068,700
Bonds & Insurance (2%)		$206,900
Sub-Total 2		**$12,618,900**
Contingencies 40% at Preliminary Design		$5,047,600
Total		**$17,670,000**

Option 2 prepared estimates for retrofitting 24 Disc Filters in six (6) existing Deep bed Filters (Nos. 1, 2, 3, 4, 5 and 6) to provide an average treatment capacity of 72 mgd and a peak treatment capacity of 144 mgd. Estimates of Probable Construction Costs for retrofitting 24 Disc Filters in existing six (6) existing filters is presented in table 3.17.2. Total estimated cost for this option is $ 23.96 million. Refer to Appendix 3.1 for more in-depth cost breakdowns.

Table 3.17.2 Summary of Cost Estimates for Retrofitting Twenty Four Disc Filters in Six Existing Deep Bed Sand Filters

Divisions	Details	Estimated Costs
Division 2 – Site Work	Misc. Site Work & Demolition	$205,000
Division 3 - Concrete	New Partition & Channel Walls and Slabs	$735,800
Division 5 - Metals	Aluminum Gratings and Supports	$148,300
Division 9 - Finishes	Sand Blasting and Re-Coating of Influent Pipe & Fittings only	$66,000
Division 10 Specialties	New Disc Filter Equipment and New Roof Structure	$8,825,200
Division 11 - Equipment	Mudwell Pumps, Motors, Valve Operators, Crane and Hoist	$401,000
Division 15 - Mechanical	Pipes, Valves and Fittings	$871,400
Division 16 - Electrical	Electrical and I&C Equipment	$2,777,600
Sub-Total 1		**$14,030,400**
Contractor's Overhead & Profit (20%)		$2,806,100
Bonds & Insurance (2%)		$280,600
Sub-Total 2		**$17,117,000**
Contingencies 40% at Preliminary Design		$6,846,800
Total		**$23,960,000**

AECOM has also developed estimates of annual Operations and Maintenance (O&M) costs for the sixteen (16) New Disc Filters retrofitted in four of the twelve existing Deep Bed Sand Filters. Operating costs are escalated at 2.5 percent per year to account for inflation. Over a 20-year operating period the estimated annual O&M costs, excluding cloth replacement costs, varied from $127,250 during the first year to $237,660 at the end of the 20-year life cycle with an average annual O&M cost of $167,190. It is estimated that the Disc Filters, after the initial placement, would also require replacement of the cloth media two times during (in 7th year and in 14th year) the 20-year life cycle. The estimated cost of cloth media replacement on the 7th year is $377,550 and that on the 14th year is $448,780. The present worth of the estimated annual O&M costs including the two replacements of the cloth media is $2,764,320. The combined present worth of the Probable Construction Costs and annual O&M costs including replacements of the cloth media using an interest rate of 4.5 percent amounts to $20.4 million.

The 20-year present worth life cycle cost evaluation is included in Appendix 3.2. This appendix also contains the calculation for the present worth of a 30-year life cycle cost, estimated at $21.6 million.

3.18 Available Alternatives

As discussed previously in this TM, there are two feasible options available to the City of Austin for improving the existing filters at the SARWWTP:

1. Restore the existing Single Media Deep Bed Sand Filters to meet the Original Design Basis; or
2. Modify the existing filters to retrofit new Cloth Media Disc Filters within the existing foot print.

The existing Single Media Deep Bed Filters have provided reliable filtration of the secondary effluent for more than 20 years, meeting the Permit discharge limits. Only in recent years have these filters indicated reduced performance and periodic excursions. AECOM investigations and evaluations have identified several possible reasons for this deterioration of performance and the following factors may have negatively impacted the existing filters:

1. Changed operations, resulting from Filter Building flooding and loss of operational controls, that has gradually deviated from Original Design Basis;
2. Manual and excessive filter backwashing not conforming to Design Criteria;
3. Media stratification due to excessive and higher rates of filter backwashing;

4. Possible deterioration of filter underdrain system and potential breaks in the precast concrete underdrain slab;
5. Significant media loss in some filter(s) possibly due to breakage in underdrain system;
6. Localized encrustation of the media and carbonate formation in the filter bed due to inadequate backwashing and media stratification; and
7. Non-uniform distribution of backwash air and water flows.

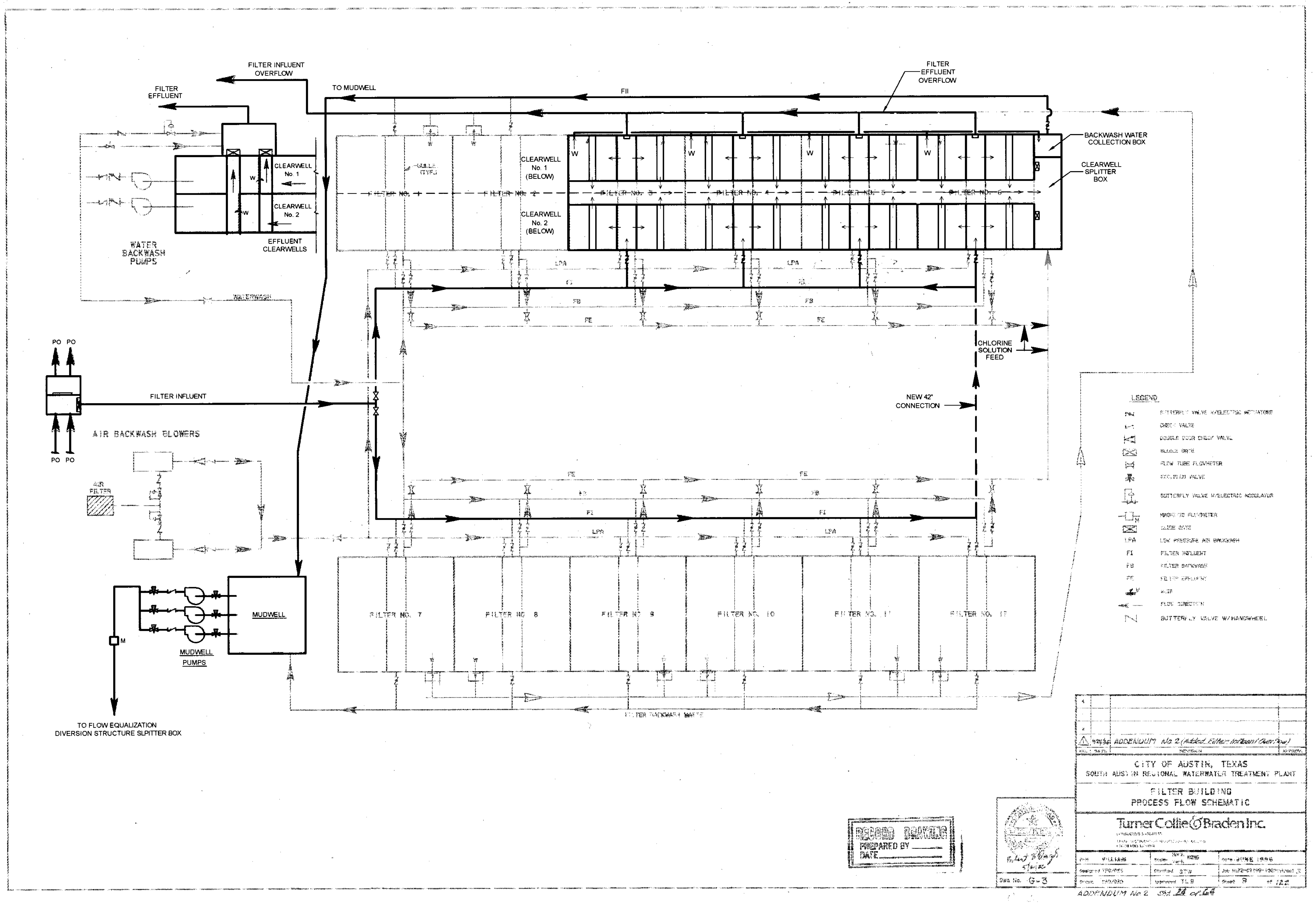
All of these factors can be readily corrected. Draining of some of the filters, removal of filter media to inspect the condition of the filter underdrian system including the precast concrete slabs and air/water backwash nozzles are necessary. Removal and replacement of the existing filter underdrain system in some or all of the filters is a distinct possibility. In addition, replacement of the filter media with new media is necessary to restore the filters to original condition with an unstratified media. All of these investigations and improvements will require significant time and effort and the Probable Construction Costs for these efforts are substantial.

Restoration of the existing Deep Bed Sand Media Filters to their Original Design condition would provide an average design flow of about 40 mgd and a peak design flow of about 80 mgd with all eleven (11) filters operating and one (1) filter on standby. In the future, if the City of Austin decides to filter wastewater effluent from all three treatment trains (A, B and C) at the SAR WWTP, then a new Filter Building, and appurtenant influent and effluent conduits would be needed to provide the required additional capacity.

The alternative to restoration of the existing Deep Bed Sand Media Filters is conversion of the existing filters to retrofit new Cloth Media Disc Filters. Retrofitting four (4) of the existing filters with Disc Filters to install twelve (16) units would provide an average filtration capacity of 48 mgd and a peak filtration capacity of 96 mgd. With one of the Disc Filter units in standby mode, the average design capacity would be 45 mgd and peak design capacity would be 90 mgd. These capacities of the Disc Filters exceed the capacities of the existing eleven (11) Deep Bed Filters with one unit in standby mode. If the City desires to add filtration capacity in the future, conversion of the remaining existing Deep Bed Filters to retrofit additional Disc Filters would provide that capacity. The exact number of Deep Bed Filters requiring conversion and retrofitting with Disc Filters in the future would depend on the filtration capacity required by the City.

Conversion and retrofitting of all twelve (12) existing Deep Bed Filters into Disc Filters would provide an average filtration capacity of 144 mgd and a peak filtration capacity of 288 mgd. With four (4) Disc Filter units in standby mode (equivalent to one existing Deep Bed filter out of service) the average design capacity would be 132 mgd and the peak design capacity would be 264 mgd. These filtration capacities far exceed the anticipated capacities required by the City at SARWWTP. Attaining these high capacities would require the construction of additional incoming conduits to and outgoing conduits from the existing Filter Building. This potential for increasing filtration capacity at the SARWWTP without constructing a new Filter Building makes the Disc Filters alternative more attractive.

Exhibits



CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

DISC FILTER SYSTEM SCHEMATIC
INFLUENT, EFFLUENT & BACKWASH PIPING

AECOM

AECOM
400 WEST 15th STREET, SUITE 500
AUSTIN, TEXAS 78701
WWW.AECOM.COM

Exhibit No. 3.1 | JOB No. 60213591 | DATE: JANUARY 2012

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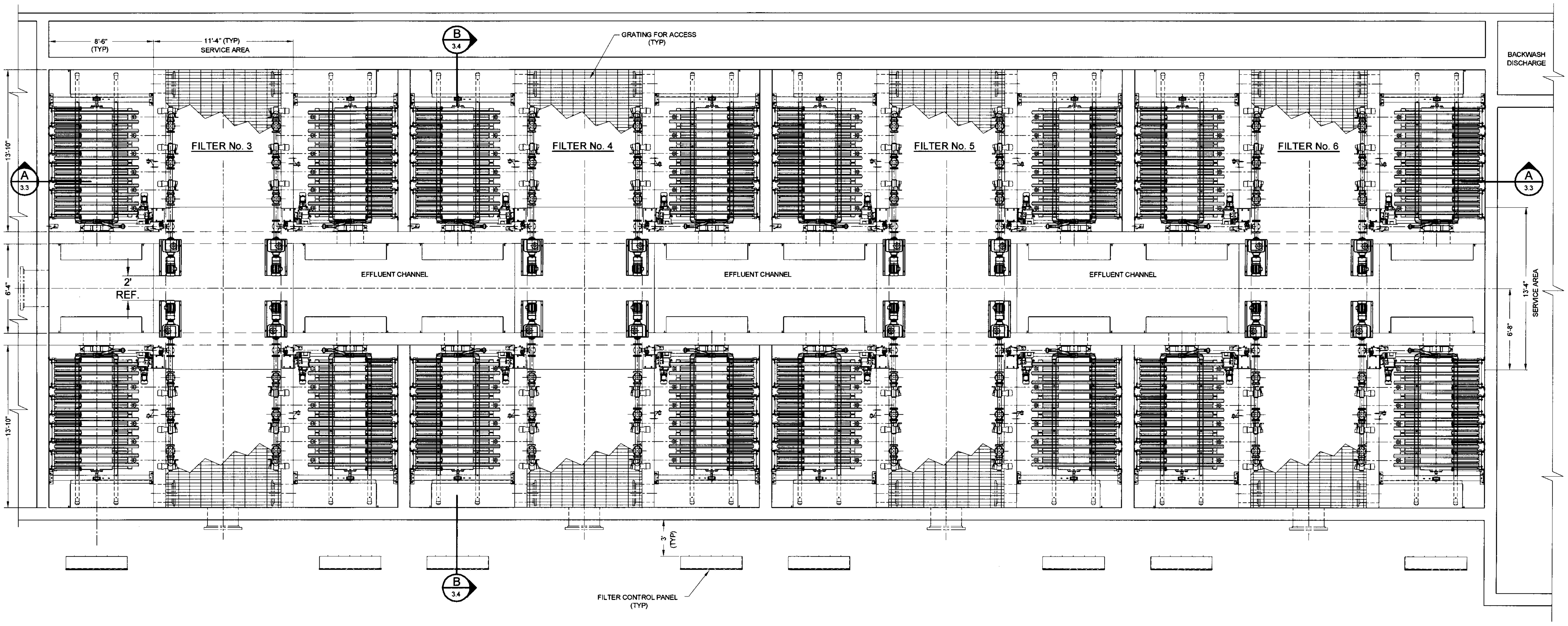

PLAN VIEW ① -
NTS

CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

RETRO-FITTING OF DISC FILTERS
PLAN VIEW

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Exhibit No. 3.2 | JOB No. 60213591 | DATE: JANUARY 2012

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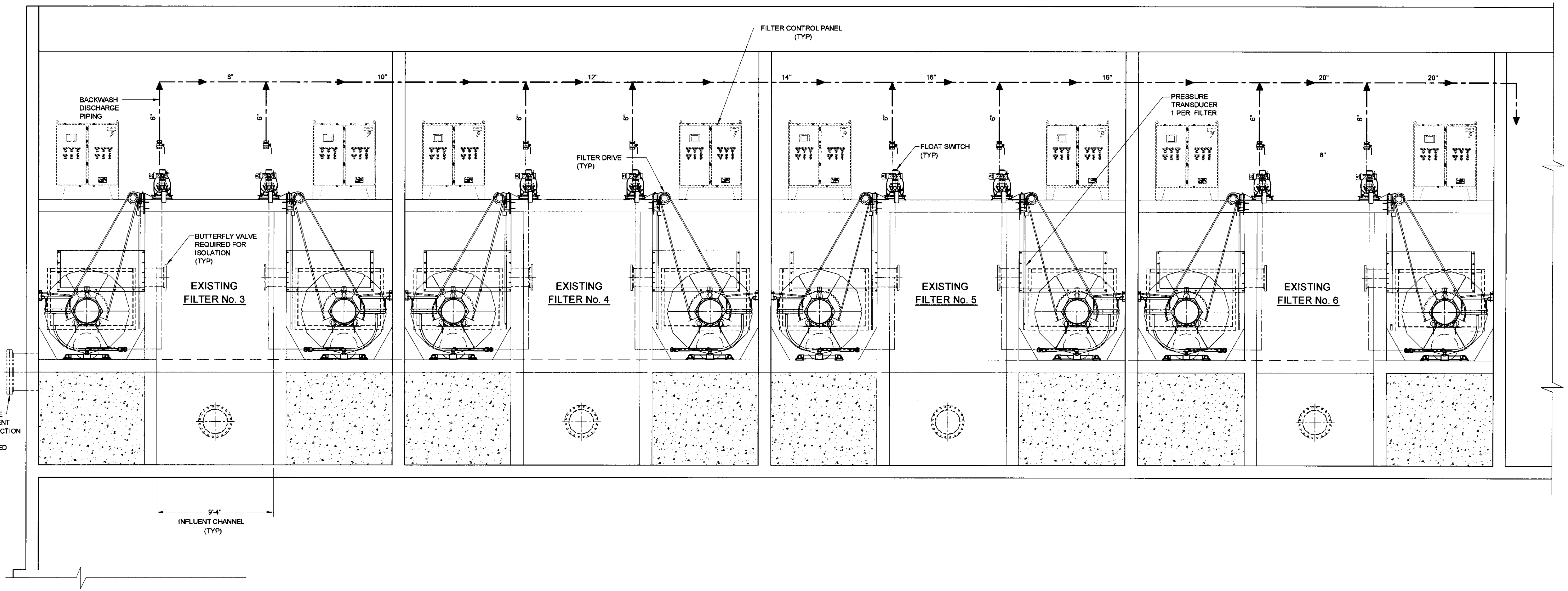

SECTION (A/3.2)
NTS

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CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

RETRO-FITTING OF DISC FILTERS
SECTION A

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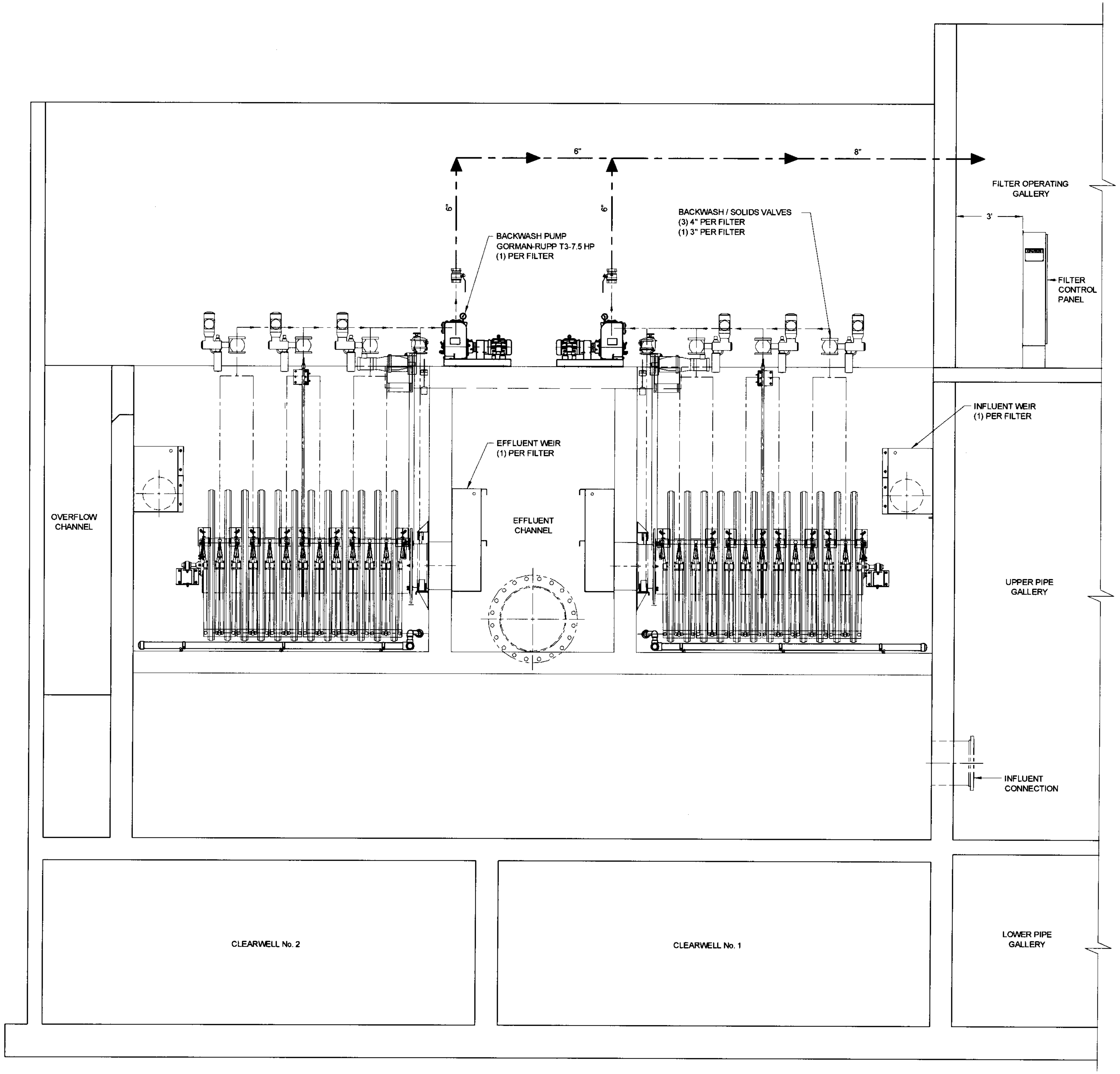
Exhibit No.	3.3	JOB No.	60213591	DATE:	JANUARY 2012



SECTION B
3.2
NTS

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CITY OF AUSTIN, TEXAS
SOUTH AUSTIN WASTEWATER TREATMENT PLANT
FILTER IMPROVEMENTS

RETRO-FITTING OF DISC FILTERS
SECTION B

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Exhibit No. 3.4
JOB No. 60213591
DATE: JANUARY 2012

Appendix 3.1:

Estimate of Probable Construction Cost: Options No. 1 and No. 2

SARWWTP FILTER BUILDING IMPROVMENTS
CONSTRUCTION COST ESTIMATE

Project: **SAR WWTP Filter Improvements Project**
AECOM Job No.: **60213591**
Date: **12/20/11**
Prepared By: **Kit Perkins/Nathan Fitzhugh**
File Name: **TM3 - Construction Estimate**
Design Stage: **Preliminary**

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

Objective:
Summarize the estimated construction costs for the SAR WWTP Filter Improvements Project.
Installing disk filters in four of the existing filter beds.

SAR WWTP FILTER IMPROVEMENTS - DISK FILTERS

Division	Item No.	Description	Unit	Qty.	Unit Material Cost	Material Cost	Labor Multiplier	Unit Labor Cost	Labor Cost	Subtotal
2-Sitework	1	Misc. Site Work	LS	1	$ 25,000	$ 25,000	100%	$ 25,000	$ 25,000	$ 50,000
	2	Demolition - Filter Troughs	EA	4	$ 1,000	$ 4,000	400%	$ 4,000	$ 16,000	$ 20,000
	3	Demolition - Filter Underdrain	EA	4	$ 1,250	$ 5,000	100%	$ 1,250	$ 5,000	$ 10,000
	4	Filter Media Removal and Cleaning	EA	4	$ 5,000	$ 20,000	100%	$ 5,000	$ 20,000	$ 40,000
	5	Filter Cleaning and Restoration	EA	8	$ 2,500	$ 20,000	100%	$ 2,500	$ 20,000	$ 40,000
	6	Isolating and Draining Pipes	LS	1	$ 10,000	$ 10,000	100%	$ 10,000	$ 10,000	$ 20,000
					MATERIAL SUBTOTAL:	$ 84,000	LABOR SUBTOTAL:		$ 96,000	
								SUBTOTAL SITEWORK (02000):		**$ 180,000**
3-Concrete	7	Concrete Partition Walls	CY	287	$ 800	$ 229,600	0%	$ -	$ -	$ 229,600
	8	Concrete Channel Walls A	CY	41	$ 800	$ 32,800	0%	$ -	$ -	$ 32,800
	9	Concrete Channel Walls B	CY	133	$ 800	$ 106,400	0%	$ -	$ -	$ 106,400
	10	Concrete Channel Walls C	CY	82	$ 800	$ 65,600	0%	$ -	$ -	$ 65,600
	11	Concrete Bottom Slabs A	CY	23	$ 600	$ 13,800	0%	$ -	$ -	$ 13,800
	12	Concrete Bottom Slabs B	CY	68	$ 600	$ 40,800	0%	$ -	$ -	$ 40,800
					MATERIAL SUBTOTAL:	$ 489,000	LABOR SUBTOTAL:		$ -	
								SUBTOTAL CONCRETE (03000):		**$ 489,000**
5-Metals	13	Aluminum Grating	SF	1,957	$ 25	$ 48,925	50%	$ 13	$ 24,463	$ 73,388
	14	Supports	SF	1,957	$ 10	$ 19,570	30%	$ 3	$ 5,871	$ 25,441
					MATERIAL SUBTOTAL:	$ 68,495	LABOR SUBTOTAL:		$ 30,334	
								SUBTOTAL METALS (05000):		**$ 98,829**
9-Finishes	15	Pipe Coating - 42" Only (Sand/Recoat)	SF	3,000	$ 11	$ 33,000	100%	$ 11	$ 33,000	$ 66,000
					MATERIAL SUBTOTAL:	$ 33,000	LABOR SUBTOTAL:		$ 33,000	
								SUBTOTAL FINISHES (09000):		**$ 66,000**

10-Specialties	16	Disk Filter Equipment	EA	16	$ 275,000	$ 4,400,000	30%	$ 82,500	$ 1,320,000	$ 5,720,000
	17	Filter Roof Structure	SF	7,266	$ 25	$ 181,650	35%	$ 9	$ 63,578	$ 245,228
					MATERIAL SUBTOTAL:	$ 4,581,650		LABOR SUBTOTAL:	$ 1,383,578	
									SUBTOTAL SPECIALTIES (10000):	**$ 5,965,228**
11-Equipment	18	Mudwell Pumps/Motors, 50HP, 4350 GPM	EA	3	$ 49,666	$ 148,998	70%	$ 34,766	$ 104,299	$ 253,297
	19	Bridge Crane (Manual Hoist)	LS	1	$ 20,000	$ 20,000	70%	$ 14,000	$ 14,000	$ 34,000
	20	36" BFV (Operator)	EA	4	$ 6,500	$ 26,000	70%	$ 4,550	$ 18,200	$ 44,200
	21	42" BFV (Operator)	EA	4	$ 6,972	$ 27,888	70%	$ 4,880	$ 19,522	$ 47,410
					MATERIAL SUBTOTAL:	$ 222,886		LABOR SUBTOTAL:	$ 156,020	
									SUBTOTAL EQUIPMENT (11000):	**$ 378,906**
15-Mechanical	22	4" Dia. Solid Waste Dischage Pipe	LF	520	$ 45	$ 23,400	35%	$ 16	$ 8,190	$ 31,590
	23	6" Dia. Washwater Pipe	LF	160	$ 75	$ 12,000	35%	$ 26	$ 4,200	$ 16,200
	24	8" Dia. Washwater Pipe	LF	150	$ 100	$ 15,000	35%	$ 35	$ 5,250	$ 20,250
	25	10" Dia. Washwater Pipe	LF	20	$ 131	$ 2,620	35%	$ 46	$ 917	$ 3,537
	26	12" Dia. Washwater Pipe	LF	12	$ 157	$ 1,884	35%	$ 55	$ 659	$ 2,543
	27	14" Dia. Washwater Pipe	LF	20	$ 210	$ 4,200	35%	$ 74	$ 1,470	$ 5,670
	28	16" Dia. Washwater Pipe	LF	24	$ 246	$ 5,904	35%	$ 86	$ 2,066	$ 7,970
	29	20" Dia. Washwater Pipe	LF	20	$ 291	$ 5,820	35%	$ 102	$ 2,037	$ 7,857
	30	36" Dia. Pipe	LF	32	$ 590	$ 18,880	35%	$ 207	$ 6,608	$ 25,488
	31	42" Dia. Pipe	LF	16	$ 767	$ 12,272	35%	$ 268	$ 4,295	$ 16,567
	32	18" Butterfly Valve	EA	16	$ 3,652	$ 58,432	70%	$ 2,556	$ 40,902	$ 99,334
	33	42" Butterfly Valve	EA	4	$ 21,291	$ 85,164	70%	$ 14,904	$ 59,615	$ 144,779
	34	36" Butterfly Valve	EA	4	$ 15,500	$ 62,000	100%	$ 15,500	$ 62,000	$ 124,000
	35	6" 90° Bend	EA	8	$ 280	$ 2,240	35%	$ 98	$ 784	$ 3,024
	36	20" 90° Bend	EA	1	$ 2,835	$ 2,835	35%	$ 992	$ 992	$ 3,827
	37	6"-8" Increaser	EA	8	$ 263	$ 2,100	35%	$ 92	$ 735	$ 2,835
	38	8"-10" Increaser	EA	1	$ 385	$ 385	35%	$ 135	$ 135	$ 520
	39	10"-12" Increaser	EA	1	$ 578	$ 578	35%	$ 202	$ 202	$ 780
	40	12"-14" Increaser	EA	1	$ 788	$ 788	35%	$ 276	$ 276	$ 1,063
	41	14"-16" Increaser	EA	1	$ 980	$ 980	35%	$ 343	$ 343	$ 1,323
	42	16"-20" Increaser	EA	1	$ 1,348	$ 1,348	35%	$ 472	$ 472	$ 1,819
	43	6"x6"x6" Tee	EA	8	$ 368	$ 2,940	35%	$ 129	$ 1,029	$ 3,969
	44	8"x8"x8" Tee	EA	1	$ 578	$ 578	35%	$ 202	$ 202	$ 780
	45	42"x42"x36" Tee	EA	4	$ 14,928	$ 59,710	35%	$ 5,225	$ 20,899	$ 80,609
	46	42"x42"x42" Tee	EA	2	$ 15,628	$ 31,255	35%	$ 5,470	$ 10,939	$ 42,194
	47	10"x10"x8" Tee	EA	1	$ 998	$ 998	35%	$ 349	$ 349	$ 1,347
	48	12"x12"x8" Tee	EA	1	$ 1,418	$ 1,418	35%	$ 496	$ 496	$ 1,914
	49	14"x14"x8" Tee	EA	1	$ 1,593	$ 1,593	35%	$ 557	$ 557	$ 2,150
	50	16"x16"x8" Tee	EA	1	$ 2,013	$ 2,013	35%	$ 704	$ 704	$ 2,717
	51	20"x20"x20" Tee	EA	2	$ 3,098	$ 6,195	35%	$ 1,084	$ 2,168	$ 8,363

	52	Sluice Gate w/ Electric Operator	EA	1	$ 12,500	$ 12,500	50%	$ 6,250	$ 6,250	$ 18,750
				MATERIAL SUBTOTAL:		$ 438,026	LABOR SUBTOTAL:		$ 245,743	
									SUBTOTAL MECHANICAL (15000):	**$ 683,769**
16-Electrical	53	Electrical Estimate (35% Equipment)	LS	1	$ 132,617	$ 132,617		$ -	$ -	$ 132,617
	54	Electrical I&C Equip (10% Disk Filters & Equipment)	LS	1	$ 609,891	$ 609,891		$ -	$ -	$ 609,891
	55	Power Distribution Support	LS	1	$ 1,580,287	$ 1,580,287		$ -	$ -	$ 1,580,287
	56	Mudwell Pumping Support	LS	1	$ 101,676	$ 101,676		$ -	$ -	$ 101,676
	57	HVAC Equipment Support	LS	1	$ 57,199	$ 57,199		$ -	$ -	$ 57,199
				MATERIAL SUBTOTAL:		$ 2,481,670	LABOR SUBTOTAL:		$ -	
									SUBTOTAL ELECTRICAL (16000):	**$ 2,481,670**
				MATERIAL TOTAL:		**$ 8,398,726.85**	**LABOR TOTAL:**		**$ 1,944,673.90**	
									Subtotal:	$ 10,343,401
									Contractor's Overhead & Profit (20%):	$ 2,068,680
									Bonds & Insurance (2%):	$ 206,868
									Subtotal:	$ 12,618,949
									Contingency 40% @Preliminary Design:	$ 5,047,580
									Total Estimated Cost:	**$ 17,666,528**

SARWWTP FILTER BUILDING IMPROVMENTS
CONSTRUCTION COST ESTIMATE

Project:	**SAR WWTP Filter Improvements Project**	AECOM
AECOM Job No.:	**60213591**	400 West 15th Street, Suite 500
Date:	**12/20/11**	Austin, Texas 78701
Prepared By:	**Kit Perkins/Nathan Fitzhugh**	Phone: (512) 472-4519
File Name:	**TM3 - Construction Estimate**	Fax: (512) 472-7519
Design Stage:	**Preliminary**	

Objective:

Summarize the estimated construction costs for the SAR WWTP Filter Improvements Project.
Installing disk filters in six (6) of the existing filter beds.

SAR WWTP FILTER IMPROVEMENTS - DISK FILTERS

Division	Item No.	Description	Unit	Qty.	Unit Material Cost	Material Cost	Labor Multiplier	Unit Labor Cost	Labor Cost	Subtotal
2-Sitework	1	Misc. Site Work	LS	1	$ 25,000	$ 25,000	100%	$ 25,000	$ 25,000	$ 50,000
	2*	Demolition - Filter Troughs	EA	6	$ 1,000	$ 6,000	400%	$ 4,000	$ 24,000	$ 30,000
	3*	Demolition - Filter Underdrain	EA	6	$ 1,250	$ 7,500	100%	$ 1,250	$ 7,500	$ 15,000
	4*	Filter Media Removal and Cleaning	EA	6	$ 5,000	$ 30,000	100%	$ 5,000	$ 30,000	$ 60,000
	5*	Filter Cleaning and Restoration	EA	6	$ 2,500	$ 15,000	100%	$ 2,500	$ 15,000	$ 30,000
	6	Isolating and Draining Pipes	LS	1	$ 10,000	$ 10,000	100%	$ 10,000	$ 10,000	$ 20,000
					MATERIAL SUBTOTAL:	$ 93,500		LABOR SUBTOTAL:	$ 111,500	
									SUBTOTAL SITEWORK (02000):	**$ 205,000**
3-Concrete	7*	Concrete Partition Walls	CY	431	$ 800	$ 344,800	0%	$ -	$ -	$ 344,800
	8*	Concrete Channel Walls A	CY	41	$ 800	$ 32,800	0%	$ -	$ -	$ 32,800
	9*	Concrete Channel Walls B	CY	222	$ 800	$ 177,600	0%	$ -	$ -	$ 177,600
	10*	Concrete Channel Walls C	CY	123	$ 800	$ 98,400	0%	$ -	$ -	$ 98,400
	11*	Concrete Bottom Slabs A	CY	35	$ 600	$ 21,000	0%	$ -	$ -	$ 21,000
	12*	Concrete Bottom Slabs B	CY	102	$ 600	$ 61,200	0%	$ -	$ -	$ 61,200
					MATERIAL SUBTOTAL:	$ 735,800		LABOR SUBTOTAL:	$ -	
									SUBTOTAL CONCRETE (03000):	**$ 735,800**
5-Metals	13*	Aluminum Grating	SF	2,936	$ 25	$ 73,400	50%	$ 13	$ 36,700	$ 110,100
	14*	Supports	SF	2,936	$ 10	$ 29,360	30%	$ 3	$ 8,808	$ 38,168
					MATERIAL SUBTOTAL:	$ 102,760		LABOR SUBTOTAL:	$ 45,508	
									SUBTOTAL METALS (05000):	**$ 148,268**
9-Finishes	15	Pipe Coating - 42" Only (Sand/Recoat)	SF	3,000	$ 11	$ 33,000	100%	$ 11	$ 33,000	$ 66,000
					MATERIAL SUBTOTAL:	$ 33,000		LABOR SUBTOTAL:	$ 33,000	
									SUBTOTAL FINISHES (09000):	**$ 66,000**

10-Specialties	16*	Disk Filter Equipment	EA	24	$ 275,000	$ 6,600,000	30%	$ 82,500	$ 1,980,000	$ 8,580,000
	17	Filter Roof Structure	SF	7,266	$ 25	$ 181,650	35%	$ 9	$ 63,578	$ 245,228
					MATERIAL SUBTOTAL:	$ 6,781,650		LABOR SUBTOTAL:	$ 2,043,578	
									SUBTOTAL SPECIALTIES (10000):	$ 8,825,228
11-Equipment	18	Mudwell Pumps/Motors, 50HP, 4350 GPM	EA	3	$ 49,666	$ 148,998	70%	$ 34,766	$ 104,299	$ 253,297
	19	Bridge Crane (Manual Hoist)	LS	1	$ 20,000	$ 20,000	70%	$ 14,000	$ 14,000	$ 34,000
	20*	36" BFV (Operator)	EA	6	$ 6,500	$ 39,000	70%	$ 4,550	$ 27,300	$ 66,300
	21	42" BFV (Operator)	EA	4	$ 6,972	$ 27,888	70%	$ 4,880	$ 19,522	$ 47,410
					MATERIAL SUBTOTAL:	$ 235,886		LABOR SUBTOTAL:	$ 165,120	
									SUBTOTAL EQUIPMENT (11000):	$ 401,006
15-Mechanical	22	4" Dia. Solid Waste Dischage Pipe	LF	520	$ 45	$ 23,400	35%	$ 16	$ 8,190	$ 31,590
	23	6" Dia. Washwater Pipe	LF	160	$ 75	$ 12,000	35%	$ 26	$ 4,200	$ 16,200
	24	8" Dia. Washwater Pipe	LF	150	$ 100	$ 15,000	35%	$ 35	$ 5,250	$ 20,250
	25	10" Dia. Washwater Pipe	LF	20	$ 131	$ 2,620	35%	$ 46	$ 917	$ 3,537
	26	12" Dia. Washwater Pipe	LF	12	$ 157	$ 1,884	35%	$ 55	$ 659	$ 2,543
	27	14" Dia. Washwater Pipe	LF	20	$ 210	$ 4,200	35%	$ 74	$ 1,470	$ 5,670
	28	16" Dia. Washwater Pipe	LF	24	$ 246	$ 5,904	35%	$ 86	$ 2,066	$ 7,970
	29*	20" Dia. Washwater Pipe	LF	30	$ 291	$ 8,730	35%	$ 102	$ 3,056	$ 11,786
		24" Dia. Washwater Pipe	LF	34	$ 344	$ 11,696	35%	$ 120	$ 4,094	$ 15,790
	30*	36" Dia. Pipe	LF	48	$ 590	$ 28,320	35%	$ 207	$ 9,912	$ 38,232
	31	42" Dia. Pipe	LF	16	$ 767	$ 12,272	35%	$ 268	$ 4,295	$ 16,567
	32*	18" Butterfly Valve	EA	24	$ 3,652	$ 87,648	70%	$ 2,556	$ 61,354	$ 149,002
	33	42" Butterfly Valve	EA	4	$ 21,291	$ 85,164	70%	$ 14,904	$ 59,615	$ 144,779
	34*	36" Butterfly Valve	EA	6	$ 15,500	$ 93,000	100%	$ 15,500	$ 93,000	$ 186,000
	35	6" 90° Bend	EA	8	$ 280	$ 2,240	35%	$ 98	$ 784	$ 3,024
	36*	24" 90° Bend	EA	1	$ 3,150	$ 3,150	35%	$ 1,103	$ 1,103	$ 4,253
	37	6"-8" Increaser	EA	8	$ 263	$ 2,100	35%	$ 92	$ 735	$ 2,835
	38	8"-10" Increaser	EA	1	$ 385	$ 385	35%	$ 135	$ 135	$ 520
	39	10"-12" Increaser	EA	1	$ 578	$ 578	35%	$ 202	$ 202	$ 780
	40	12"-14" Increaser	EA	1	$ 788	$ 788	35%	$ 276	$ 276	$ 1,063
	41	14"-16" Increaser	EA	1	$ 980	$ 980	35%	$ 343	$ 343	$ 1,323
	42	16"-20" Increaser	EA	1	$ 1,348	$ 1,348	35%	$ 472	$ 472	$ 1,819
		20"-24" Increaser	EA	1	$ 2,083	$ 2,083	35%	$ 729	$ 729	$ 2,811
	43	6"x6"x6" Tee	EA	8	$ 368	$ 2,940	35%	$ 129	$ 1,029	$ 3,969
	44	8"x8"x8" Tee	EA	1	$ 578	$ 578	35%	$ 202	$ 202	$ 780
	45*	42"x42"x36" Tee	EA	6	$ 14,928	$ 89,565	35%	$ 5,225	$ 31,348	$ 120,913
	46	42"x42"x42" Tee	EA	2	$ 15,628	$ 31,255	35%	$ 5,470	$ 10,939	$ 42,194
	47	10"x10"x8" Tee	EA	1	$ 998	$ 998	35%	$ 349	$ 349	$ 1,347
	48	12"x12"x8" Tee	EA	1	$ 1,418	$ 1,418	35%	$ 496	$ 496	$ 1,914
	49	14"x14"x8" Tee	EA	1	$ 1,593	$ 1,593	35%	$ 557	$ 557	$ 2,150
	50	16"x16"x8" Tee	EA	1	$ 2,013	$ 2,013	35%	$ 704	$ 704	$ 2,717
	51	20"x20"x20" Tee	EA	2	$ 3,098	$ 6,195	35%	$ 1,084	$ 2,168	$ 8,363

	52	Sluice Gate w/ Electric Operator	EA	1	$ 12,500	$ 12,500	50%	$ 6,250	$ 6,250	$ 18,750
					MATERIAL SUBTOTAL:	$ 554,541		LABOR SUBTOTAL:	$ 316,898	
									SUBTOTAL MECHANICAL (15000):	**$ 871,439**
16-Electrical	53	Electrical Estimate (35% 11-Equipment)	LS	1	$ 140,352	$ 140,352		$ -	$ -	$ 140,352
	54	Electrical I&C Equip (10% Disk Filters & Equipment)	LS	1	$ 898,101	$ 898,101		$ -	$ -	$ 898,101
	55	Power Distribution Support	LS	1	$ 1,580,287	$ 1,580,287		$ -	$ -	$ 1,580,287
	56	Mudwell Pumping Support	LS	1	$ 101,676	$ 101,676		$ -	$ -	$ 101,676
	57	HVAC Equipment Support	LS	1	$ 57,199	$ 57,199		$ -	$ -	$ 57,199
					MATERIAL SUBTOTAL:	$ 2,777,615		LABOR SUBTOTAL:	$ -	
									SUBTOTAL ELECTRICAL (16000):	**$ 2,777,615**
					MATERIAL TOTAL:	**$ 11,314,751.35**		**LABOR TOTAL:**	**$ 2,715,604.08**	
									Subtotal:	$ 14,030,355
									Contractor's Overhead & Profit (20%):	$ 2,806,071
									Bonds & Insurance (2%):	$ 280,607
									Subtotal:	$ 17,117,034
									Contingency 40% @Preliminary Design:	$ 6,846,813
									Total Estimated Cost:	**$ 23,963,847**

Appendix 3.2:

Present Worth Calculations

SARWWTP FILTER BUILDING IMPROVMENTS
BASIS OF PRESENT WORTH CALCULATIONS

Project:	**SAR WWTP Filter Improvements Project**
AECOM Job No.:	**60213591**
Date:	**6/13/11**
Prepared By:	**Kit Perkins**
File Name:	**Present Worth**
Design Stage:	**Preliminary**

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

Objective:

Summarize the basis and assumptions for the present worth calcs for the SAR WWTP Filter Improvements Project.

General Assumptions:

kWh Cost:	$0.11
Maintenance Hour Rate:	$27.11

Initial Cost Assumptions:

Filter Rehabilitation Initial Cost:	$ 17,780,000
Disk Filter Installation Initial Cost (4 filters):	$ 17,670,000
Disk Filter Installation Initial Cost (6 filters):	$ 23,960,000

Assumptions for Filter Rehabilitation Alternative:

No media replacement for the deep bed filters is assumed for the filter rehabilitation alternative.

Backwash Pump		Mudwell Pump		Blower Pump	
Backwash Pump HP:	150	Mudwell Pump HP:	50	Blower Pump HP:	200
Backwash Volume per Backwash (gal):	225,000			Backwash Air Volume per Backwash (scfm):	110,250
Backwash Vol/day (1 bw/filter, 12 filters):	2,700,000			Backwash Vol/day (1 bw/filter, 12 filters):	1,323,000
Backwash Water/Year:	985,500,000			Backwash Air/Year (scfm):	482,895,000
Backwash Pump Capacity (gpm):	11,000	Mudwell Pump Capacity (gpm):	4,350	Blower Capacity (scfm):	3,500
Backwash Operating Hrs:	1,493	Mudwell Operating Hrs:	3,776	Blower Operating Hrs:	2299.5
Annual BW Pump Power (kWh):	167,020	Annual Mudwell Pump Power (kWh):	140,783	Annual Blower Pump Power (kWh):	342,947

No annual maintenance cost for the deep bed sand filters is assumed.

Energy

Item	Interval	kWh	Cost	Total
Backwash Solid Waste Pump Energy (kWh):	Annual	167,020	$0.11	$18,372
Mudwell Pump Energy (kWh):	Annual	140,783	$0.11	$15,486
Blower Pump Energy (kWh):	Annual	342,947	$0.11	$37,724
Contingency (40%)	Annual	260,300	$0.11	$28,633
Total Energy (kWh):	**Annual**	**911,050**	**$0.11**	**$100,216**

Chemicals

Item	Cost (lb)	Dose (mg/L)	Liters / Day	Pounds / Day	Annual Cost
Chlorine (Mudwell)	$ 0.23	5.0	10,206,000	113	$9,445
Chlorine (Filtered Water)	$ 0.23	2.5	151,200,000	833	$69,960
Sulfur Dioxide (Filtered Water)	$ 0.30	1.0	151,200,000	333	$36,501

*Based on 40MGD Effluent

Chloine for backwash water not required

Assumptions for Disk Filter Installation (4 filters):

Number of Disk Filters: 4

Mudwell Pump

Mudwell Pump HP:	50
Backwash Volume per Day / (gal):	546,120
Backwash Water/Year:	199,333,800
Mudwell Pump Capacity (gpm):	4,350
Mudwell Operating Hrs:	764
Annual Mudwell Pump Power (kWh):	28,476

*Backwash Solid Waste Pump Energy

and disk drive motor energy provided by the manufacturer.

Maintenance

Item	Interval (YR)	Hours	Material	Total
Main V-Ring Seal	10	64	$16,048	$17,783
Filter Media Cloths	7	288	$309,808	$317,616

Energy

Item	Interval	Hours	Material	Total	
Disk Drive Motor Energy (kWh):	Annual	9,215	$0.11	$1,014	
Backwash Solid Waste Pump Energy (kWh):	Annual	84,908	$0.11	$9,340	*Adjusted for a 7.5hp Motor
Mudwell Pump Energy (kWh):	Annual	28,476	$0.11	$3,132	
Contingency (40%)	Annual	49,039	$0.11	$5,394	
Total Energy (kWh):	**Annual**	**171,638**	**$0.11**	**$18,880**	

Chemicals

Item	Cost (lb)	Dose (mg/L)	Liters / Day	Pounds / Day	Annual Cost	
Chlorine (Mudwell)	$ 0.23	5.0	2,064,334	23	$1,910	
Chlorine (Filtered Water)	$ 0.23	2.5	151,200,000	833	$69,960	
Sulfur Dioxide (Filtered Water)	$ 0.30	1.0	151,200,000	333	$36,501	*Based on 40MGD Effluent

Chloine for backwash water not required

Assumptions for Disk Filter Installation (6 filters):

Number of Disk Filters: 6

Mudwell Pump

Mudwell Pump HP:	50
Backwash Volume per Day / (gal):	819,180
Backwash Water/Year:	299,000,700
Mudwell Pump Capacity (gpm):	4,350
Mudwell Operating Hrs:	1,146
Annual Mudwell Pump Power (kWh):	42,714

*Backwash Solid Waste Pump Energy

and disk drive motor energy provided by the manufacturer.

Maintenance

Item	Interval (YR)	Hours	Material	Total
Main V-Ring Seal	10	96	$21,397	$24,000
Filter Media Cloths	7	432	$413,077	$424,789

Energy

Item	Interval	Hours	Material	Total	
Disk Drive Motor Energy (kWh):	Annual	9,215	$0.11	$1,014	
Backwash Solid Waste Pump Energy (kWh):	Annual	84,908	$0.11	$9,340	*Adjusted for a 7.5hp Motor
Mudwell Pump Energy (kWh):	Annual	42,714	$0.11	$4,698	
Contingency (40%)	Annual	54,734	$0.11	$6,021	
Total Energy (kWh):	**Annual**	**191,570**	**$0.11**	**$21,073**	

Chemicals

Item	Cost (lb)	Dose (mg/L)	Liters / Day	Pounds / Day	Annual Cost	
Chlorine (Mudwell)	$ 0.23	5.0	3,096,500	34	$2,865	
Chlorine (Filtered Water)	$ 0.23	2.5	151,200,000	833	$69,960	
Sulfur Dioxide (Filtered Water)	$ 0.30	1.0	151,200,000	333	$36,501	*Based on 40MGD Effluent

Chloine for backwash water not required

SARWWTP FILTER BUILDING IMPROVEMENTS
20-YEAR PRESENT WORTH SUMMARY

Project: **SAR WWTP Filter Improvements Project**
AECOM Job No.: **60213591**
Date: **6/13/11**
Prepared By: **Kit Perkins**
File Name: **Present Worth Evl.xlsc**
Design Stage: **Preliminary**

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

Objective:
Summarize the estimated present worth for the alternatives for the SAR WWTP Filter Improvements Project for a 20-year duration.

Assumptions:
Inflation Rate: 2.5%
Interest Rate: 4.5%

FILTER REHABILITATION ALTERNATIVE

Item	Year:	Capital Cost:	Energy Cost:	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	
	0	$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	$ 17,996,121
	1	$ -	$ 102,721	$ 9,681	$ 71,709	$ 37,413	$ 211,985
	2	$ -	$ 105,289	$ 9,923	$ 73,502	$ 38,349	$ 207,927
	3	$ -	$ 107,921	$ 10,171	$ 75,339	$ 39,307	$ 203,948
	4	$ -	$ 110,619	$ 10,425	$ 77,223	$ 40,290	$ 200,045
	5	$ -	$ 113,385	$ 10,686	$ 79,153	$ 41,297	$ 196,216
	6	$ -	$ 116,219	$ 10,953	$ 81,132	$ 42,330	$ 192,461
	7	$ -	$ 119,125	$ 11,227	$ 83,160	$ 43,388	$ 188,777
	8	$ -	$ 122,103	$ 11,507	$ 85,239	$ 44,473	$ 185,164
	9	$ -	$ 125,155	$ 11,795	$ 87,370	$ 45,585	$ 181,620
	10	$ -	$ 128,284	$ 12,090	$ 89,555	$ 46,724	$ 178,144
	11	$ -	$ 131,491	$ 12,392	$ 91,793	$ 47,892	$ 174,735
	12	$ -	$ 134,779	$ 12,702	$ 94,088	$ 49,090	$ 171,391
	13	$ -	$ 138,148	$ 13,019	$ 96,440	$ 50,317	$ 168,111
	14	$ -	$ 141,602	$ 13,345	$ 98,851	$ 51,575	$ 164,893
	15	$ -	$ 145,142	$ 13,679	$ 101,323	$ 52,864	$ 161,737
	16	$ -	$ 148,771	$ 14,021	$ 103,856	$ 54,186	$ 158,642
	17	$ -	$ 152,490	$ 14,371	$ 106,452	$ 55,540	$ 155,606
	18	$ -	$ 156,302	$ 14,730	$ 109,114	$ 56,929	$ 152,628
	19	$ -	$ 160,210	$ 15,099	$ 111,841	$ 58,352	$ 149,706
	20	$ -	$ 164,215	$ 15,476	$ 114,637	$ 59,811	$ 146,841
	Total						$ 21,546,698

DISK FILTERS ALTERNATIVE (4 Filters)

Item	Year:	Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,670,000	$ 18,880	$ 17,783	$ 317,616	$ 1,910	$ 69,960	$ 36,501	
	0	$ 17,670,000	$ 18,880	$ -	$ -	$ 1,910	$ 69,960	$ 36,501	$ 17,797,251
	1	$ -	$ 19,352	$ -	$ -	$ 1,958	$ 71,709	$ 37,413	$ 124,816
	2	$ -	$ 19,836	$ -	$ -	$ 2,007	$ 73,502	$ 38,349	$ 122,427
	3	$ -	$ 20,332	$ -	$ -	$ 2,057	$ 75,339	$ 39,307	$ 120,084
	4	$ -	$ 20,840	$ -	$ -	$ 2,109	$ 77,223	$ 40,290	$ 117,786
	5	$ -	$ 21,361	$ -	$ -	$ 2,161	$ 79,153	$ 41,297	$ 115,531
	6	$ -	$ 21,895	$ -	$ -	$ 2,215	$ 81,132	$ 42,330	$ 113,320
	7	$ -	$ 22,443	$ -	$ 377,545	$ 2,271	$ 83,160	$ 43,388	$ 388,582
	8	$ -	$ 23,004	$ -	$ -	$ 2,328	$ 85,239	$ 44,473	$ 109,024
	9	$ -	$ 23,579	$ -	$ -	$ 2,386	$ 87,370	$ 45,585	$ 106,937
	10	$ -	$ 24,168	$ 22,764	$ -	$ 2,445	$ 89,555	$ 46,724	$ 119,549
	11	$ -	$ 24,772	$ -	$ -	$ 2,507	$ 91,793	$ 47,892	$ 102,883
	12	$ -	$ 25,392	$ -	$ -	$ 2,569	$ 94,088	$ 49,090	$ 100,914
	13	$ -	$ 26,027	$ -	$ -	$ 2,633	$ 96,440	$ 50,317	$ 98,983
	14	$ -	$ 26,677	$ -	$ 448,783	$ 2,699	$ 98,851	$ 51,575	$ 339,419
	15	$ -	$ 27,344	$ -	$ -	$ 2,767	$ 101,323	$ 52,864	$ 95,230
	16	$ -	$ 28,028	$ -	$ -	$ 2,836	$ 103,856	$ 54,186	$ 93,408
	17	$ -	$ 28,728	$ -	$ -	$ 2,907	$ 106,452	$ 55,540	$ 91,620
	18	$ -	$ 29,447	$ -	$ -	$ 2,979	$ 109,114	$ 56,929	$ 89,867
	19	$ -	$ 30,183	$ -	$ -	$ 3,054	$ 111,841	$ 58,352	$ 88,147
	20	$ -	$ 30,937	$ 29,140	$ -	$ 3,130	$ 114,637	$ 59,811	$ 98,542
	Total								$ 20,434,321

DISK FILTERS ALTERNATIVE (6 Filters)

Item		Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 23,960,000	$ 21,073	$ 24,000	$ 424,789	$ 2,865	$ 69,960	$ 36,501	
Year	0	$ 23,960,000	$ 21,073	$ -	$ -	$ 2,865	$ 69,960	$ 36,501	$ 24,090,399
	1	$ -	$ 21,600	$ -	$ -	$ 2,937	$ 71,709	$ 37,413	$ 127,903
	2	$ -	$ 22,140	$ -	$ -	$ 3,011	$ 73,502	$ 38,349	$ 125,455
	3	$ -	$ 22,693	$ -	$ -	$ 3,086	$ 75,339	$ 39,307	$ 123,054
	4	$ -	$ 23,260	$ -	$ -	$ 3,163	$ 77,223	$ 40,290	$ 120,699
	5	$ -	$ 23,842	$ -	$ -	$ 3,242	$ 79,153	$ 41,297	$ 118,389
	6	$ -	$ 24,438	$ -	$ -	$ 3,323	$ 81,132	$ 42,330	$ 116,123
	7	$ -	$ 25,049	$ -	$ 504,940	$ 3,406	$ 83,160	$ 43,388	$ 484,945
	8	$ -	$ 25,675	$ -	$ -	$ 3,491	$ 85,239	$ 44,473	$ 111,721
	9	$ -	$ 26,317	$ -	$ -	$ 3,579	$ 87,370	$ 45,585	$ 109,583
	10	$ -	$ 26,975	$ 30,721	$ -	$ 3,668	$ 89,555	$ 46,724	$ 127,268
	11	$ -	$ 27,649	$ -	$ -	$ 3,760	$ 91,793	$ 47,892	$ 105,428
	12	$ -	$ 28,341	$ -	$ -	$ 3,854	$ 94,088	$ 49,090	$ 103,411
	13	$ -	$ 29,049	$ -	$ -	$ 3,950	$ 96,440	$ 50,317	$ 101,431
	14	$ -	$ 29,775	$ -	$ 600,216	$ 4,049	$ 98,851	$ 51,575	$ 423,590
	15	$ -	$ 30,520	$ -	$ -	$ 4,150	$ 101,323	$ 52,864	$ 97,586
	16	$ -	$ 31,283	$ -	$ -	$ 4,254	$ 103,856	$ 54,186	$ 95,718
	17	$ -	$ 32,065	$ -	$ -	$ 4,360	$ 106,452	$ 55,540	$ 93,886
	18	$ -	$ 32,866	$ -	$ -	$ 4,469	$ 109,114	$ 56,929	$ 92,090
	19	$ -	$ 33,688	$ -	$ -	$ 4,581	$ 111,841	$ 58,352	$ 90,327
	20	$ -	$ 34,530	$ 39,326	$ -	$ 4,695	$ 114,637	$ 59,811	$ 104,905
	Total								$ 26,963,913

SARWWTP FILTER BUILDING IMPROVMENTS
30-YEAR PRESENT WORTH SUMMARY

Project:	**SAR WWTP Filter Improvements Project**
AECOM Job No.:	**60213591**
Date:	**3/12/12**
Prepared By:	**Kit Perkins/Nathan Fitzhugh**
File Name:	**Present Worth Evl03122012-30yr.xlsc**
Design Stage:	**Preliminary**

AECOM
400 West 15th Street, Suite 500
Austin, Texas 78701
Phone: (512) 472-4519
Fax: (512) 472-7519

Objective:

Summarize the estimated present worth for the alternatives for the SAR WWTP Filter Improvements Project for a 30-year duration.

Assumptions:

Inflation Rate:	2.5%
Interest Rate:	4.5%

FILTER REHABILITATION ALTERNATIVE

Item		Capital Cost:	Energy Cost:	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	
Year	0	$ 17,780,000	$ 100,216	$ 9,445	$ 69,960	$ 36,501	$ 17,996,121
	1	$ -	$ 102,721	$ 9,681	$ 71,709	$ 37,413	$ 211,985
	2	$ -	$ 105,289	$ 9,923	$ 73,502	$ 38,349	$ 207,927
	3	$ -	$ 107,921	$ 10,171	$ 75,339	$ 39,307	$ 203,948
	4	$ -	$ 110,619	$ 10,425	$ 77,223	$ 40,290	$ 200,045
	5	$ -	$ 113,385	$ 10,686	$ 79,153	$ 41,297	$ 196,216
	6	$ -	$ 116,219	$ 10,953	$ 81,132	$ 42,330	$ 192,461
	7	$ -	$ 119,125	$ 11,227	$ 83,160	$ 43,388	$ 188,777
	8	$ -	$ 122,103	$ 11,507	$ 85,239	$ 44,473	$ 185,164
	9	$ -	$ 125,155	$ 11,795	$ 87,370	$ 45,585	$ 181,620
	10	$ -	$ 128,284	$ 12,090	$ 89,555	$ 46,724	$ 178,144
	11	$ -	$ 131,491	$ 12,392	$ 91,793	$ 47,892	$ 174,735
	12	$ -	$ 134,779	$ 12,702	$ 94,088	$ 49,090	$ 171,391
	13	$ -	$ 138,148	$ 13,019	$ 96,440	$ 50,317	$ 168,111
	14	$ -	$ 141,602	$ 13,345	$ 98,851	$ 51,575	$ 164,893
	15	$ -	$ 145,142	$ 13,679	$ 101,323	$ 52,864	$ 161,737
	16	$ -	$ 148,771	$ 14,021	$ 103,856	$ 54,186	$ 158,642
	17	$ -	$ 152,490	$ 14,371	$ 106,452	$ 55,540	$ 155,606
	18	$ -	$ 156,302	$ 14,730	$ 109,114	$ 56,929	$ 152,628
	19	$ -	$ 160,210	$ 15,099	$ 111,841	$ 58,352	$ 149,706
	20	$ -	$ 164,215	$ 15,476	$ 114,637	$ 59,811	$ 146,841
	21	$ -	$ 168,320	$ 15,863	$ 117,503	$ 61,306	$ 144,031
	22	$ -	$ 172,528	$ 16,260	$ 120,441	$ 62,839	$ 141,274
	23	$ -	$ 176,841	$ 16,666	$ 123,452	$ 64,410	$ 138,571
	24	$ -	$ 181,262	$ 17,083	$ 126,538	$ 66,020	$ 135,918
	25	$ -	$ 185,794	$ 17,510	$ 129,702	$ 67,670	$ 133,317
	26	$ -	$ 190,439	$ 17,947	$ 132,944	$ 69,362	$ 130,766
	27	$ -	$ 195,200	$ 18,396	$ 136,268	$ 71,096	$ 128,263
	28	$ -	$ 200,080	$ 18,856	$ 139,675	$ 72,874	$ 125,808
	29	$ -	$ 205,082	$ 19,327	$ 143,166	$ 74,696	$ 123,400
	30	$ -	$ 210,209	$ 19,811	$ 146,746	$ 76,563	$ 121,039
	Total						$ 22,869,085

DISK FILTERS ALTERNATIVE (4 Filters)

Item		Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 17,670,000	$ 18,880	$ 17,783	$ 317,616	$ 1,910	$ 69,960	$ 36,501	
Year	0	$ 17,670,000	$ 18,880	$ -	$ -	$ 1,910	$ 69,960	$ 36,501	$ 17,797,251
	1	$ -	$ 19,352	$ -	$ -	$ 1,958	$ 71,709	$ 37,413	$ 124,816
	2	$ -	$ 19,836	$ -	$ -	$ 2,007	$ 73,502	$ 38,349	$ 122,427
	3	$ -	$ 20,332	$ -	$ -	$ 2,057	$ 75,339	$ 39,307	$ 120,084
	4	$ -	$ 20,840	$ -	$ -	$ 2,109	$ 77,223	$ 40,290	$ 117,786
	5	$ -	$ 21,361	$ -	$ -	$ 2,161	$ 79,153	$ 41,297	$ 115,531
	6	$ -	$ 21,895	$ -	$ -	$ 2,215	$ 81,132	$ 42,330	$ 113,320
	7	$ -	$ 22,443	$ -	$ 377,545	$ 2,271	$ 83,160	$ 43,388	$ 388,582
	8	$ -	$ 23,004	$ -	$ -	$ 2,328	$ 85,239	$ 44,473	$ 109,024
	9	$ -	$ 23,579	$ -	$ -	$ 2,386	$ 87,370	$ 45,585	$ 106,937
	10	$ -	$ 24,168	$ 22,764	$ -	$ 2,445	$ 89,555	$ 46,724	$ 119,549
	11	$ -	$ 24,772	$ -	$ -	$ 2,507	$ 91,793	$ 47,892	$ 102,883
	12	$ -	$ 25,392	$ -	$ -	$ 2,569	$ 94,088	$ 49,090	$ 100,914
	13	$ -	$ 26,027	$ -	$ -	$ 2,633	$ 96,440	$ 50,317	$ 98,983
	14	$ -	$ 26,677	$ -	$ 448,783	$ 2,699	$ 98,851	$ 51,575	$ 339,419
	15	$ -	$ 27,344	$ -	$ -	$ 2,767	$ 101,323	$ 52,864	$ 95,230
	16	$ -	$ 28,028	$ -	$ -	$ 2,836	$ 103,856	$ 54,186	$ 93,408
	17	$ -	$ 28,728	$ -	$ -	$ 2,907	$ 106,452	$ 55,540	$ 91,620
	18	$ -	$ 29,447	$ -	$ -	$ 2,979	$ 109,114	$ 56,929	$ 89,867
	19	$ -	$ 30,183	$ -	$ -	$ 3,054	$ 111,841	$ 58,352	$ 88,147
	20	$ -	$ 30,937	$ 29,140	$ -	$ 3,130	$ 114,637	$ 59,811	$ 98,542
	21	$ -	$ 31,711	$ -	$ 533,462	$ 3,209	$ 117,503	$ 61,306	$ 296,476
	22	$ -	$ 32,504	$ -	$ -	$ 3,289	$ 120,441	$ 62,839	$ 83,182
	23	$ -	$ 33,316	$ -	$ -	$ 3,371	$ 123,452	$ 64,410	$ 81,590
	24	$ -	$ 34,149	$ -	$ -	$ 3,455	$ 126,538	$ 66,020	$ 80,028
	25	$ -	$ 35,003	$ -	$ -	$ 3,542	$ 129,702	$ 67,670	$ 78,497
	26	$ -	$ 35,878	$ -	$ -	$ 3,630	$ 132,944	$ 69,362	$ 76,994
	27	$ -	$ 36,775	$ -	$ -	$ 3,721	$ 136,268	$ 71,096	$ 75,521
	28	$ -	$ 37,694	$ -	$ 634,118	$ 3,814	$ 139,675	$ 72,874	$ 258,966
	29	$ -	$ 38,637	$ -	$ -	$ 3,909	$ 143,166	$ 74,696	$ 72,658
	30	$ -	$ 39,602	$ 37,301	$ -	$ 4,007	$ 146,746	$ 76,563	$ 81,226
	Total								$ 21,619,458

DISK FILTERS ALTERNATIVE (6 Filters)

Item		Capital Cost:	Energy Cost:	Main V-Ring Seal Replacement	Filter Fabric Replacement	Chlorination (Mudwell)	Chlorination (Filtered Water)	Sulfur Dioxide (Filtered Water)	Present Worth:
1st Year Costs		$ 23,960,000	$ 21,073	$ 24,000	$ 424,789	$ 2,865	$ 69,960	$ 36,501	
Year	0	$ 23,960,000	$ 21,073	$ -	$ -	$ 2,865	$ 69,960	$ 36,501	$ 24,090,399
	1	$ -	$ 21,600	$ -	$ -	$ 2,937	$ 71,709	$ 37,413	$ 127,903
	2	$ -	$ 22,140	$ -	$ -	$ 3,011	$ 73,502	$ 38,349	$ 125,455
	3	$ -	$ 22,693	$ -	$ -	$ 3,086	$ 75,339	$ 39,307	$ 123,054
	4	$ -	$ 23,260	$ -	$ -	$ 3,163	$ 77,223	$ 40,290	$ 120,699
	5	$ -	$ 23,842	$ -	$ -	$ 3,242	$ 79,153	$ 41,297	$ 118,389
	6	$ -	$ 24,438	$ -	$ -	$ 3,323	$ 81,132	$ 42,330	$ 116,123
	7	$ -	$ 25,049	$ -	$ 504,940	$ 3,406	$ 83,160	$ 43,388	$ 484,945
	8	$ -	$ 25,675	$ -	$ -	$ 3,491	$ 85,239	$ 44,473	$ 111,721
	9	$ -	$ 26,317	$ -	$ -	$ 3,579	$ 87,370	$ 45,585	$ 109,583
	10	$ -	$ 26,975	$ 30,721	$ -	$ 3,668	$ 89,555	$ 46,724	$ 127,268
	11	$ -	$ 27,649	$ -	$ -	$ 3,760	$ 91,793	$ 47,892	$ 105,428
	12	$ -	$ 28,341	$ -	$ -	$ 3,854	$ 94,088	$ 49,090	$ 103,411
	13	$ -	$ 29,049	$ -	$ -	$ 3,950	$ 96,440	$ 50,317	$ 101,431
	14	$ -	$ 29,775	$ -	$ 600,216	$ 4,049	$ 98,851	$ 51,575	$ 423,590
	15	$ -	$ 30,520	$ -	$ -	$ 4,150	$ 101,323	$ 52,864	$ 97,586
	16	$ -	$ 31,283	$ -	$ -	$ 4,254	$ 103,856	$ 54,186	$ 95,718
	17	$ -	$ 32,065	$ -	$ -	$ 4,360	$ 106,452	$ 55,540	$ 93,886
	18	$ -	$ 32,866	$ -	$ -	$ 4,469	$ 109,114	$ 56,929	$ 92,090
	19	$ -	$ 33,688	$ -	$ -	$ 4,581	$ 111,841	$ 58,352	$ 90,327
	20	$ -	$ 34,530	$ 39,326	$ -	$ 4,695	$ 114,637	$ 59,811	$ 104,905
	21	$ -	$ 35,393	$ -	$ 713,468	$ 4,813	$ 117,503	$ 61,306	$ 369,998
	22	$ -	$ 36,278	$ -	$ -	$ 4,933	$ 120,441	$ 62,839	$ 85,239
	23	$ -	$ 37,185	$ -	$ -	$ 5,056	$ 123,452	$ 64,410	$ 83,608
	24	$ -	$ 38,115	$ -	$ -	$ 5,183	$ 126,538	$ 66,020	$ 82,008
	25	$ -	$ 39,068	$ -	$ -	$ 5,312	$ 129,702	$ 67,670	$ 80,438
	26	$ -	$ 40,044	$ -	$ -	$ 5,445	$ 132,944	$ 69,362	$ 78,899
	27	$ -	$ 41,046	$ -	$ -	$ 5,581	$ 136,268	$ 71,096	$ 77,389
	28	$ -	$ 42,072	$ -	$ 848,089	$ 5,721	$ 139,675	$ 72,874	$ 323,186
	29	$ -	$ 43,123	$ -	$ -	$ 5,864	$ 143,166	$ 74,696	$ 74,455
	30	$ -	$ 44,202	$ 50,341	$ -	$ 6,011	$ 146,746	$ 76,563	$ 86,471
	Total								$ 28,305,604

Appendix 3.3:

Process Technical Memorandum:

Alternative Filtration Technologies

CITY OF AUSTIN
WALNUT CREEK WWTP
TERTIARY FILTER REHABILITATION PROJECT

TM2 ALTERNATIVE FILTRATION TECHNOLOGIES

CITY OF AUSTIN CIP ID: 3023.025
B&V PROJECT NO. 168622

JULY 18, 2011

BLACK & VEATCH
Building a world of difference.

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ATTACHMENT TM2-A	ALTERNATIVE FILTRATION TECHNOLOGIES WORKSHOP POWERPOINT PRESENTATION
ATTACHMENT TM2-B	WWETCO FILTER TECHNOLOGY EVALUATION
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ATTACHMENT TM2-E	ENGINEER'S OPINION OF PROABABLE CONSTRUCTION COST
ATTACHMENT TM2-F	NOVA WATER TECHNOLOGIES PRELIMINARY DESIGN REPORT

1.0 INTRODUCTION

1.1 Background

This TM2 presents the assessment and evaluation of various alternative filtration technologies for incorporation into the existing filter complex at the Walnut Creek WWTP (WCWWTP) as a replacement to the existing granular media filters. The following information is summarized in the sections below:

- Historical plant operational data on filter performance reviewed to form the basis of design for the filter system
- Design criteria for the alternative filtration technologies systems
- A summary of available alternative filtration technologies
- Evaluation of the alternative filtration technologies and resulting selection of the two technologies for detailed assessment
- Conceptual design and costs for two alternative technologies: Cloth Media Filters and NOVA Ultrascreen
- Considerations for future expansion

Potential alternative filtration technologies were discussed during a workshop held with the City on June 21, 2011 and subsequent follow-up meetings. Each technology presented during the workshop is summarized in this TM2, and a detailed evaluation, including costs, is summarized for each of the two alternatives selected by City.

2.0 REVIEW OF HISTORICAL DATA

2.1 Description of Existing Filtration Facilities

In 1974 Contract IV resulted in the construction of Filter Building 1. The secondary facilities were rated for an average day design flow of 18 mgd and a maximum day design flow of 36 mgd. The design of the filter complex at the completion of this project included filters 1 through 4, designed as dual media filters with 22-inches of anthracite over 12-inches of sand. Figure TM2-1 shows Filter 2 as it has completed a backwash cycle.

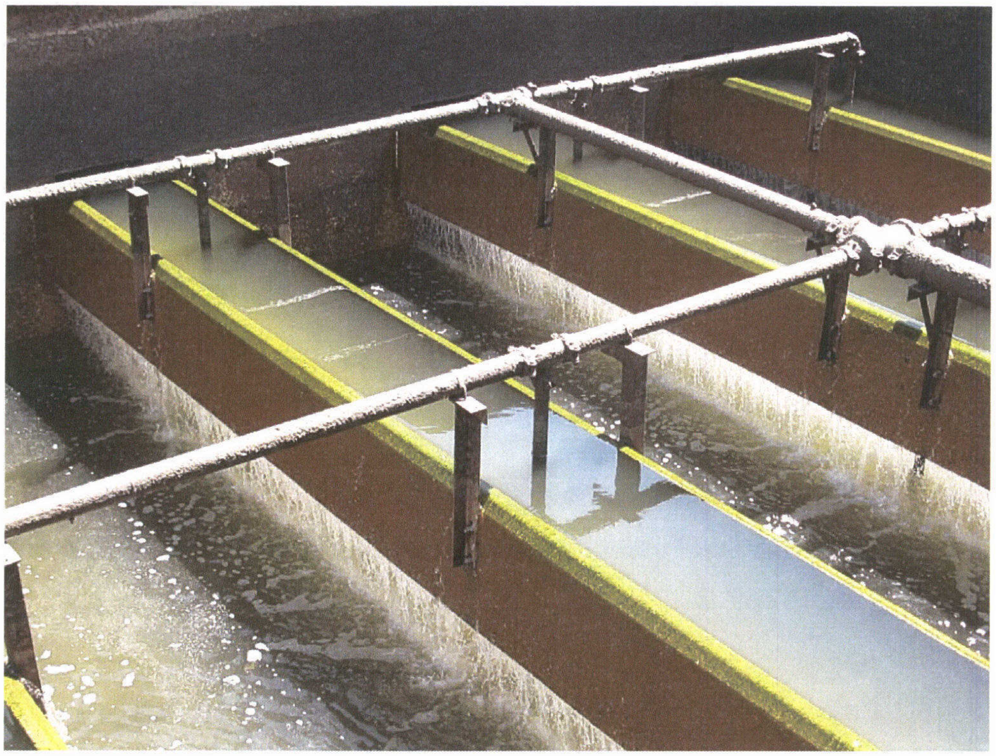


Figure TM2-1 – Filter in Filter Building 1

The sand is supported on 10-inches of support gravel which is constructed on clay tile filter underdrains. Each filter cell is 30 ft by 36 ft (1,080 sqft). Based on the flow rates the following were established as the operating and design conditions:

- Average flow (all filters in operation) – 2.87 gpm/sf
- Average flow (with one filter in backwash) - 3.82 gpm/sf
- Peak flow (all filters in operation) – 5.74 gpm/sf
- Peak flow (with one filter in backwash) – 7.64 gpm/sf

In May 1987 Filter Building 2 was constructed providing 6 additional mono media anthracite filter bays (32 ft x 34 ft). The design documents do not provide information on the selection of the anthracite as the filter media for Filters 5 through 10. Figure TM2-2 shows filters from the Filter Building 2 complex.

Figure TM2-2- Filter in Filter Building 2

The Walnut Creek Wastewater Treatment Plant 75 mgd upgrade in 2002 indicated that the filter complex can treat 120 mgd peak flow and 75 mgd average annual flow with nine cells in operation and 5 feet of head loss through the filters. Therefore, the current design hydraulic throughput rating on the filters is as follows:

- Average flow (all filters in operation) – 4.78 gpm/sf
- Average flow (with one filter in backwash) - 5.31 gpm/sf
- Peak flow (all filters in operation) – 7.65 gpm/sf
- Peak flow (with one filter in backwash) – 8.51 gpm/sf

2.2 Discharge Requirements

The Walnut Creek WWTP has two discharge requirements that pertain to the effluent filter system. The Texas Pollution Discharge Elimination System (TPDES) permit has a 30 day average total suspend solids (TSS) effluent discharge requirement of 15 mg/L and peak day limit of 40 mg/L based on 24 hour composite sampling. Figure TM2-3 shows the influent and effluent TSS concentrations have been in compliance with this requirement for the past five years, due to the considerable efforts of the plant staff. This data indicates that the average concentration discharged from the final clarifiers is 7 mg/L TSS. In addition, the data shows that influent TSS concentrations discharged to the filters over the past 12 months have averaged 10 to 12 mg/L. While influent concentrations appear to be increasing, the effluent concentrations are well below the permit limit of 15 mg/L.

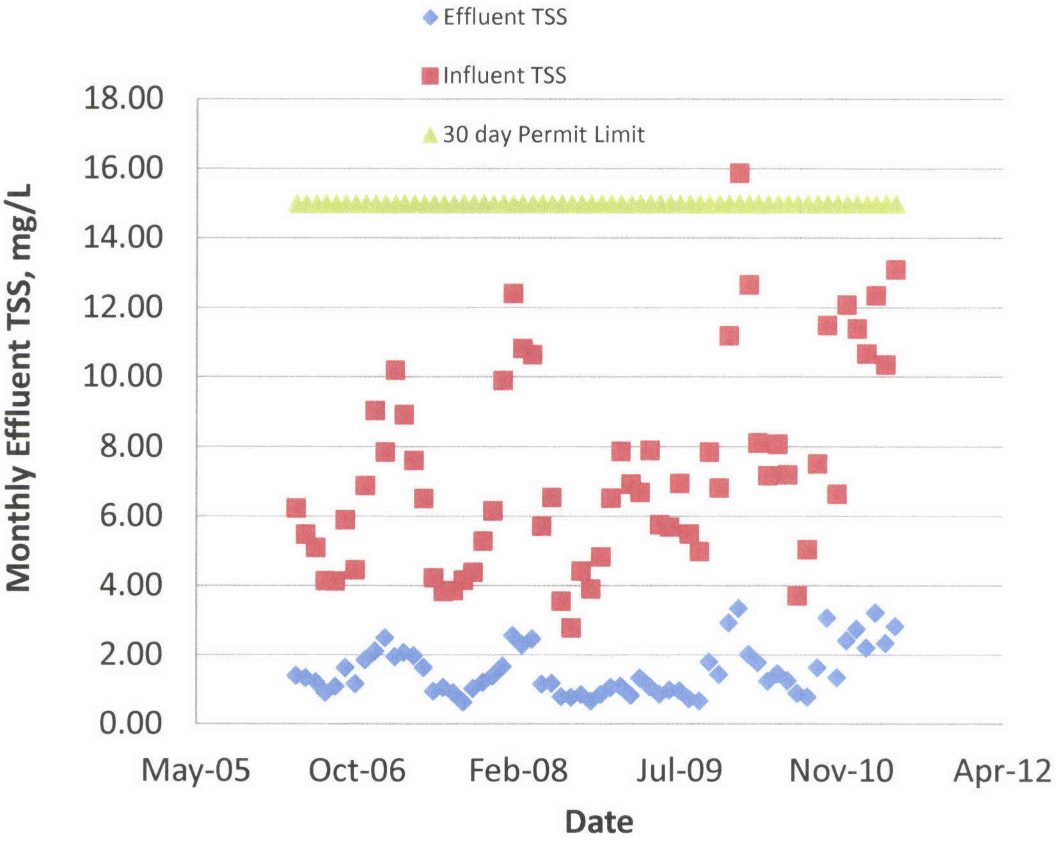


Figure TM2-3 - Historical TSS Concentrations

The permit limit for reuse water includes a 30 day average turbidity discharge requirement of 3 NTU based on a minimum of two grab samples per week. As shown in Figure TM2-4 the average monthly turbidity has been below 3 mg/L since 2006. However the plant did report a 2.98 mg/L monthly average turbidity concentration in February 2011. An overall observation from the figure indicates higher effluent turbidity values (above 2 NTU) during the winter versus lower turbidity values (less than 1.5 NTU) during the summer.

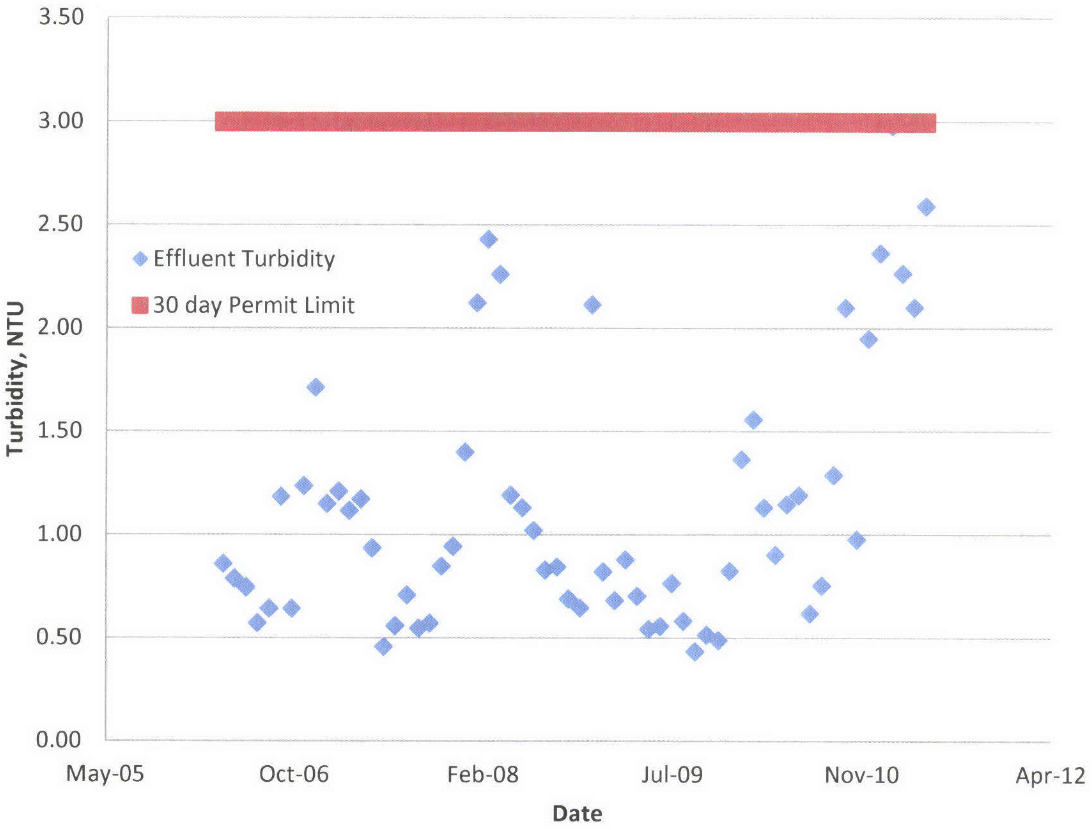


Figure TM2-4 - Monthly average Turbidity Values

2.3 Hydraulic Loading Rates

One of the key design parameters for granular filtration is the average and peak hydraulic loading rates. A review of the hydraulic loading rates based on the plant flow records submitted to Texas Commission on Environmental Quality (TCEQ) is shown on Figure TM2-

5. It appears that the hydraulic loading rate is a function of the flow arriving at the WCWWTP. Hydraulic rates are higher during wet periods and lower during dry periods. Data from one month, February 2010, indicated that the filters were operating near the average design throughput rate of 4.78 gpm/sf.

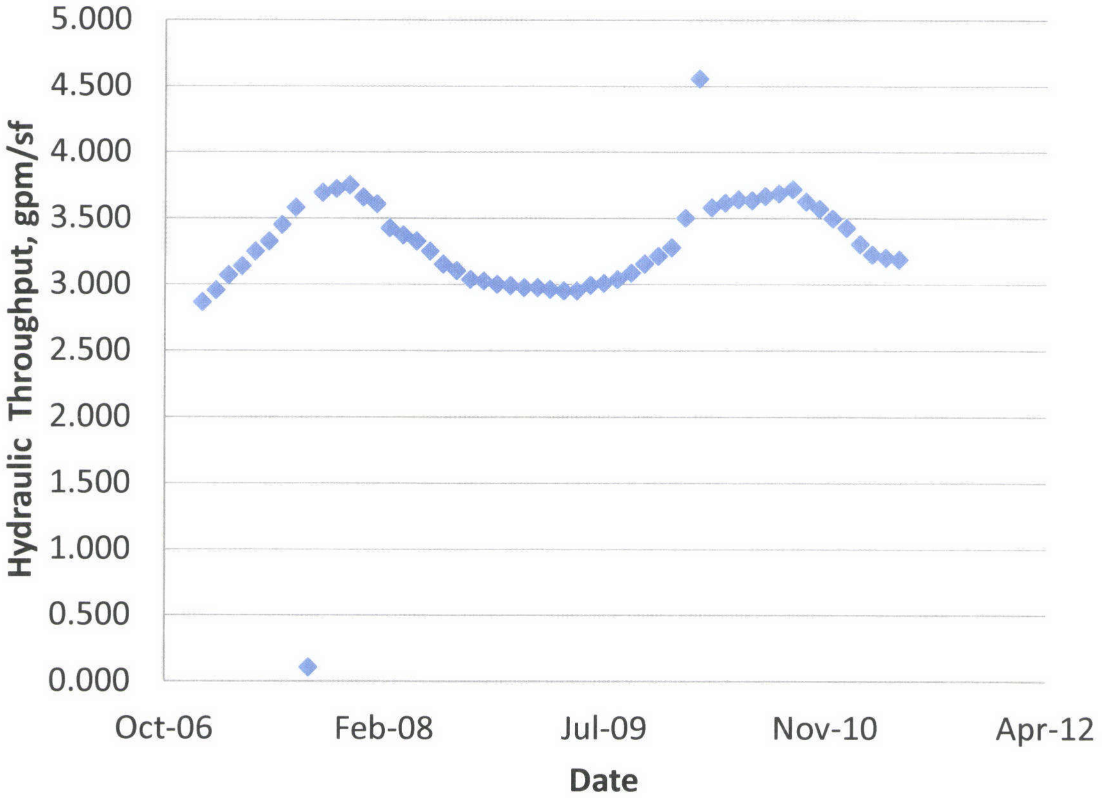


Figure TM2-5 – Historical Hydraulic Throughput rates

Flow data indicates that peak day flows of 127 mgd (September 2010) and peak two hour flows of 163 mgd (September 2010) have been reported. With the design capacity of the filter system established at 120 mgd, flows in excess of the design would have bypassed the filter system.

2.4 Solids Removal Rates

A second key design and operation parameter for the existing filters is solids loading rate. Figure TM2-6 shows the average solids loading rate based on the flow reported on the discharge monitoring report (DMR) submitted to TCEQ. The solids loading rates are quite low, generally under 0.50 ppd/sf.

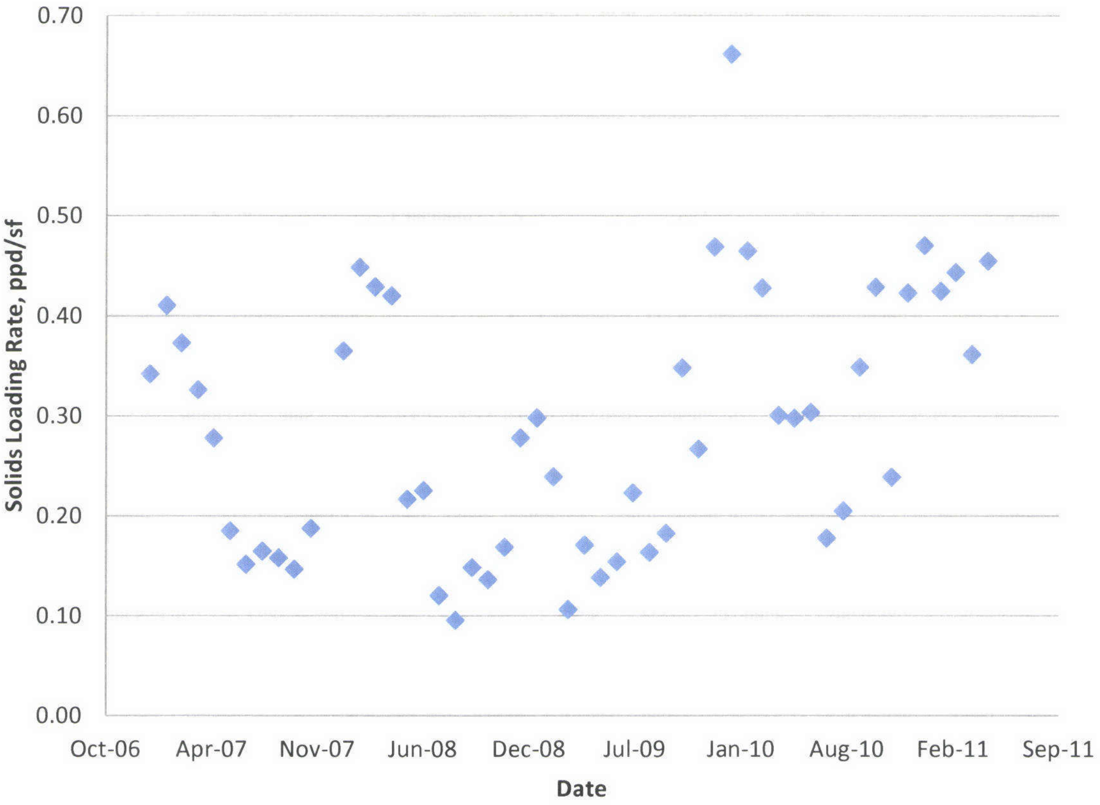


Figure TM2-6 - Historical Solids Loading Rate

2.5 Backwash Requirements

Through field testing it was determined there may be some issues with the accuracy of the flow meters, therefore it was very difficult to establish the actual backwash volume used. Based on testing conducted as part of TM1 it appears that 2% - 200,000 gallons - of backwash water was required after running at 5 mgd for 48 hours (3.2 gpm/sf). A further discussion of the development of the backwash requirements is provided in TM3.

3.0 DESIGN CRITERIA

The peak and average flow rates used for this evaluation were based on the plant design conditions of 75 mgd average and 120 mgd peak flow. Therefore, alternatives to the existing filters were also based on providing a system that has the same capacity.

Filter systems would also need to achieve the same effluent TSS and turbidity as detailed in the discharge permits. The more critical of these is the 30 day average of 3 NTU based on 2 grab samples a week. Concepts for alternative filtration technologies were based on achieving or exceeding that permit requirement.

4.0 SUMMARY OF ALTERNATIVE FILTRATION TECHNOLOGIES

4.1 Effluent Filtration Technology

Figure TM2-7 illustrates the all inclusive Filtration Spectrum and filtration technologies.

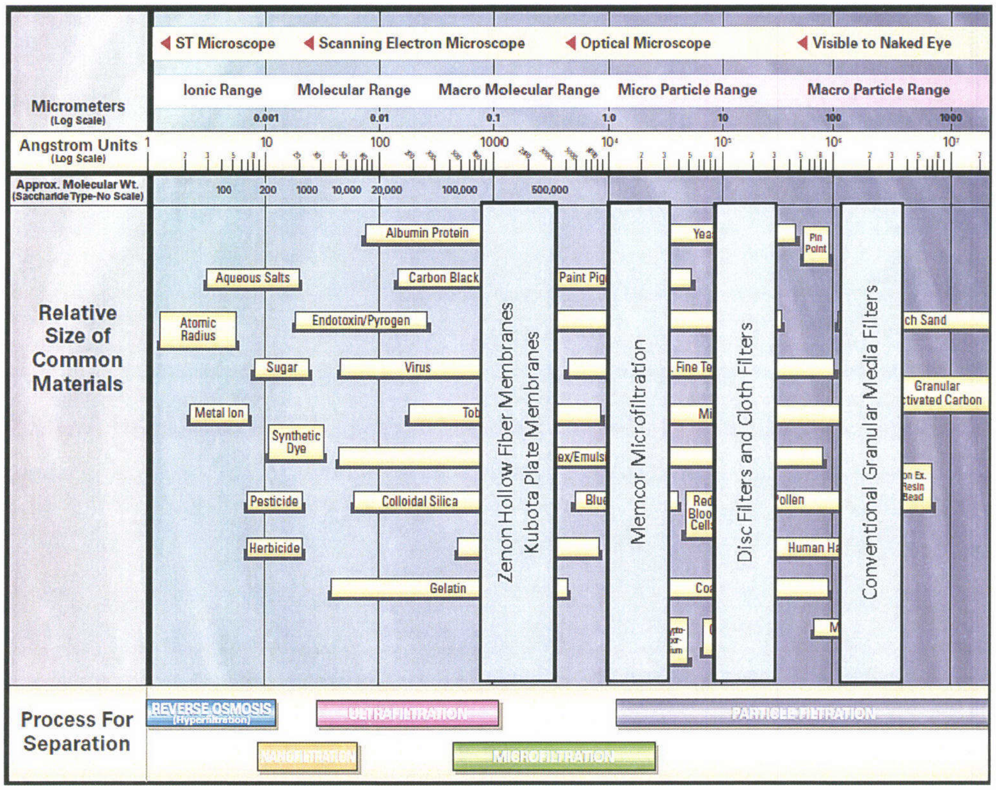


Figure TM2-7 Filtration Spectrum with Applicable Filtration Methods

The general separation processes shown on Figure TM2-7 and described below include: (1) Particle Filtration, (2) Microfiltration, (3) Ultrafiltration, (4) Nanofiltration, and (5) Reverse Osmosis.

- Particle Filtration. Particle filtration covers the range of micro particles (from about 1 micron to about 50 micron) to macro particles (from about 50 micron to about 1,000 micron). Conventional granular media filtration falls in the 100 micron to 300 micron particle range. Single media (sand or anthracite or granular activated carbon), dual media (anthracite over sand or granular activated carbon over sand), and multi-media (anthracite over sand over garnet or granular activated carbon over sand over garnet) all fall within the macro particle filtration range. This would include such filtration technologies as traveling bridge and upflow technologies. Newer surface filtration technologies, such as the Disc Filters and other cloth/stainless steel media filters use synthetic polyester membranes and operate in the larger pore opening microfiltration range (10 micron to 20 micron). Compressible media filtration (CMF) works using the same principles of granular filtration but using a synthetic media

- Microfiltration. Microfiltration (MF) is normally used in the macro molecular range (from about 0.5 micron to about 1 micron) to the lower end of the micro particle range (from about 1 micron to about 3 micron). Microfiltration uses synthetic polyester or other types of membranes to filter out the smaller particles. Higher operating pressures are required for use of microfiltration membranes as compared to conventional granular media or cloth media filtration. Memcor, Koch and other manufacturers supply this type of membranes.

- Ultrafiltration. Ultrafiltration (UF) is normally used in the molecular to macro molecular range (from about 0.03 micron to about 0.1 micron). Because ultrafiltration operates to remove molecular particles, higher operating pressures are normally required for this type of pressure filtration. Hollow fiber ultrafiltration membranes with larger pore openings are used by some manufacturers. Hollow fiber membranes create a vacuum induced filtration through the larger pore openings and require smaller differential pressures as compared to pressures needed to filter through smaller pore openings in other ultrafiltration membranes.

Submerged ultrafiltration membranes are sometimes used for filtration of mixed liquor suspended solids (MLSS) and are used in place of the normal sedimentation/clarification process normally used in secondary treatment. Zenon, Kubota, Koch, Hydranautics and other manufacturers supply these types of Ultrafiltration membranes.

- Nanofiltration. Nanofiltration is normally used in the lower end of the ionic range (about 0.001 micron) to the upper end of the molecular range (about 0.008 micron). Nanofiltration requires higher differential pressures because of filtration through very small pore openings. Nanofiltration is not used for clarified effluent filtration.

- Reverse Osmosis. Reverse Osmosis membranes are used in the lower end of the ionic range (about 0.0001 micron to 0.001 micron). Reverse Osmosis membranes are primarily used in brackish water filtration and in desalination of sea water. Reverse Osmosis membranes require significantly higher operating pressures and are not used for clarified effluent filtration.

Also shown on the filtration spectrum are specific filtration technologies including:

- Zenon Zee-Weed Hollow Fiber membrane
- Kubota Plate membrane
- Memcor Microfiltration membrane
- Disc and Cloth filters by Aqua Aerobics, Siemens, Veolia and others
- Conventional granular filtration systems.

Conventional filtration approaches are similar to the existing filtration system and will be discussed in TM3. The following alternative filtration technologies are described in detail below.

- Traveling Bridge
- Upflow
- Compressible Media filters
- Cloth media
- NOVA (Stainless Steel media)

4.2 Traveling Bridge Filters

Traveling bridge filters are continuously operating down flow filters in which filtering of effluent and backwashing of the filters take place simultaneously. A shallow bed of granular media is used primarily for surface filtration in Traveling Bridge Filters. In this type of filter, the filter bed is partitioned into a number of 12” to 18” wide filter cells, each extending the full width of the filter bed. Incoming water is allowed to enter and flood the filter bed, flow downwards through the granular media in the filter cells, and then enter an effluent channel. The effluent channel supplies backwash water and also discharges filtered water into a clearwell normally located under the filter.

A slow moving traveling bridge carrying a backwash pump and a backwash hood stops over each filter cell, covers the cell top and isolates it. The backwash pump (installed on the traveling bridge) draws filtered water from the effluent channel and supplies it for backwashing from underneath the filter bed. Backwash water moving up through the filter bed washes the filter media in that isolated cell while filtration continues in the other filter cells, uninterrupted. Once the backwashing of that filter cell is completed, the bridge, hood and backwash pump moves slowly over to the next filter cell and initiates backwash of the new cell. During this movement from one end of the filter to the other, filtering operation of all the cells, except the one being backwashed, is maintained. Because of this continuous backwash process, no set limit for turbidity breakthrough or maximum terminal headloss through the filter bed is used for backwash in traveling bridge filters. Figure TM2-8 illustrates a schematic of the traveling bridge filter and Figure TM2-9 shows a traveling bridge in service.

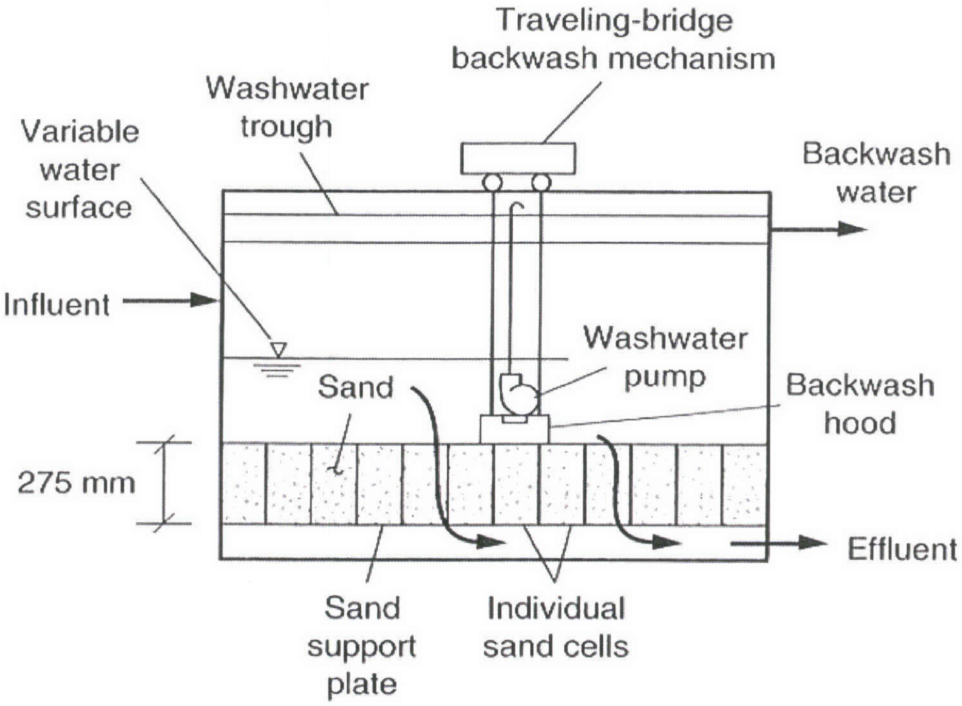


Figure TM2-8 - Schematic of the Traveling Bridge Filter

Figure TM2-9 - Automatic Traveling Bridge Filter System

Advantages/Disadvantages. The traveling bridge filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Proven technology
- Filter remains in service during backwash
- Low backwash rates between 2 to 5 percent of total throughput
- Low Headloss through filter
- Backwash water equalization is not required

Disadvantages:

- Complex mechanical equipment
- Higher maintenance requirements
- Reduced effluent quality due to shallow media depth

4.3 Upflow Granular Media Filtration

4.3.1 Intermittent Backwash Granular Media Filtration

This method of filtration uses a stratified media consisting of one to two layers of gravel supporting two or more layers of sand. Normally a coarse layer (30 mm to 40 mm size) of gravel supports a finer layer (10 mm to 15 mm size) of support gravel. On top of the support gravel lays a coarse layer (2 mm to 4 mm size) of sand which in turn supports a deep bed fine layer (1 mm to 2 mm size) of sand. A buried restraining grid is used to form sand arches to create a tight filter bed. Influent for filtration is supplied from the bottom of the bed.

The bed is drained prior to backwashing with effluent. Air scouring with low pressure air is used first to break up the sand arches. Air scouring is followed by a combined air/water backwash. Backwashing is followed by filter media settling (stratification) and a pre-filtration period to assure effluent clarity. Higher filtration rates (6 gpm/ft2 to 12 gpm/ft2) have reportedly been obtained (WEF MOP 8) with this type of upflow filtration. Figure

TM2-10 illustrates the process flow schematic of the Upflow Intermittent Backwash Granular Media Filter.

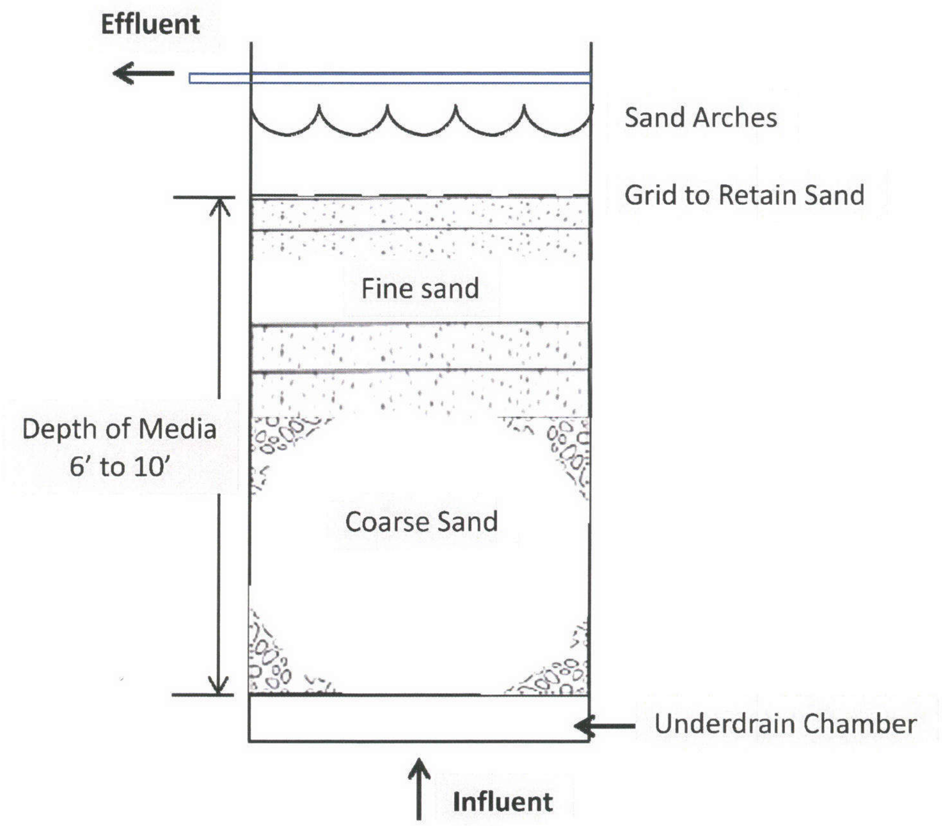


Figure TM2-10 - Upflow Intermittent Backwash Granular Media Filter

4.3.2 Continuous Backwash Upflow Granular Media Filtration

In continuous upflow filtration, wastewater is introduced at the bottom of the filter bed and flows upwards through the granular media. The flow is distributed uniformly through the media using mechanical means. Wastewater effluent flows up through a downward moving granular media. The filtered water exists from the media and overflows a weir into an effluent pipe. An air lift system is used to lift the granular media and solids removed into a sand washer. As the granular media is lifted to the top of the filter media, solids are separated from the granular media due to abrasion of the particles. A sand washer is used to washout the solids over a weir. The granular media is continuously cleaned while a filtrate stream and a reject washwater stream is continuously produced. Figure TM2-11 illustrates the process flow schematic of the Upflow Continuous Backwash Granular Media Filter. Figure TM2-12 shows an operating upflow filtration system.

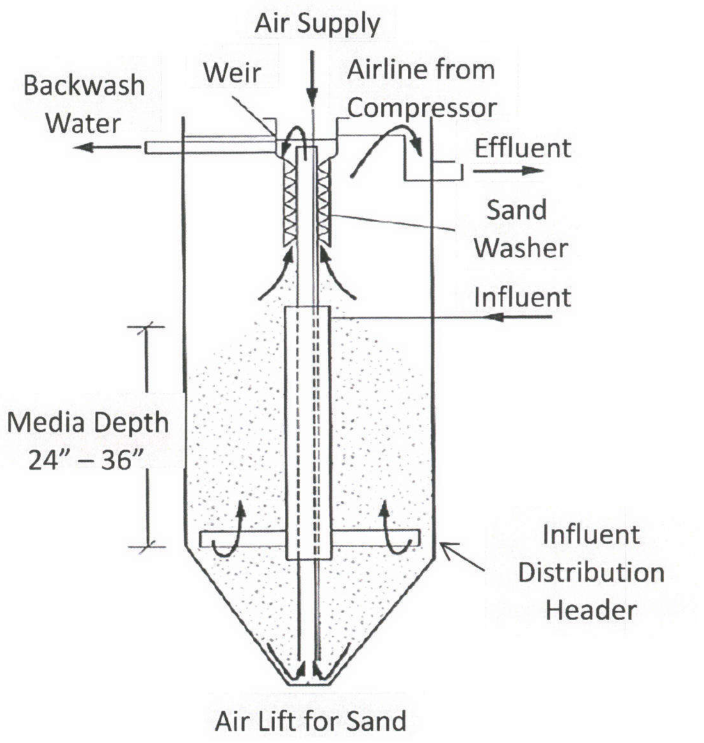


Figure TM2-11 - Upflow Continuous Backwash Granular Media Filter

Figure TM2-12 - Upflow Filtration System

Advantages/Disadvantages. The upflow continuous backwash filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Established technology
- Can handle higher TSS concentrations without blinding
- Low maintenance due to no moving mechanical parts
- Filter remains in service while backwashed
- Lower backwash rates between 5 to 10 percent of total throughput
- Equalization of backwash water is not required

Disadvantages:

- Foreign objects can plug airlift pipe

- Higher headloss through filter
- Proprietary equipment, could be difficult for competitive bidding

4.4 Compressible Media Filtration

The compressible media filter (CMF) uses compressible fiber media set between two plates. The porosity of the filter media can be adjusted by changing the compression level of the media. Fluid flows through the media as opposed to around the media in conventional filters in either an upflow or downflow configuration. Significantly higher surface loadings are possible due to the porosity of the media. These filters are designed based on peak hydraulic loading rates between 20 to 30 gpm/sf. The depth of the media bed is typically in the range of 24 to 30 inches. During a backwash cycle, the compression plates are opened allowing the media to expand. The direction of flow in the filter is reversed and air is introduced to help scour the media. A typical backwash rate is approximately 10 gpm for 30 minutes. Figure TM2-13 shows a picture of the respective media (orange being downflow and pink being upflow) from the respective CMF vendors. Figure TM2-14 shows an operating CMF facility.

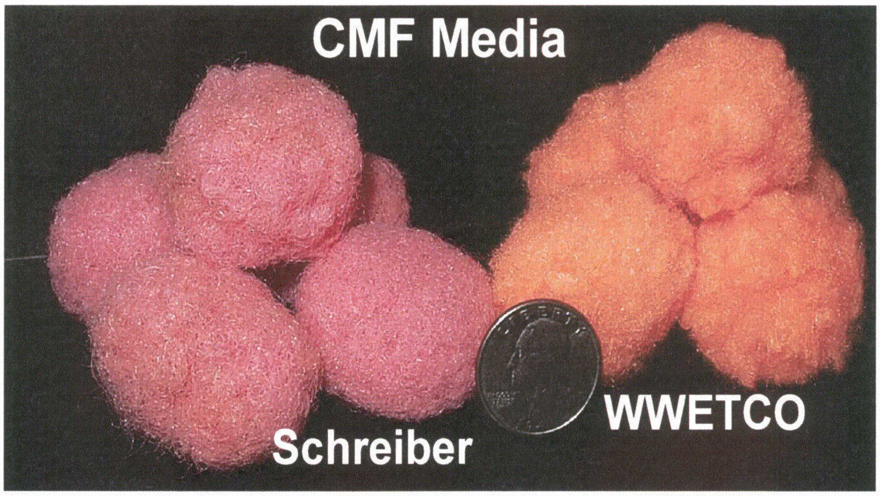


Figure TM2-13 - CMF Media

Figure TM2-14 – CMF Installations

Advantages/Disadvantages. The compressible media filtration technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Smallest footprint
- Design for significantly higher hydraulic loading rates
- Reduced backwash rates
- Porosity of media is adjustable

Disadvantages:

- Developing technology
- Process reliability has not been established
- Life span of media is unknown
- Filter must be taken out-of-service for backwashing

4.5 Cloth Media Filter

The cloth media filter uses a high density cloth membrane as the filter media. The cloth membrane is attached to pie-shaped hollow disks mounted vertically on a common effluent tube that conveys filtered process water from the filter basin. Two types of configuration are available on the market. Flow direction in the first configuration moves from the outside of the media to the inside. The second configuration filters from the inside of the media to the outside. The cloth covered disks are stationary and submerged in the filter basin during normal operation. Various types of media can be used ranging from a cloth pile (shown in Figure TM2-15) to a synthetic media. Heavier solids are allowed to settle in the filter basin and periodically pumped from the basin. This reduces the solids load on the membranes and the required frequency of the backwash cycle.

The disks also remain submerged and in operation during a backwash cycle. Suction heads located on each side of the filter disk draw filtered water back through the cloth membrane removing the entrapped particles as the disc rotates at a speed of 1 fps. A high pressure spray backwash cycle is also used approximately once per week to control bio-growth on the cloth media. The cloth media filters are typically designed for peak hydraulic loading rates as high as 6 gpm/sf. Figure TM2-16 shows a cloth media installation.

Figure TM2-15 - Example of Cloth Media

Figure TM2-16 - Cloth Media Filter Installation

Advantages/Disadvantages. The cloth media filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Small footprint
- Low headloss through filter
- Very low backwash water requirements, less than 2- 3 % of throughput
- Filter remains in service while backwashed

Disadvantages:

- Developing technology
- Equipment reliability not yet established
- Proprietary equipment, could be difficult for competitive bidding
- Cloth media may not be compatible with polymer if required for filter performance optimization

4.6 NOVA Filter Technology

The NOVA Ultrascreen Filter is an "inside to out" disk filter system. This means that the flow to be filtered enters between the disks on the inside and the filtered effluent is on the outside of the disks. The disks rotates continuously as shown in Figure TM2-17.

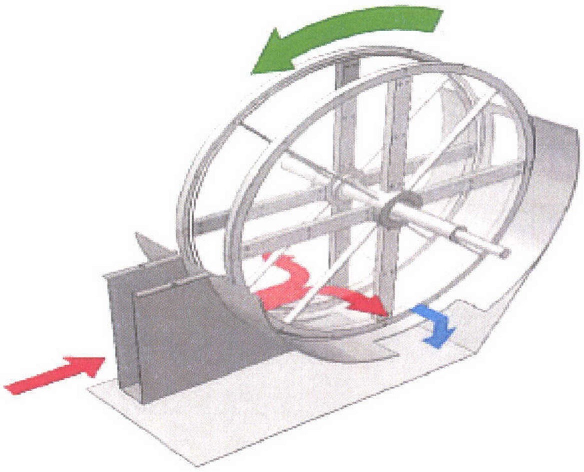


Figure TM2-17 - Schematic of Ultrascreen Filter

The premise of this filter is that it uses the principle of "dynamic tangential filtration." Dynamic tangential filtration means that the rotation of the disks allows for higher hydraulic throughput compared to static cloth media disk systems. The Nova system contains multiple disk units similar to other disk filter systems. One disk unit is comprised of two disk units with approximately 24 inches separating each disk. Each is composed of six parts, similar to other disk systems. The major difference between the Ultrascreen and other cloth systems is that the media is a stainless steel mesh. By having each disk composed of multiple pieces allowing ease of maintenance.

Since the area between each disk is open it allows for easy access for removal of debris should any material need to be removed. This open area between disk units allows for the installation of a backwash channel for removal of backwash solids.

As headloss builds up on the media a backwash cycle is initiated by the use of two level sensors (high water level and low water level). When the water level reaches the high level sensor, a backwash cycle is initiated. Spray nozzles located on the outside of the media spray clean water though the media removing the captured material on the inside of the filter disk. Source water for each backwash water is either filtered water or from other non-potable water sources. If filtered water is used, a solids strainer needs to be used to protect the backwash nozzles from plugging. Water from backwashing is collected in a trough located in the open area between each disk and is connected to a main backwash channel to remove the backwashed solids. Based on the design of the filter, all rotating bearings are located above the water level.

Advantages / Disadvantages. The Nova filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Small footprint
- Low headloss through filter
- Very low backwash water requirements, less than 1 % of throughput
- Filter remains in service while backwashed

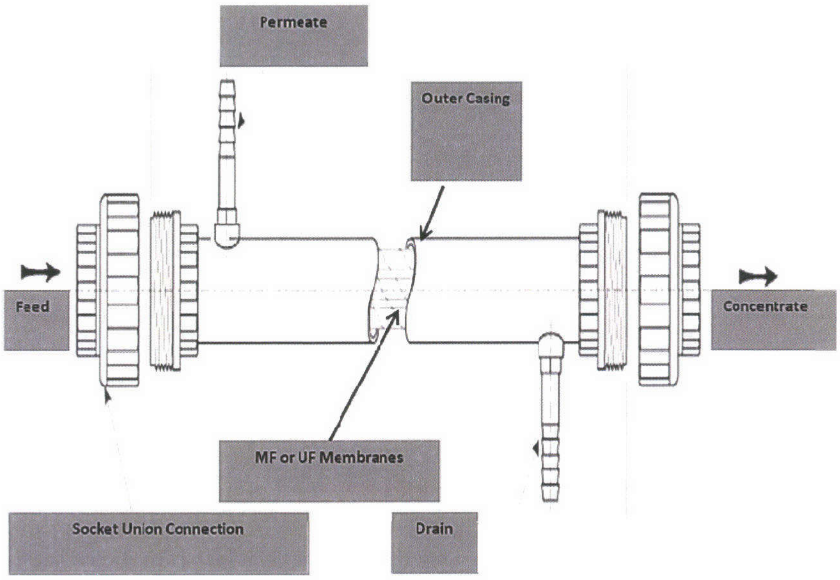
Disadvantages:

- Developing technology
- Equipment reliability not yet established
- Proprietary equipment, could be difficult for competitive bidding

4.7 Membrane Filtration

Microfiltration (MF) and Ultrafiltration (UF) membranes may also be used for separation of particles by straining and/or sieving on a surface. As mentioned above Microfiltration membranes are normally used to remove particles in the range of 0.5 micron to 3.0 micron while Ultrafiltration membranes are used for removing particles in the 0.03 to 0.4 micron range.

Both MF and UF membranes are used for filtration in unsubmerged tubular configurations and Submerged Hollow Fiber and Submerged Plate configurations. In tubular MF and UF configurations, the membranes are encased in an outer casing. MLSS or clarified effluent to be filtered is pumped through the membrane tubes. Under pressure, solids and other particles are retained inside the membrane tubes and water (called permeate) passes through the micro pores into the outer casing. An example of tubular MF and UF Filters is presented in Figure TM2-18.



FigureTM2-18 - Example of tubular MF and UF Filters

Submersible MF and UF membranes are used as either tubular hollow fiber filters or plate filters. Hollow fiber membranes are used with the water passing through the pore openings from outside of the fiber strand to the inside under a vacuum induced trans-membrane pressure. Figure TM2-19 illustrates a submersible hollow fiber strand, a filter module built of many such strands and cassettes makes up many modules.

Submersible plate membranes are used similar to the hollow fiber membranes except these membranes work under pressure. Figure TM2-20 illustrates a submersible plate membrane.

Both MF and UF membranes shown above have been used for MLSS and effluent filtration. Required pressures for these types of membranes are higher than other types of filtration discussed. These types of membrane filtration systems are much more expensive (in both capital and operating costs) as compared to other filtration methods described earlier in this section and require considerably more operations and maintenance. Because of these reasons MF and UF membrane filtration systems are not normally used for secondary effluent filtration.

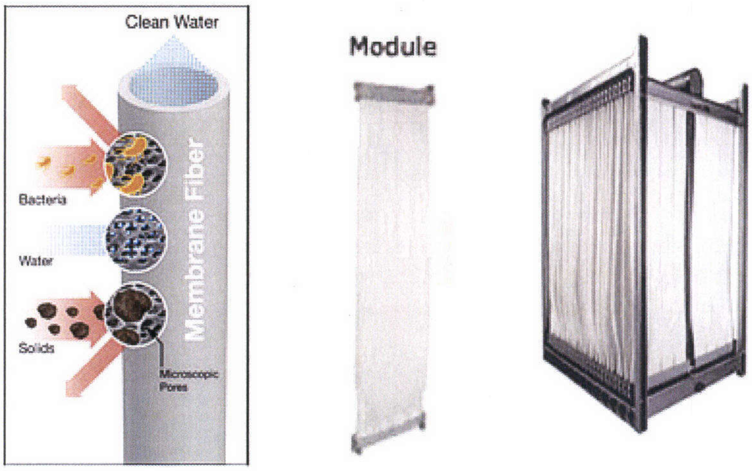


Figure TM2-19 - Example Submersible Hollow Fiber strand

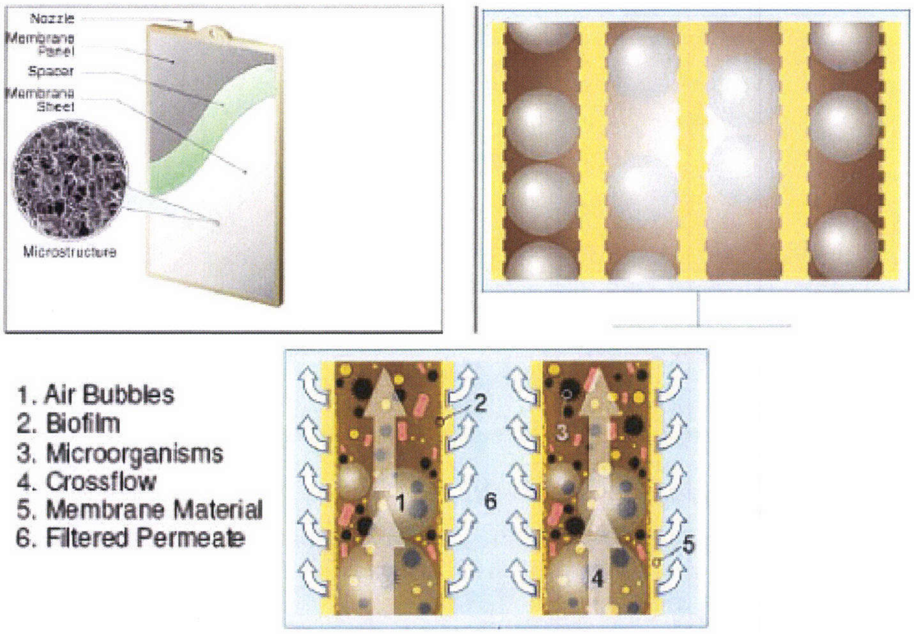


Figure TM2-20 - Schematic of Submersible Plate Membrane

5.0 EVALUATION OF ALTERNATIVES FILTRATION TECHNOLOGIES

5.1 Description of Evaluation Criteria

A workshop was held June 9, 2011 to discuss various alternative filtration technologies and select two of the filter technologies for further evaluation. At the outset of the workshop various criteria important to the City were discussed. Results of this discussion indicated that membrane filtration alternatives (microfiltration, ultrafiltration, and reverse osmosis) would not be included in the evaluation. This was due to the cost and over all complexity of these types of systems.

Each filter system was discussed during the workshop and then decisions made on the specific criteria. The workshop presentation slides are included as reference in Attachment TM2-A.

5.2 Results of Evaluation

Table TM2-1 summarizes the results of the discussions on each of the criteria during the workshop. Based on the discussion the Aqua cloth media filter was decided to be one of the technologies to be considered for WCWWTP. The meeting concluded with the WWETCO compressible media filter and the Nova Ultrascreen requiring additional research.

Table TM2-1

Evaluation of Alternative Filtration Technology

Filtration Technology	Criteria						
	Experience at WCWWTP Flows	Modify into Existing Structure	Optimize Existing Facilities	Flexibility for Expansion	Flexibility for Future Regulations	Energy Optimization	Reliability/ Complexity
Conventional	•	•	•		•		•
Traveling Bridge	•						
Upflow					•	•	•
CMF		•	•	•	•		•
Cloth	•	•	•	•	•	•	•
NOVA		•	•	•	•	•	
Staff indicated during the Workshop that Microfiltration and Reverse Osmosis would not be evaluated							

Additional information was presented to City Staff on June 23 on both filter systems and is included in Attachments TM2-B and TM2-C. Based on the discussion with the City, the NOVA Ultrascreen was selected as the second alternative filtration technology for evaluation during this study. The Nova system was selected based on the following criteria:

- Received conditional acceptance from the California Department of Public Health
- Stainless Steel construction
- Similar concept to other disc filtration technology

5.3 Selected Alternative Technologies for WCWWTP

Based on the outcome of the workshop and subsequent discussions with the City, the following two filtration technologies were selected for detailed evaluation as alternatives to the existing granular media filters at the WCWWTP:

- Cloth Media Filtration

- NOVA Ultrascreen

6.0 CONCEPTUAL DESIGN OF SELECTED FILTRATION ALTERNATIVES

The alternative filtration technologies were selected for evaluation in part because they are suitable for retrofitting into the existing filter boxes at the filter complex, and that is the approach used for the conceptual design of the alternatives. Cloth media filters are offered by several different manufacturers, and the details of the layout are specific to each manufacturer. To expedite this conceptual design, equipment from Aqua Aerobics was selected for the cloth media alternative. The stainless steel mesh screen is offered only by NOVA and their input was solicited for that design.

For both alternatives, the filter influent conduits that convey flow from the chlorine contact basins to the filter complex were assumed to be left in service. This includes the overflow boxes that divert secondary effluent to the plant outfall in the event the capacity of the screens is exceeded. Likewise, the existing conduit that conveys filter effluent to the outfall was left in service for both alternatives. Refer to TM3 for a discussion of the hydraulic capacity of these conduits. The backwash drain line that returns spent backwash from the filter complex to the flow equalization basins was left in service for both alternatives, and the existing connection of the Water Reclamation Initiative (WRI) low service pump station to the north clearwell was assumed to remain in service. Thus the improvements described for each alternative are confined to the filter complex itself.

6.1 Cloth Media Alternative

The cloth media alternative is described in detail in the Preliminary Design Report prepared by Aqua Aerobics dated July 12, 2011 attached to this TM2 as Attachment TM2-D. This design report recommends the installation of 24 AquaDisk Model #ADFSC-54X12E-PC units. The size of these units is such that they can be installed with four units to one of the existing filter boxes. Thus six existing filter boxes would be retrofitted to provide 75 mgd of firm filter capacity.

6.1.1 Description of Improvements

These units are configured as outside-in filters, so the disk units will be submerged in concrete boxes that contain filter influent. Separate channels will be constructed within each box to remove filter effluent from the center shaft and convey the combined effluent to the existing filter gullet and thence to the clearwell. In order to accomplish this retrofit and maintain some of the existing filters in service, it is recommended that filter boxes 5 through 10 be retrofitted with these units, with filters 1 through 4 remaining in service throughout construction to provide the basic filtration needs for the WRI and non-potable system, as well as filter a portion of the plant effluent. The following paragraphs describe the modifications to the existing filter complex for the Cloth Media Alternative.

Mechanical. The existing piping systems in the gallery for backwash supply, backwash drain, low pressure air and surface wash would be completely demolished and removed. The existing 36-inch filter influent conduits to each filter box would be retrofitted to remove the existing 36-inch valve and install a tee connection. Each filter box will be served by two 18-inch filter influent lines off of this tee. The filter influent piping will be routed down to a lower level in the filter gallery where it is accessible and each 18-inch feed will be provided with a magnetic flow meter and throttling valve to move the filter flow control to the influent side of these units. Each 18-inch influent line will feed two AquaDisk units, the split of flow between those two units will be accomplished with fixed weirs inside the filter box.

On the effluent of each filter, the flow from all four units will be collected in the existing filter gullet and will be routed into the gallery using the existing 30-inch piping connection. The existing flow meter and throttling valve on the effluent will be removed and a new isolation valve installed to allow isolation of each filter box from the common effluent channel. The existing filter effluent channel and clearwell will remain in service.

Backwash for these units is accomplished using one pump for each pair of AquaDisk units. Each pump is connected to eight electrically actuated valves which cycle on and off in conjunction with the pump and disk drive to clean the cloth media based on differential head across the filters. The pumps and valves are located within the filter gallery adjacent to each filter. The suction piping from each pump consists of a manifold of eight valves that are connected to backwash shoe assemblies that are submerged within the filter boxes. The discharge from each pump will be metered and routed to the existing spent filter backwash piping which is routed under the slab of the gallery.

Periodically, solids that settle to the bottom of the concrete basins are removed by opening an electrically actuated plug valve that will direct solids to the spent backwash drain. One solid waste valve is provided in the gallery for each pair of AquaDisk units. Scum is removed from each filter box by periodically allowing the water level in the box to increase above the normal operating level until flow reaches a fixed scum drawoff weir. Flow is allowed to go over this weir to the spent backwash drain for a period of time before the filter is returned to normal operation.

Structural. Structural modifications will be required in order to install these AquaDisk units into filter boxes 5 – 10. These modifications include removal of all of the media, backwash troughs, concrete sub-floor that contains the underdrain nozzles, and the baffle walls that support the sub-floor. New structural concrete will be placed to form the influent channels, filter boxes and effluent channels within each filter box. Access platforms with grating will be installed to allow access to the units for replacement of filter media.

These units have a significant amount of equipment located within the existing filter boxes, which are currently exposed. It is recommended that these basins be covered in order to protect the equipment and plant personnel who will be maintaining the equipment. The proposed basin covers consist of a structural steel framing system supporting a flat roof that is located at the same elevation of the roof of the control building. The existing fascia system around the control building that gives the plant its distinctive "Aztec" architecture will be removed and a similar fascia will be constructed around the full perimeter of the filter complex. This fascia system will be situated over the existing perimeter walls to provide the illusion of a completed structure, but in fact there will be an open area of approximately 5.5 feet vertically around the entire perimeter. The flat roof will be provided with roof drains to direct rainwater to storm drains and will be provided with lighting in the form of high-bay task lights for night work as well as skylights that will admit natural light into the filter boxes.

Electrical and Controls. The equipment offering provided by Aqua Aerobics includes twelve control panels, one for each pair of AquaDisk units. These panels will be located in the filter control building on the operating floor. The panels include a Programmable Logic Controller (PLC) that controls all of the valves and motors associated with each pair of units. These panels include variable frequency drives for the sludge pumps and motor starters for the disk drive units. Power will be supplied to these units from a central MCC which will also power lighting, HVAC and other building loads. A Graphic User Interface (GUI) will be provided with each unit to allow operator control.

6.1.2 Construction and Operating Costs

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM2, limited to work within the existing filter complex related directly to the installation of Cloth Media Filters. Demolition of existing equipment and piping that is no longer in service is included in these costs. However, these costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM2-E includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM2-2 lists the capital cost for the Cloth Media Alternative.

Table TM2-2

Capital Costs for the Cloth Media Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	361,000
Division 3 – Concrete	606,900
Divisions 4 through 9 – Filter Superstructure and Metals	1,065,500
Division 13 – Special Construction (Aqua Aerobics)	8,680,000
Division 15 – Mechanical	355,900
Division 16 – Electrical	159,900
General Conditions, Overhead and Profit	2,245,800
Contingencies	5,390,000
Total Capital Cost	**18,865,000**

The operating and maintenance cost for this alternative is based on maintaining a significant number of highly mechanized units. There will be 24 drive units, each driving 12 disks. Each of the 288 disks installed will be fitted with a mechanical dewatering shoe, and those will be marshaled into a total of 72 electrically actuated drain valves. Twelve backwash pumps will be installed along with 12 drain valves. This is a significant installation of equipment and will require operator attention. The following assumptions have been made regarding the operating and maintenance costs of this equipment:

- The overall efficiency of these filters is 98%, so that 2% of the influent flow is recycled through the spent filter backwash system. Electrical power costs are calculated based on information from Aqua Aerobics, 363 kw-hr/day for the backwash pump and 60 kw-hr/day for the disk drive unit. These costs are all captured as cost of backwash.
- Routine operation costs are estimated at four hours per day, similar to the cost of granular filters with a new control system in place.
- Routine maintenance of equipment is estimated at eight hours per week to cover all equipment lubrication, calibration of instrumentation, and general maintenance.
- Filter cloth media has a life of seven years. The annual costs are calculated based on replacing 42 disks per year with a material replacement cost of $1,614 per disk and 1.5 staff-hours per disk.
- Main V-ring seal has a life of ten years. The annual costs are calculated based on replacing 2.5 units per year with a material replacement cost of $1,000 per unit and four staff-hours per unit.

A summary of the operating and maintenance costs associated with this alternative are summarized in Table TM2-3.

Table TM2-3

Operating and Maintenance Costs for the Cloth Media Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$26,600
Labor Costs	$52,900
Replacement Parts and Materials	$73,700
Total Annual Cost	**$153,200**

6.2 NOVA Ultrascreen Alternative

The NOVA Ultrascreen alternative is described in detail in the Preliminary Design Report prepared by NOVA Water Technologies dated July 14, 2011 attached to this TM2 as Attachment TM2-F. This design report recommends the installation of 14 NOVA Ultrascreen Disk Filters, Model #UL1612CS. The size of these units is such that they can be installed with two units to one of the existing filter boxes. Thus seven existing filter boxes would be retrofitted to provide 75 mgd of firm filter capacity.

6.2.1 Description of Improvements

These units are configured as complete, covered filters, with all flow contained within the unit and piping connections required. Therefore the area now occupied by the filter boxes will be converted into concrete floor space to house the new mechanical equipment. Separate piping connections will be made to the inlet, outlet, drain, and overflow from each box and this pipe will be routed to the appropriate location within the filter gallery. In order to accomplish this retrofit and maintain some of the existing filters in service, it is recommended that filter box renovation begin with filter 10 and proceed from east to west, keeping filters 1 through 4 in service to provide the basic filtration needs for the WRI and non-potable system, as well as filter a portion of the plant effluent. The following paragraphs describe the modifications to the existing filter complex for the NOVA Ultrascreen Alternative.

Mechanical. The existing piping systems in the gallery for backwash supply, backwash drain, low pressure air and surface wash would be completely demolished and removed. The existing 36-inch filter influent conduits to each filter box would be retrofitted to remove the existing 36-inch valve and install a flow meter and throttling valve. The new filter influent piping will provide flow control to a pair of units on the influent side. Each influent line will feed two filter units; the split of flow between those two units will be accomplished within the filter mechanism.

On the effluent of each filter, the flow from each pair of units will be collected in a new piping system that is routed into the gallery and connected to the filter effluent conduit connection through the gallery wall. The existing flow meter and throttling valve on the effluent will be removed and isolation valves will be installed to allow isolation of each filter unit from the common effluent channel. The existing filter effluent channel and clearwell will remain in service.

Washing of the screen units for these units is accomplished using a skid-mounted booster pump and nozzle arrangement on each of the filter units. These booster pumps take suction from the filtered water within the unit and supply spray nozzles within the filter boxes. The discharge from the nozzles and the solids washed off the screens are collected in a backwash trough that will be connected to the existing backwash waste piping in the gallery.

Periodically, solids that settle to the bottom of the units can be removed by opening an electrically actuated solids valve that will direct solids to the spent backwash drain.

Structural. Structural modifications will be required in order to install these Ultrascreen units into Filter Boxes 4 through 10. These modifications include removal of all of the media, backwash troughs, concrete sub-floor that contains the underdrain nozzles in filters 5 through 10, and the baffle walls that support the sub-floor in Filters 5 through 10. In filter 4, the existing underdrains will be removed down to structural concrete. A layer of compacted sand fill will be used to raise the grade up to within a foot of the new operating deck, and new structural concrete will be placed to form the deck within each filter box. Access to this deck will be provided with stairs and railings.

These units have a significant amount of equipment located within the existing filter boxes, which are currently exposed. It is recommended that these basins be covered in order to protect the equipment and plant personnel who will be maintaining the equipment. The proposed basin covers consist of a structural steel framing system supporting a flat roof that is located at the same elevation of the roof of the control building. The existing fascia system around the control building that gives the plant its distinctive "Aztec" architecture will be removed and a similar fascia will be constructed around the full perimeter of the filter complex. This fascia system will be situated over the existing perimeter walls to provide the illusion of a completed structure, but in fact there will be an open area of approximately 5.5 feet vertically around the entire perimeter. The flat roof will be provided with roof drains to direct rainwater to storm drains and will be provided with lighting in the form of high-bay task lights for night work as well as skylights that will admit natural light into the filter boxes.

Electrical and Controls. Control panels will be provided for the system and be located in the filter control building on the operating floor. The panels include a Programmable Logic Controller (PLC) that controls all of the valves and motors associated the units. Power will be supplied to these units from a central MCC which will also power lighting, HVAC and other building loads. A Graphic User Interface (GUI) will be provided with each unit to allow operator control.

6.2.2 Construction and Operating Costs

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM2, limited to work within the existing filter complex related directly to the installation of NOVA Ultrascreen Filters. Demolition of existing equipment and piping that is not longer in service is included in these costs. However, these costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM2-E includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM2-4 lists the capital cost for the NOVA Ultrascreen Alternative.

Table TM2-4

Capital Costs for the NOVA Ultrascreen Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	$361,000
Division 3 – Concrete	$187,100
Divisions 4 through 9 – Filter Superstructure and Metals	$1,431,300
Division 13 – Special Construction (Aqua Aerobics)	$7,560,000
Division 15 – Mechanical	$265,900
Division 16 – Electrical	$123,800
General Conditions, Overhead and Profit	$1,985,800
Contingencies	$4,766,000
Total Capital Cost	**$16,680,900**

The operating and maintenance cost for this alternative is based on maintaining a significant number of highly mechanized units. There will be 14 drive units, each driving 24 disks. Each of the 336 disks installed will be fitted with eight filter panels and 18 spray nozzles. Each unit has two drive motors that run continuously and a backwash pump that operates intermittently. This is a significant installation of equipment and will require operator attention. The following assumptions have been made regarding the operating and maintenance costs of this equipment:

- The overall efficiency of these filters is 99%, so that 1% of the influent flow is recycled through the spent filter backwash system. Electrical power costs are calculated based on information from NOVA, 216 kw-hr/day/unit for the drive motors and 36 kw-hr/day/unit for the backwash pump. These costs are all captured as cost of backwash.

- Routine operation costs are estimated at four hours per day, similar to the cost of granular filters with a new control system in place.

- Routine maintenance of equipment is estimated at eight hours per week to cover all equipment lubrication, calibration of instrumentation, and general maintenance.

- Filter panels have a life of 15 years. The annual costs are calculated based on replacing 22 disks per year with a material replacement cost of $2,400 per disk and four staff-hours per disk.

- Filter lateral seals have a life of five years. The annual costs are calculated based on replacing 34 sets of seals per year with a material replacement cost of $450 per set and two staff-hours per set.

- Filter spray nozzles have a life of 11 years. The annual costs are calculated based on replacing 550 nozzles each year with a material replacement cost of $30/nozzle and 0.5 staff hours per nozzle.

A summary of the operating and maintenance costs associated with this alternative are summarized in Table TM2-5.

Table TM2-5

Operating and Maintenance Costs for the NOVA Ultrascreen Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$137,600
Labor Costs	$62,600
Replacement Parts and Materials	$86,900
Total Annual Cost	**$287,100**

6.3 Hydraulic Considerations and Future Expansion

Two common features of these alternative filtration technologies are that they have less head loss and less space requirement than granular media filtration. These two features could provide benefits to the plant that are not quantifiable with the cost information provided for a 75 mgd retrofit. This section describes the potential benefits to the plant for either alternative filtration technology compared to granular media filtration.

6.3.1 Hydraulic Considerations

The filter complex is currently capable of treating a peak hydraulic flow of 120 mgd with a total loss through the granular filters of eight feet, even when the Colorado River is at the 100 year flood stage (refer to TM3 for a description of the hydraulic analysis). As additional flow is routed through the plant, less head is available for filtration, to the point that granular filtration becomes limited by the head available and flow must be bypassed around this process. If either of the alternative filtration technologies described in this section are implemented, the required head for the filtration process would be reduced to approximately 3 feet maximum. This would free up approximately five feet in the hydraulic profile which could be used to ensure more flow is filtered under high flow conditions.

To make this hydraulic improvement, the existing weir in the filter clearwell would have to be raised above its current elevation. This will require raising the roof of the clearwell, which is constructed below filters 1 and 3 in filter building 1, or constructing a new filter effluent structure. Given that neither of these alternatives will require the space afforded by filter boxes 1 and 3, raising the roof of the clearwell would seem the best choice. This would also increase the storage available for the WRI system and the non-potable system.

The costs associated with this potential improvement have not been included in this TM2, as the goal is to describe a filter improvements project rated for 75 mgd maximum month flow and both alternatives can fit into the existing hydraulic profile without this modification. If expansion to 100 mgd maximum month flow is considered, then this modification will become necessary to convey the increased flow from the filter complex to the plant outfall.

6.3.2 Future Plant Expansion

The next expansion of the Walnut Creek WWTP is envisioned to be a 25 mgd expansion to a total maximum month capacity of 100 mgd. Since only 60 to 70 percent of the existing filter area is used for these filtration alternatives, space is available to add more filter units within the existing footprint and achieve this filtration capacity. It is assumed that the peak hydraulic capacity of a plant rated at 100 mgd maximum month would be approximately 200 mgd, which is the rated capacity of the plant outfall. Under normal river stage, it is possible to route this entire flow through the alternative filtration technologies described in this section without bypassing, provided improvements are made to the clearwell effluent weir. If the Colorado River is at the 100 year flood stage and the total plant flow is 200 mgd, a significant amount of flow will have to bypass the filters even with this alternative technology.

However, expansion of the existing filter complex to a rated capacity of 100 mgd maximum month may not be practical. This expansion will also require secondary treatment improvements, which will likely be constructed south of the existing secondary treatment train. It may not be practical to route secondary effluent from the south side of the plant back to the effluent conduit system that exists on the north side of the plant. This evaluation is beyond the scope of the filter improvements project.

ATTACHMENT TM2-A
ALTERNATIVE FILTRATION TECHNOLOGIES WORKSHOP POWERPOINT PRESENTATION

BUILDING A WORLD OF DIFFERENCE

9 June 2011

SAR/WC WWTPs JOINT FILTRATION TECHNOLOGY WORKSHOP

CITY OF AUSTIN, TEXAS

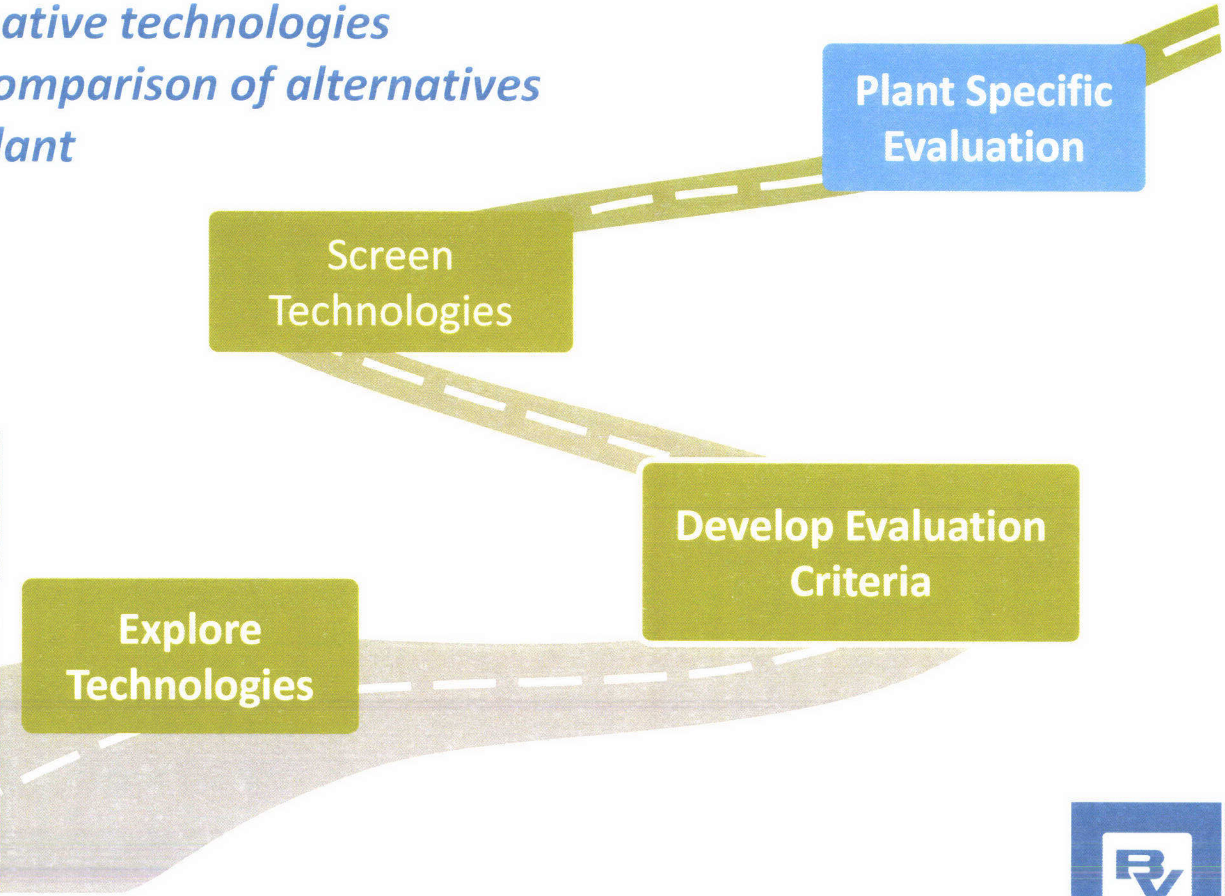
Austin WATER

BLACK & VEATCH
Building a world of difference.

AECOM

BEGIN WITH THE GOAL IN MIND

1. *Explore available filtration technologies*
2. *Review general evaluation criteria*
3. *Screen technologies: Existing + up to two alternative technologies*
4. *Detailed comparison of alternatives for each plant*



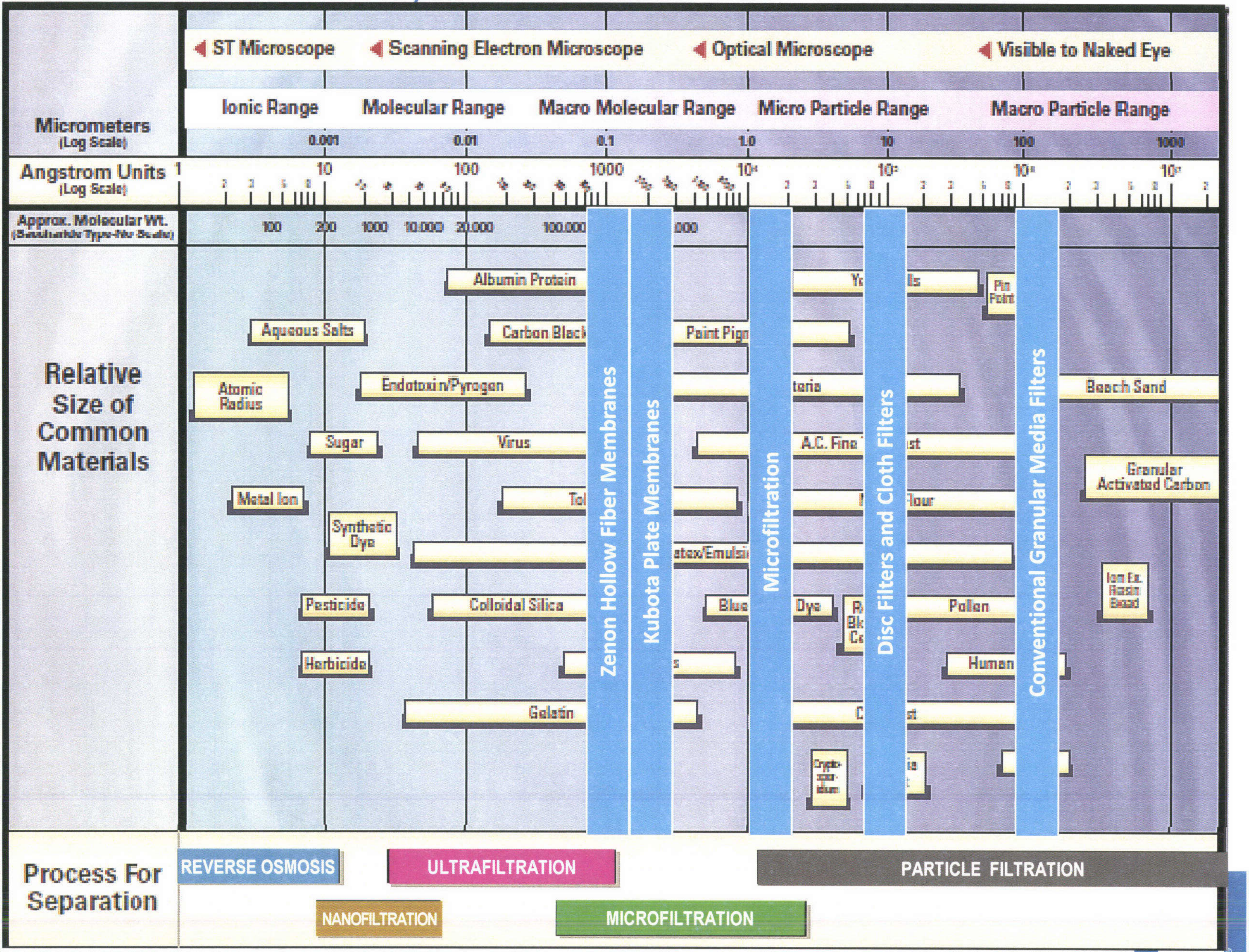
Explore Technologies

Develop Evaluation Criteria

Screen Technologies

Plant Specific Evaluation

CONVENTIONAL, DISC AND MEMBRANE FILTRATION SPECTRUM



EFFLUENT FILTRATION TECHNOLOGIES

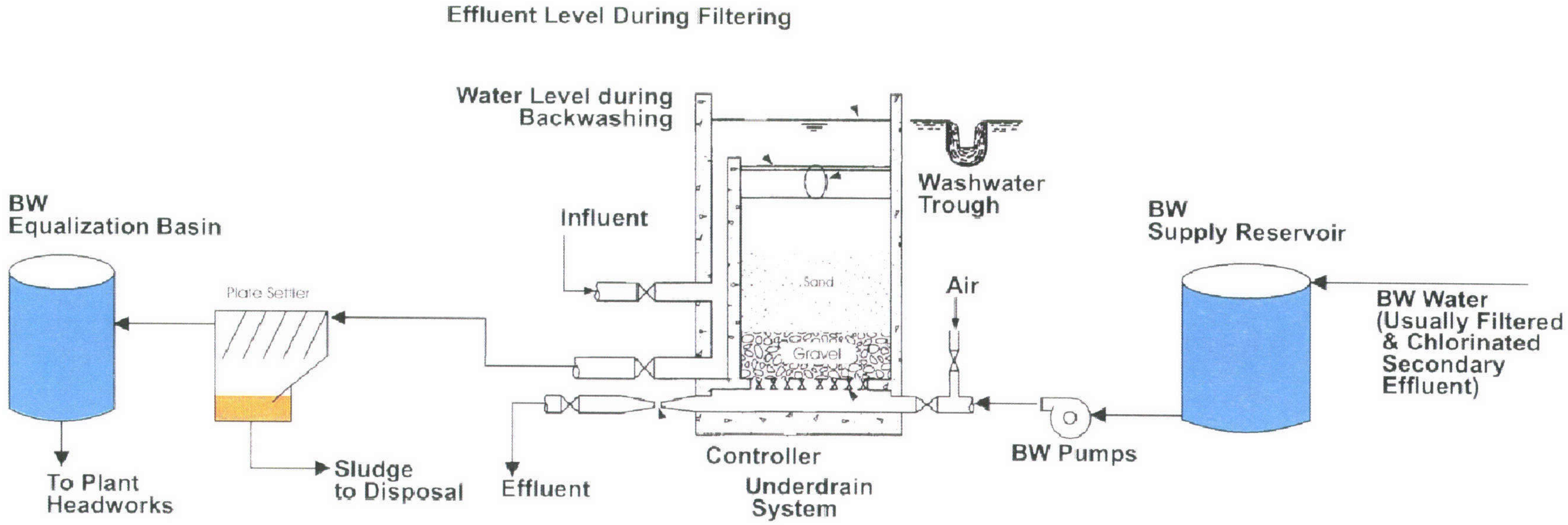
FILTRATION METHOD	FILTRATION RANGE	APPLICATION
DOWNFLOW DEPTH FILTRATION		
Conventional Granular Media Filtration Single Media Deep Bed Filters Dual Media Filters Multi-Media Filters **Traveling Bridge Filters**	100 to 200 microns	• Tested and proven old technology • Used extensively in Effluent Filtration • Very low pressures (2 to 5 psi)
UPFLOW MEDIA FILTRATION		
Continuous Backwash Granular Media Filtration **Compressible Media** **Intermittent Backwash Granular Media Filtration**	100 to 200 microns	• Tested and proven technology • Traditionally used in smaller WWTPs • Very low pressures (2 to 5 psi)
SURFACE FILTRATION		
Cloth Media Filtration **Nova** **Diatomaceous Earth Filtration**	10 to 20 microns	• Newer technology • Very low pressures (1 to 2 psi) • Often used for upgrading Granular Media Filters in older WWTPs
MEMBRANE FILTRATION		
Microfiltration	0.5 to 3.0 microns	• Tested and proven technology • Requires higher operating pressures (10 to 20 psi)
Reverse Osmosis	0.0001 to 0.001 microns	• Normally not used in Effluent Filtration • Requires very high operating pressures (200 to 500 psi)

WHAT TECHNOLOGY FITS BOTH PLANTS?

	Size of Plant	Existing Structure	Optimize Facilities	Future Reg			
Conventional							
Traveling Bridge							
Upflow							
Compressible Media							
Cloth Media							
Nova							
Microfiltration							
Reverse Osmosis							

DOWNFLOW DEPTH FILTRATION

CONVENTIONAL DEEP BED FILTER



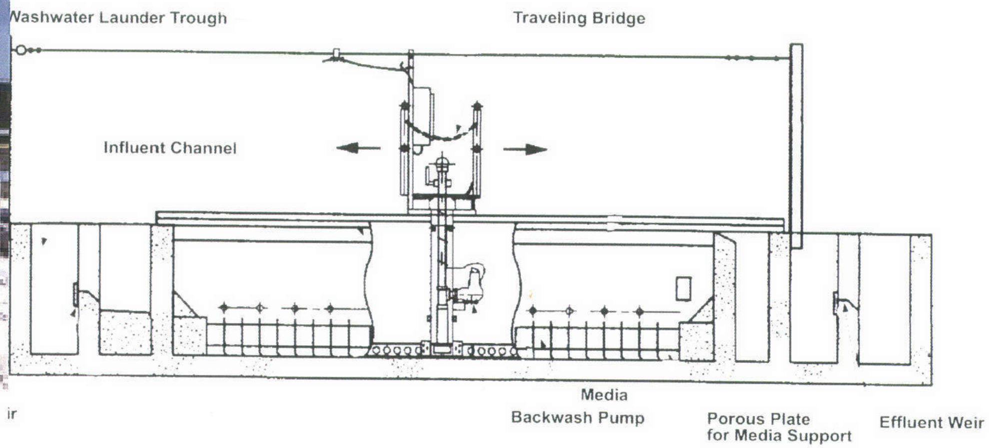
Advantages

- Proven and reliable technology for large plants
- Higher quality effluent
- Can handle a wide range of flow and load variations
- Staff familiar with technology

Disadvantages

- Requires complex ancillary facilities for backwash
- Higher O&M on ancillary equipment
- Higher headloss through filter compared to disc technology

TRAVELING BRIDGE FILTER



Advantages

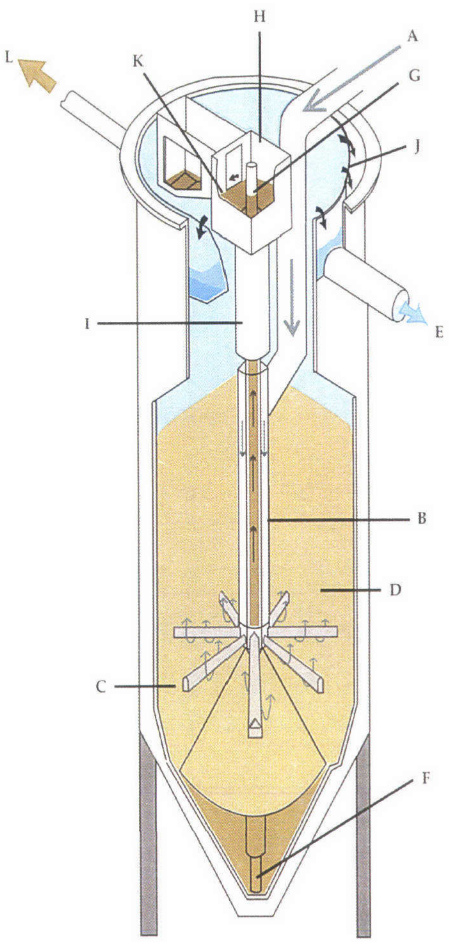
- Automatic backwash operation
- Low headloss through filter compared to Conventional
- Backwash water equalization is not required
- Proven at larger flows

Disadvantages

- Complex mechanical equipment
- More operator attention
- Higher maintenance requirements
- Reduced effluent quality due to shallow media depth
- Restricted hydraulic overflow rates
- Configuration not compatible with existing plant

UPFLOW MEDIA FILTRATION

CONTINUOUS BACKWASH DEEP BED FILTERS



Parkson Dynasand Filter

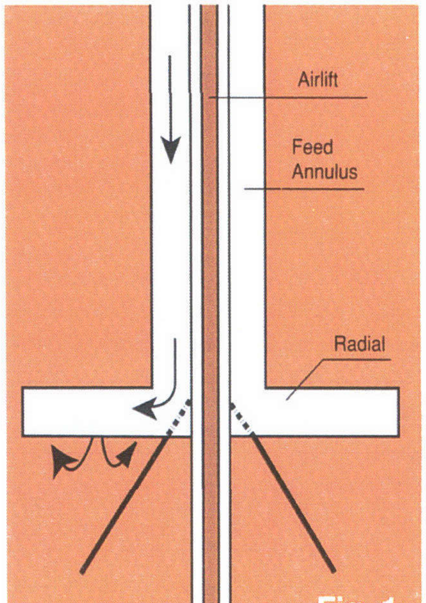


Fig. 1

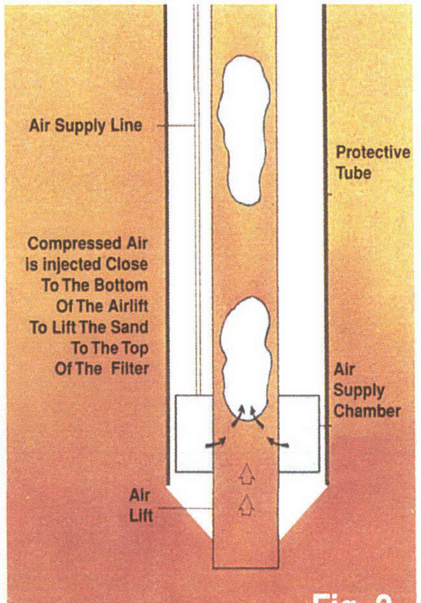
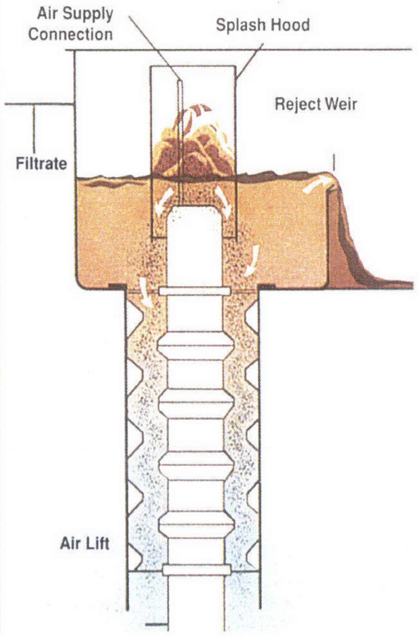
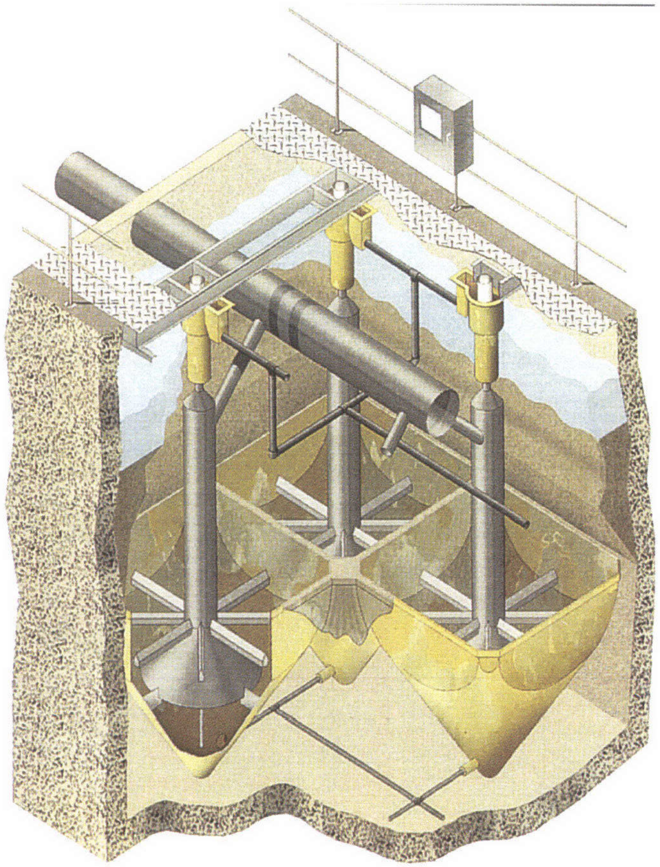


Fig. 2

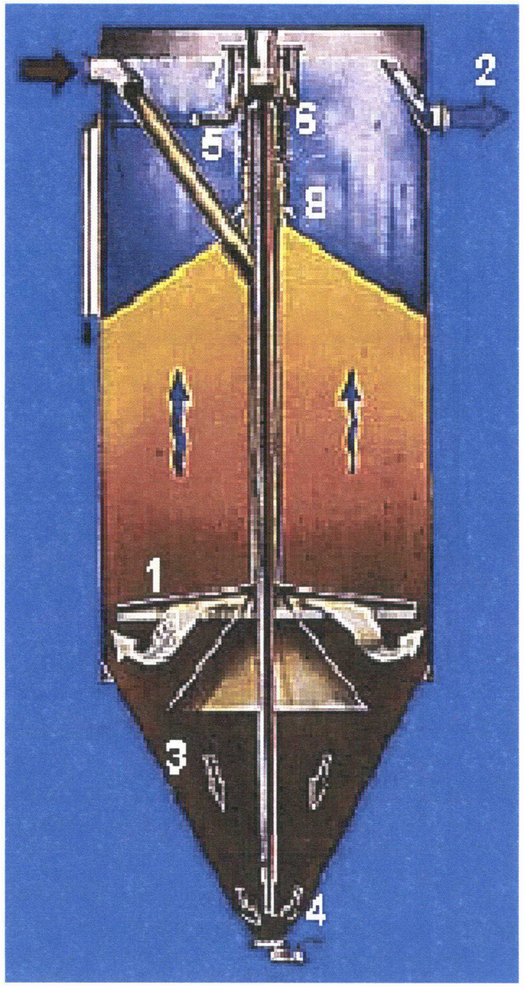


DYNASAND FILTER INSTALLATION OPTIONS

Steel Tanks



Concrete Basins



CONTINUOUS BACKWASH DEEP BED FILTERS

Advantages

- Can handle higher TSS concentration without blinding
- Low maintenance due to no moving mechanical parts
- Continuous backwash operations
- Equalization of backwash water is not required

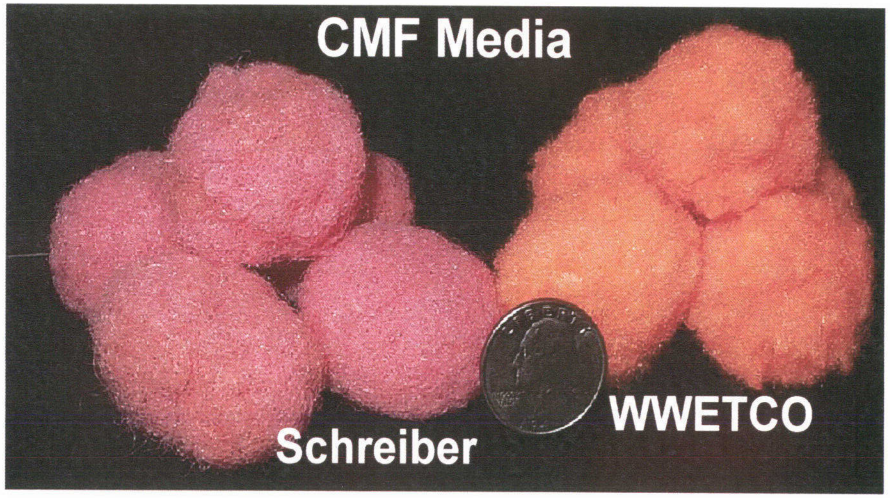
Disadvantages

- Foreign objects can plug airlift pipe
- More complicated to operated
- Proprietary equipment
- Typically used at smaller plants

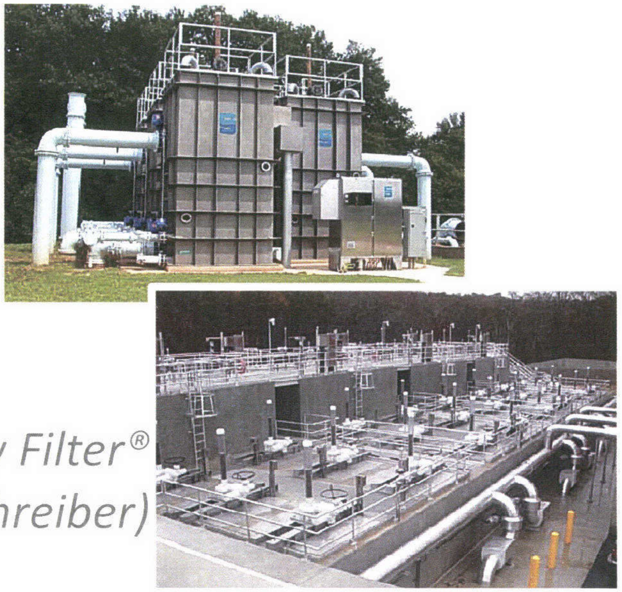
COMPRESSIBLE MEDIA

- Synthetic fibers bundled together with stainless steel ring to form 1 to 1½ inch spheres
- 30-inch bed depth
- Solids removal down to ~4 microns
- Long life (10+ years) with negligible degradation

Filter bed porosity can be altered by compressing the media



TWO SUPPLIERS CURRENTLY PROVIDING COMPRESSIBLE MEDIA SYSTEMS



Fuzzy Filter®
(Schreiber)

WWETCO
FlexFilter™
(WesTech)

Advantages

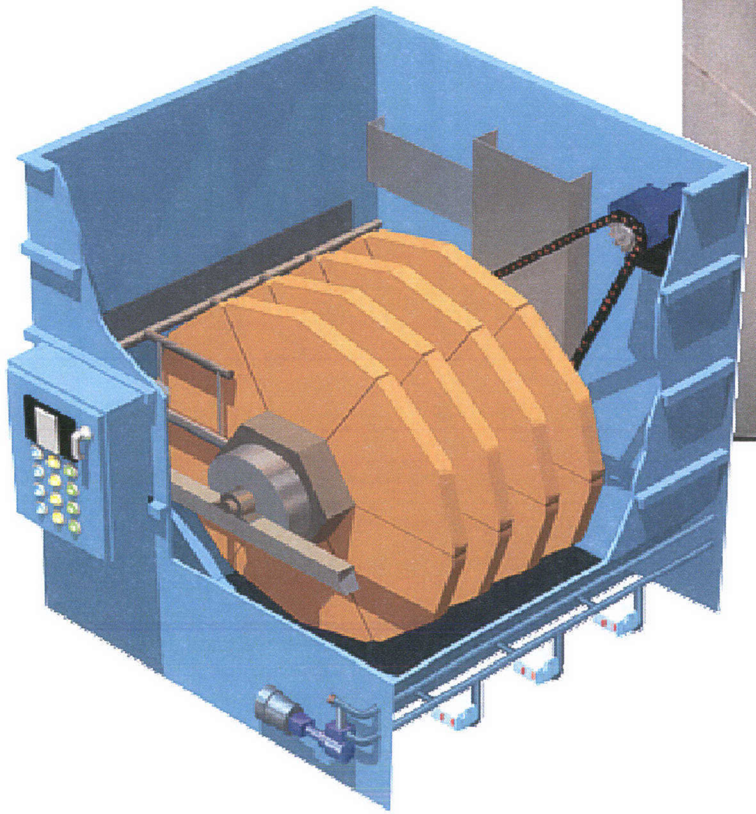
- Higher hydraulic throughput
- Generally upflow

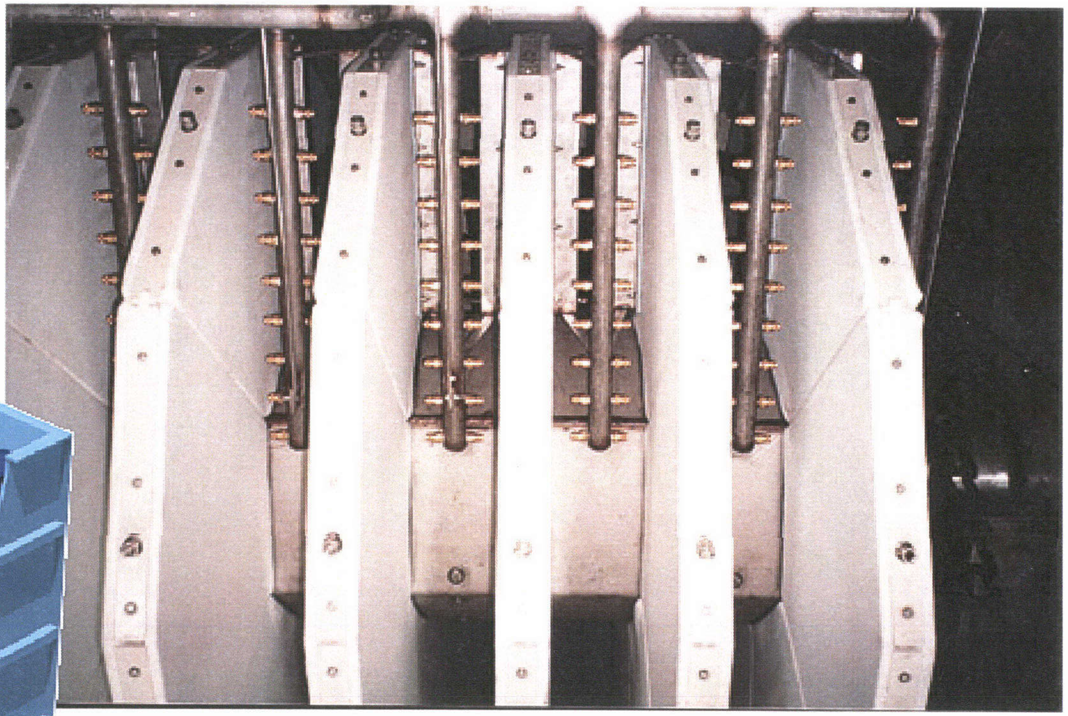
Disadvantages

- Typically used at smaller plants
- Limited manufactures
- Maintenance intensive (upflow)

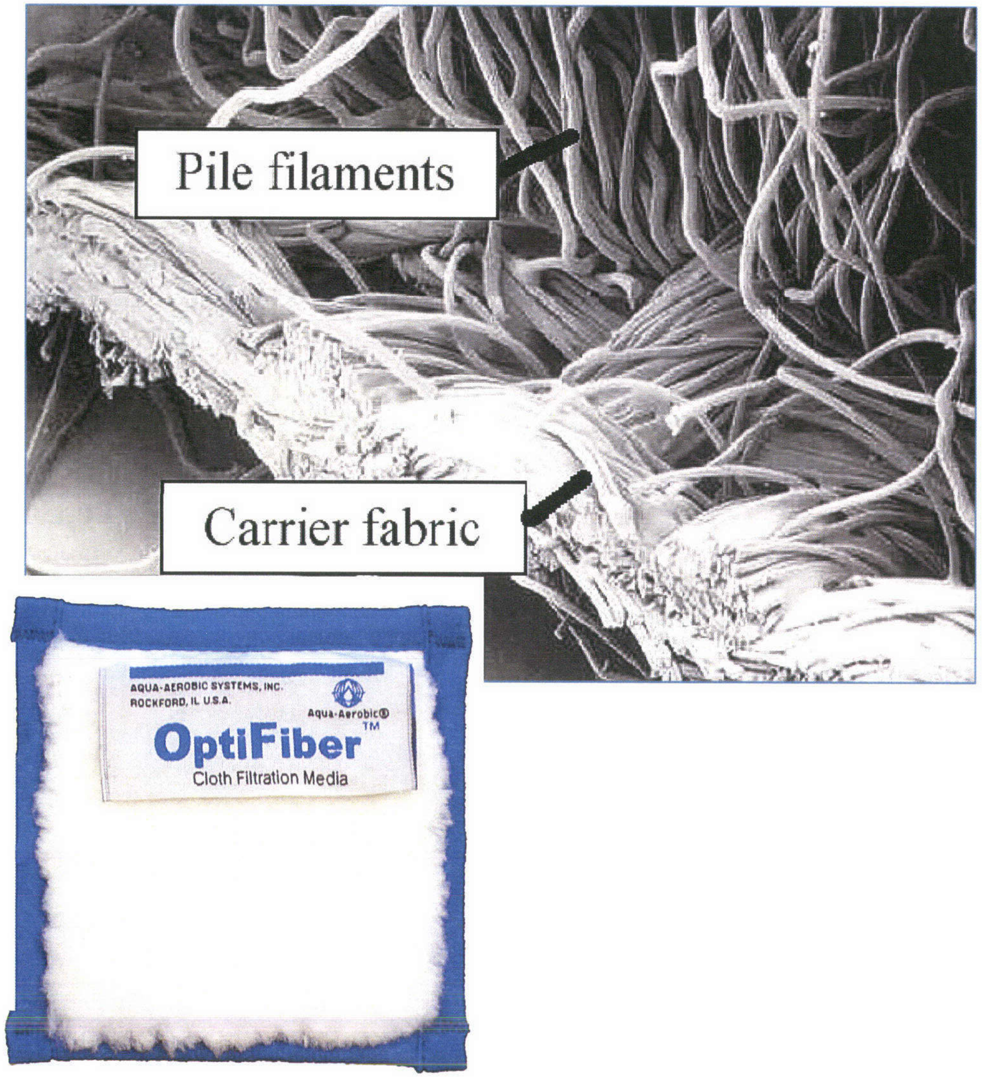
SURFACE FILTRATION

DISC CLOTH MEDIA FILTERS





CLOTH MEDIA — THE KEY COMPONENT



DISC CLOTH MEDIA FILTER

Advantages

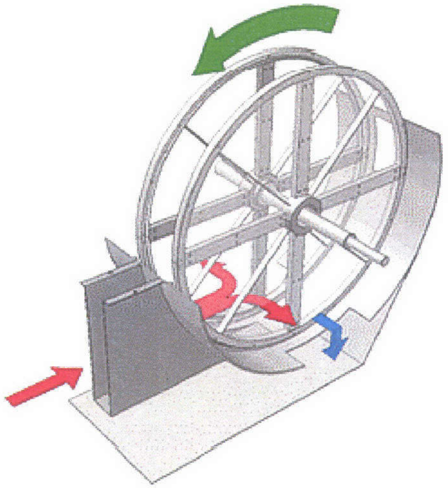
- Easy to retrofit into existing facilities
- Automatic backwash operation
- Low headloss through filter compared to conventional

Disadvantages

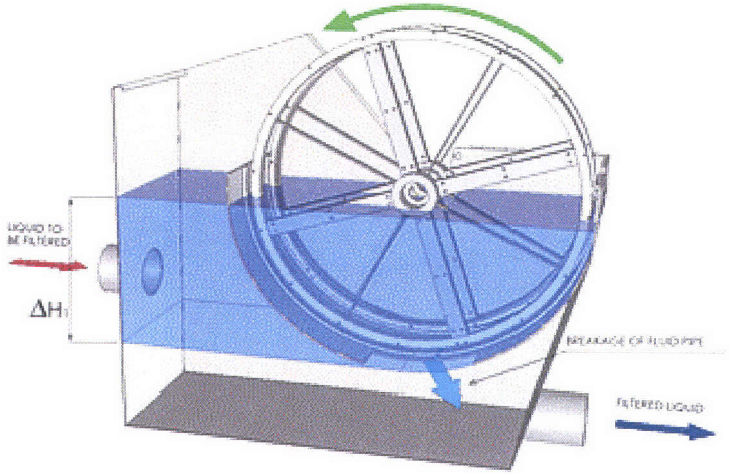
- Media replacement
- Hydraulics
- More mechanical equipment

MICROFILTER — NOVA

The Ultrascreen Microfilter®
Flow Patterns



The Ultrascreen Microfilter®
Disk Submergence



Advantages

- Stainless steel fabric
- Automatic backwash operation

Disadvantage

- Not fully proven technology
- Limited installation
- Maintenance history unknown

DISCUSSION AND EVALUATION

RELATIVE COST COMPARISON

	Cost	O&M					
Conventional							
Traveling Bridge							
Upflow							
Cloth Media							
Compressible Media							
Nova							
Microfiltration							
Reverse Osmosis							

Building a **world** of difference.®

Together

BLACK & VEATCH

ATTACHMENT TM2-B
WWETCO FILTER TECHNOLOGY EVALUATION

Introduction

A number of alternative filtration technologies were discussed at the alternative technology workshop held on June 9, 2011. One of the technologies was the WWETCO Flexfilter manufactured by Westech. The purpose of this memo is to provide City of Austin staff additional information on this technology and make a recommendation regarding whether or not this type of filter should be included as an alternative to granular filtration as part of the Walnut Creek WWTP Filter Improvements. Attached for additional information is (1) a copy of the brochure provided by the manufacture and (2) a 3D rendering of the implementation of the WWETCO filter into one of the filter boxes at the Walnut Creek WWTP.

Description of the Technology

Typically compressible fiber media is placed between two plates. In the WWETCO Flexfilter the water flows down through the media. The porosity of the filter media can be adjusted by changing the compression level of the media. Fluid flows through the media as opposed to around the media in conventional filters. Significantly higher surface loadings are possible due to the porosity of the media. These filters are design based on a peak hydraulic loading rates between 20 to 30 gpm/sf with average rates around 6 gpm/sf based on achieving reuse quality effluent. The depth of the media bed is typically in the range of 24 to 30 inches. During a backwash cycle, the compression plates are opened allowing the media to expand. The WWETCO Flexfilter uses pressure on a synthetic bladder to cause the media to expand during backwashing The direction of flow in the filter is reversed and air is introduced to help scour the media. A typical backwash rate is approximately 10 gpm for 30 minutes. Figure 1 shows the WWETCO Flexfilter in filtration and backwash modes.

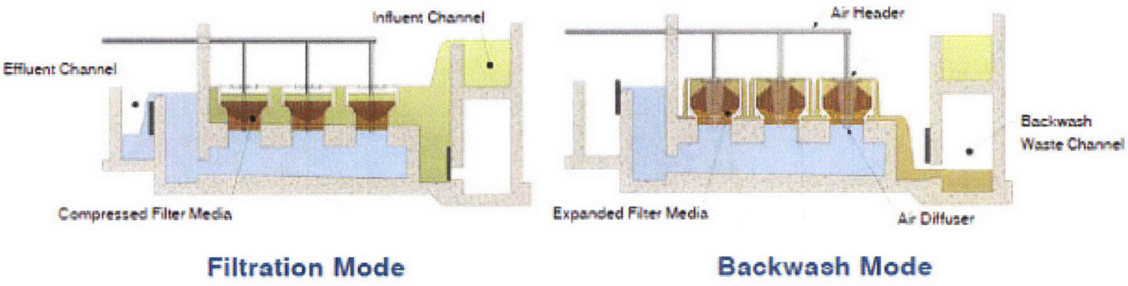


Figure 1 – WWETCO Flexfilter

Conditional Acceptance by the State of California

The state of California has a program to evaluate new technologies to be used in reuse application within the State. This program includes testing of filtration equipment to determine whether or not the equipment is capable of the same performance as granular media filtration. If the equipment passes the test, it receives a conditional acceptance for use in treatment plants that produce reuse water. The WWETCO Flexfilter has not been tested nor has it received conditional acceptance by the California Department of Public Health. The upflow version of this technology, the "Fuzzy Filter" manufactured by Scrieber, does have conditional acceptance for reuse applications in the state of California.

Installations

Currently a 100 mgd WWETCO filter system for high rate treatment of combined sewer overflows is being designed for the City of Springfield, OH. A full installation list is being obtained from the manufacturer.

Summary of Advantages and Disadvantages

Advantages of the WWETCO Flexfilter System:

- Higher hydraulic throughputs rates compared to conventional filter systems (up to an average rate of 5 gpm/sf with a peak of 10.6 gpm/sf)
- No mechanical parts within the filter
- Lower percent of backwash water used compared to other filtration sytems
- Can handle higher solids loading and maintain effluent quality

Disadvantages of the WWETCO Flexfilter System:

- Few large installations
- No experience at the design flowrates for the Walnut Creek system
- Limited long term maintenance requirements

Recommendation

The WWETCO Flexfilter appears to be a promising filtration technology. If the City wishes to collect additional information the following are recommended:

1. A Trip be made to Columbus, GA to visit an operating WWETCO filter system.
2. Conduct a full scale demonstration study to assess operating and maintenance requirements.

However, due to the limited schedule, it may not be possible to conduct the site visit or the demonstration study. If it is not possible to conduct these items, then it recommended that the WWETCO Flexfilter manufactured by WesTech ***not*** be considered for further evaluation for this project due to a lack of experience at the flow rates at the Walnut Creek plant, increased maintenance requirements, and increased power requirements.

ATTACHMENT TM2-C
NOVA FILTER TECHNOLOGY EVALUATION

Introduction

A wide range of filtration technologies were discussed at the filtration alternative workshop held on June 9, 2011. One of the technologies was the Ultrascreen Disk Filter manufactured by NOVA water Technologies, LLC. The purpose of this memo is to provide City of Austin staff additional information on the this technology and offer a recommendation on whether it should be included as one of the alternative technologies that will be compared to granular filtration as part of the Walnut Creek WWTP Filter Improvements Project. Attached for additional information is (1) a copy of the brochure provided by the manufacture and (2) a copy the slides presented to Black & Veatch at a seminar on June 16, 2011.

Description of the Technology

The Ultrascreen Filter is an "inside to out" disk filter system. This means that the flow to be filtered enters between the disks on the inside and the filtered water is on the outside of the disks. The disks rotate continuously as shown in Figure 1.

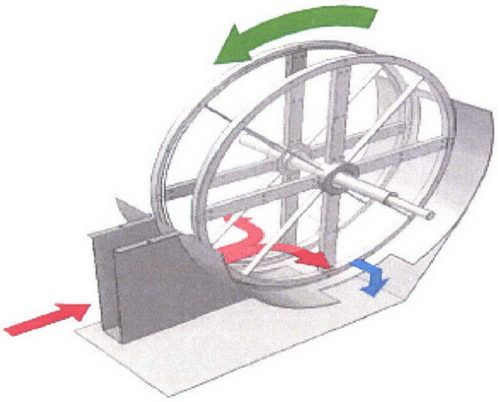


Figure 1 Isometric View of Ultrascreen Filter

This filter utilizes the principle of "dynamic tangential filtration." Dynamic tangential filtration means that with the rotation of the disks allows for higher hydraulic throughput compared to static cloth media disk systems. The Nova system contains multiple disk units similar to other disk filter systems. One disk unit is comprised of two disk units with approximately 24 inches separating each disk. Each disk unit is composed of 6 parts similar to other disk systems. The major difference between the Ultrascreen and other cloth systems is that the media is a stainless steel mesh. Maintenance of the filter is simplified because each disk is composed of multiple pieces.

Since the area between each disk is open, this configuration allows for easy access to remove debris that accumulates upstream of the disk. This open area between disk units also allows room for a backwash channel that conveys backwash solids removed from the disks to waste. As headloss builds up on the media a backwash cycle is initiated by the use of two level sensors. When the water level inside the disk unit reaches the high level sensor, a backwash cycle is initiated. Spray nozzles located on the outside of the media spray clean water through the media removing the captured material on the inside of the filter disk. Source water for each backwash water is either filtered water or other non-potable water sources. If filtered water is used, a solids strainer needs to be used to protect the backwash nozzles from plugging. Backwash water is sprayed from the outside of the filter to the inside of the filter to clean the media. Water from backwashing is collected in a trough located in the open area between each disk and is connected to a main backwash channel to remove the backwashed solids. Based on the design of the filter, all rotating bearings are located above the water level.

Conditional Acceptance by the State of California

The state of California has a program to evaluate new technologies to be used for reuse application within the State. This program allows filtration equipment to receive "conditional acceptance" and be used for treatment of reuse water within the state. The testing conducted as part of this program is designed to demonstrate that the equipment is capable of the same performance as granular media filtration. The Ultrascreen filter has been tested and received conditional acceptance by the California Department of Public Health.

Conditions of the acceptance by the California Department of Public Health include:

1. Filter screen specified as AISI 316 steel micronic screen mesh with a nominal size rating of 20 microns (down to 10 micron when using "dynamic tangential filtration".

2. Filtration rate not to exceed 6 gpm/ft2 when complimented with a disinfection process which has been demonstrated to achieve **4-log** inactivation of plaque-forming units of F-specific bacteriophage MS2, or polio virus, in the filtered wastewater.

3. Filtration rate not to exceed 16 gpm/ft2 when complimented with a disinfection process which has been demonstrated to achieve **5-log** inactivation of plaque forming units of F-specific bacteriophage MS2, or polio virus in the filtered wastewater.

4. Required schedule of inspection and assessment of the screen condition.

5. Operations plans shall provide for assurances that adequate sludge wasting is practiced to ensure against excessive solids buildup in the filter vessel.

Installations

The manufacture indicates that 36 of these system have been installed or being installed in the US. Of these installations only one has a design capacity greater than 20 mgd. The production office for Nova is located in the Jacksonville, FL area with 5 of the operating filter systems being local to the Jacksonville area.

Summary of Advantages and Disadvantages

Advantages of the Nova Filtration System:

- Higher hydraulic throughputs rates (up to average rate of 6 gpm/sf with a peak of 16 gpm/sf)
- Long life with stainless steel materials of construction
- Lower percent of backwash water used compared to other filtration systems

Disadvantages of the Nova Filtration System:

- Few large installations
- No experience at the design flowrates for the Walnut Creek system
- Limited long term maintenance requirements
- Maintenance of auxiliary equipment

Recommendation

The Ultrascreen filter appears to be an promising filtration technology. If the City wishes to collect additional information the following are recommended:

1. A trip be made to Jacksonville, Fl to visit the Nova production facility and operating filter systems in the Jacksonville area.
2. Conduct a full scale demonstration study to assess operating and maintenance requirements.

However, due to the limited schedule, it may not be possible to conduct the site visit or the demonstration study. If it is not possible to conduct these items, then it is recommended that the Ultrascreen Filter manufactured by Nova ***not*** be considered for further evaluation in this project due to lack of experience with this technology for plants as large as the Walnut Creek plant, increased maintenance requirements, and increased power requirements.

ATTACHMENT TM2-D
AQUA-AEROBIC, INC. PROCESS DESIGN REPORT

PROCESS DESIGN REPORT

AQUA-AEROBIC
SYSTEMS, INC.

AUSTIN CITY OF - WALNUT CREEK TX

Design#: 128917

Option: Preliminary Design

Designed By: Eric Roundy on Tuesday, July 12, 2011

Design Notes

Filtration

- The cloth media filter recommendation is based upon the following conditions (as shown on the design sheet): 15 mg/l average daily influent TSS, 20 mg/l peak influent TSS, and an acceptable upstream process such as an activated sludge plant with a minimum of SRT of 5 days.

- The anticipated filtered effluent quality is based on the filter influent conditions as shown under "Design Parameters" of this Process Design Report. In addition, the filter influent should be free of algae and other colloidal solids that are not filterable through a nominal 10 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- The anticipated effluent quality is based upon filterable influent solids.

- For this application, pile filter cloth is recommended, which has a nominal pore size of 10 microns.

- A minimum of twelve (12) composite samples per month shall be obtained for turbidity analysis.

- The following filter recommendation has been designed in accordance with the Texas Administrative Code Chapter 210.33 related to reclaimed water. The cloth media filters shall provide a 30 day average filtered effluent of 3 NTU or less.

Equipment

- Aqua-Aerobic Systems, Inc. (AASI) is familiar with the Buy American provision of the American Recovery and Reinvestment Act of 2009 as well as other Buy American provisions (i.e. FAR 52.225, EXIM Bank, USAid, etc.). AASI can provide a system that is in full compliance with Buy American provisions. As the project develops AASI can work with you to ensure full compliance with a Buy American provision, if required. Please contact the factory should compliance with a Buy American provision be required.

AquaDISK Tertiary Filtration - Design Summary

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment: Secondary

Avg. Design Flow	= 75 MGD	= 52083.33 gpm	= 283500 m³/day
Max Design Flow	= 120 MGD	= 83333.3 gpm	= 453600 m³/day

			Effluent			
DESIGN PARAMETERS	**Influent**	**mg/l**	**Required**	**<= mg/l**	**Anticipated**	**<= mg/l**
Avg. Total Suspended Solids:	TSSa	15	--	--	--	--
Max. Total Suspended Solids:	TSSm	20	--	--	--	--
***Turbidity:**	--	--	NTU	3	NTU	3

*Note: Tubidity represented in Nephelometric Turbidity Units (NTU's) in lieu of mg/l.

AquaDISK FILTER RECOMMENDATION

Qty Of Filter Units Recommended = 24
Number Of Disks Per Unit = 12
Total Number Of Disks Recommended = 288
Total Filter Area Provided = 15494.4 ft² = (1439.48 m²)
Filter Model Recommended = AquaDisk Concrete: Model ADFSC-54 x 12E-PC

AquaDISK FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash.

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 52083.3 / 15494.4 ft²
= 3.36 gpm/ft² (2.29 l/s/m²) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 83333.3 / 15494.4 ft²
= 5.38 gpm/ft² (3.66 l/s/m²) at Max. Flow

Solids Loading:

Solids Loading Rate = (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 20016 lbs/day / 15494.4 ft²
= 1.29 lbs. TSS /day/ft² (6.30 kg. TSS/day/m²)

Equipment Summary

Cloth Media Filters

AquaDisk Tanks/Basins

24 AquaDisk Model # ADFSC-54x12E-PC Concrete Filter Basin Accessories consisting of:

- Concrete basin(s) (by others).
- 304 stainless steel support brackets.
- Effluent seal plate weldment.
- 316 stainless steel anchors.

24 Effluent Weir Installation(s) consisting of:

- Effluent weir(s).
- 316 stainless steel anchors.

AquaDisk Centertube Assemblies

24 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- 304 stainless steel centertube support beam(s).
- Centertube bearing kit(s).
- Effluent centertube lip seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Neoprene media sealing gaskets.
- Cloth will be chlorine resistant.

AquaDisk Drive Assemblies

24 Drive System(s) consisting of:

- Gearbox with motor.
- Drive spocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- 316 stainless steel anchors.
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

24 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.
- 304 stainless steel backwash collection manifold(s).
- 304 stainless steel union(s).
- PVC solids manifold installation(s).

12 Backwash/Solids Waste Pump(s) consisting of:

- Centrifugal pump with 7.5 HP, 3 ph. motor.
- 316 stainless steel anchors.
- 0 to 15 psi pressure gauge(s).

- 0 to 30 inches mercury vacuum gauge(s).

AquaDisk Instrumentation

12 Pressure Transducer Assembly(ies) each consisting of:

- Mounting bracket weldment(s).
- Transducer pipe weldment(s).
- Pressure transducer(s).
- Aneroid bellows.
- Stainless steel anchor kit(s).
- Nylon electrical cable tie wrap(s).

12 Vacuum Gauge(s) with Transmitter(s) consisting of:

- Vacuum transmitter(s).
- 0 to 30 inches mercury vacuum gauge(s).
- 1/4" Threaded bronze ball valve.

12 Float Switch(es) consisting of:

- Float switch mounting bracket(s).
- Float switch(es).
- Stainless steel anchor kit(s).

6 Flow Meter(s) will be provided as follows:

- 8" magnetic flow-meter and converter(s).

AquaDisk Valves

12 Set(s) of Backwash Valves consisting of:

- 4 inch (102mm) diameter Milliken 601-N0 electrically operated eccentric plug valve(s) with 125# (57kg) flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with a Auma SG07, 220 VAC, 50 hz, single phase open/close service electric actuator. Valve actuator includes local controls and compartment heater.

12 Solids Waste Valve(s) consisting of:

- 4 inch (102mm) diameter Milliken 601-N0 electrically operated eccentric plug valve(s) with 125# (57kg) flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with a Auma SG07, 220 VAC, 50 hz, single phase open/close service electric actuator. Valve actuator includes local controls and compartment heater.

AquaDisk Controls w/Starters

12 Control Panel(s) consisting of:

- Selector switch(es).
- Circuit breaker with handle.
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Indicating pilot light(s).
- MicroLogix 1400 PLC(s).
- Ethernet switch(es).
- Power supply(ies).
- Operator interface(s).
- Motor starter(s).
- Terminal blocks.
- UL label(s).
- Air conditioner(s).
- 7 1/2 HP VFD(s).

AquaDISK: Operation & Maintenance Requirements Design# 128917

AQUA-AEROBIC SYSTEMS, INC.

Project: AUSTIN CITY OF - WALNUT CREEK TX

Qty / Model#: 24 / ADFSC54x12E-PC

Description: AquaDisk Concrete: Model ADFSC-54 x 12E-PC

Avg Flow (Gal): 75,000,000.00

Influent TSS (mg/l): 15

Qty Of Disks Per Unit: 12

Area Provided/Disk: 53.8

I. LUBRICATION REQUIREMENTS

	# of Units		Minutes/Unit		Times/Year		Hours/Year
1) Backwash / Solids Waste Pump - Routine Lubrication:	48	x	5	x	12	/ 60 =	48.00
2) Backwash / Solids Waste Pump - Drain and Refill:	48	x	30	x	1	/ 60 =	24.00
3) Drive Gear Box:	24	x	30	x	0.25	/ 60 =	3.00
4) Drive Motor:	24	x	5	x	0.25	/ 60 =	0.50
						TOTAL LUBRICATION REQUIREMENTS:	75.50

II. PARTS REPLACEMENT

	Replace Interval (Years)	# of Units		Minutes/Unit		Hours Per Replacement	Material Cost Per Unit	Total Material Cost
1) Main "V-Ring" Seal:	10	24	x	240	=	96.0	$ 1,003	$ 24,072
2) Filter Media Cloths (6/Disks):	7	1728	x	15	=	432.0	$ 269	$ 464,832

III. POWER CONSUMPTION

1) Backwash / Solids Waste Pump (Kw Hours/Year): 132,668.0

2) Disk Drive Motor (Kw Hours/Year): 21,597.1

ITEM WEIGHTS
EFFLUENT SEAL PLATE = 217 LBS.
CENTERTUBE = 1073 LBS.
EFFLUENT WEIR WELDMENT = 450 LBS.
DRIVE MOTOR ASSEMBLY = 310 LBS.
DISK SEGMENT ASSEMBLY = 24 LBS.
PUMP WITH MOTOR MOUNTED ON BASE = APPROX. 325 LBS.

1. DRAWING FOR REFERENCE ONLY.
ALL NEW WALLS ARE SHOWN AT 1'.
ALL DIMENSIONS TO BE VERIFIED BY CUSTOMER.
2. AQUA-AEROBIC SYSTEMS PROVIDES PUMPS AND VALVES LOOSE FOR INSTALLATION BY THE INSTALLING CONTRACTOR. ALL INTERCONNECTING PIPING, WIRING, AND WALL SPOOL PIPES ARE PROVIDED BY THE INSTALLING CONTRACTOR.
3. IF FREEZING IS A CONCERN, AQUA-AEROBIC SYSTEMS RECOMMENDS THE FILTERS BE PLACED IN A HEATED BUILDING. IF A BUILDING IS NOT PROVIDED, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO, HEAT TRACING AND INSULATION OF PUMPS AND PIPING, AS WELL AS PROTECTION AGAINST INTERNAL TANK FREEZING, SHALL BE PROVIDED BY THE INSTALLING CONTRACTOR.
4. THE GRAPHIC ELEMENTS OF THIS COMPUTER GENERATED DRAWING ARE DRAWN FULL SIZE. THE DIMENSIONS ARE ASSOCIATIVE. IF THE SIZE OF THE GRAPHIC ELEMENTS IS CHANGED THE DIMENSIONS WILL NOT BE CORRECT.
5. AN INFLUENT VALVE IS REQUIRED FOR ISOLATION / MAINTENCE OF EACH FILTER UNIT. INFLUENT VALVES SHALL BE PROVIDED BY OTHERS AND INSTALLED BY OTHERS.
6. WALL SPOOL PIPING SHALL BE STAINLESS STEEL. PROVIDED BY OTHERS AND INSTALLED BY OTHERS.

JOB NAME: CITY OF AUSTIN - WALNUT CREEK
JOB LOCATION: TEXAS

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
B		07/12/2011	DAL	REDESIGNED PER CUSTOMER REQUEST
A		06/29/2011	DAL	WAS: (2) PUMPS / (7) VALVES

AQUA-AEROBIC SYSTEMS, INC.

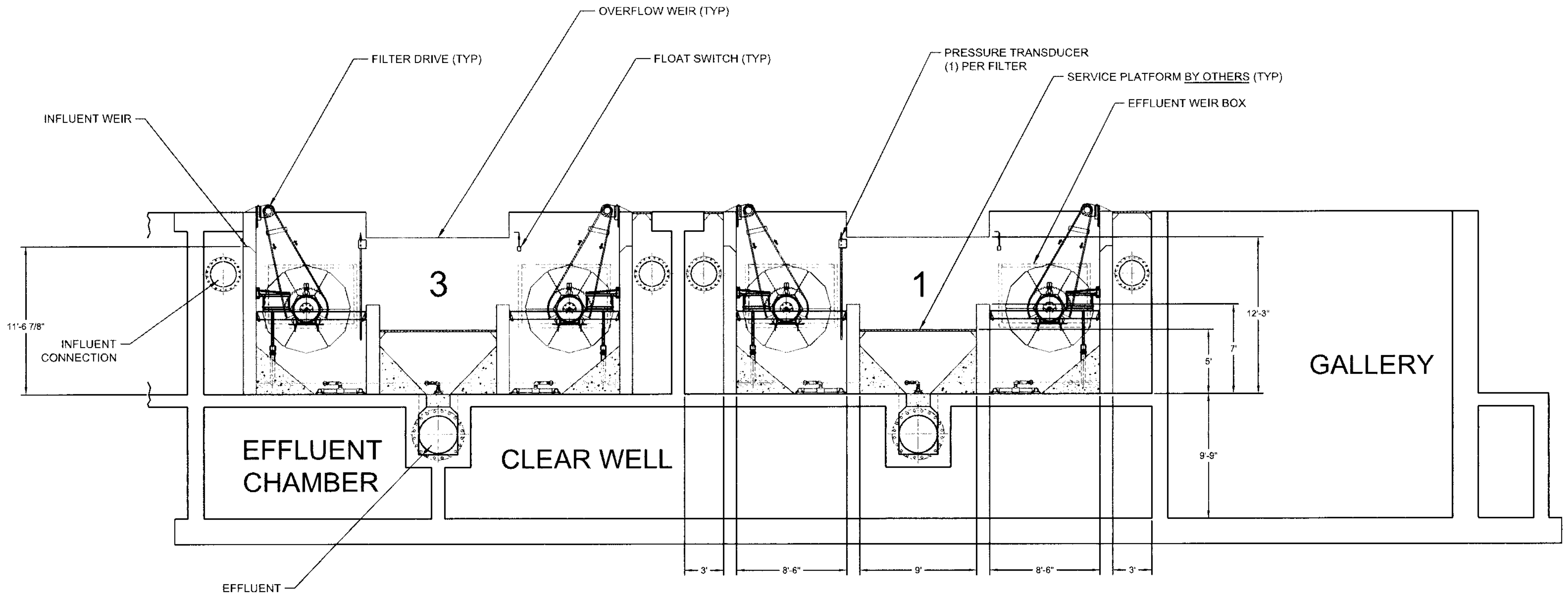
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED

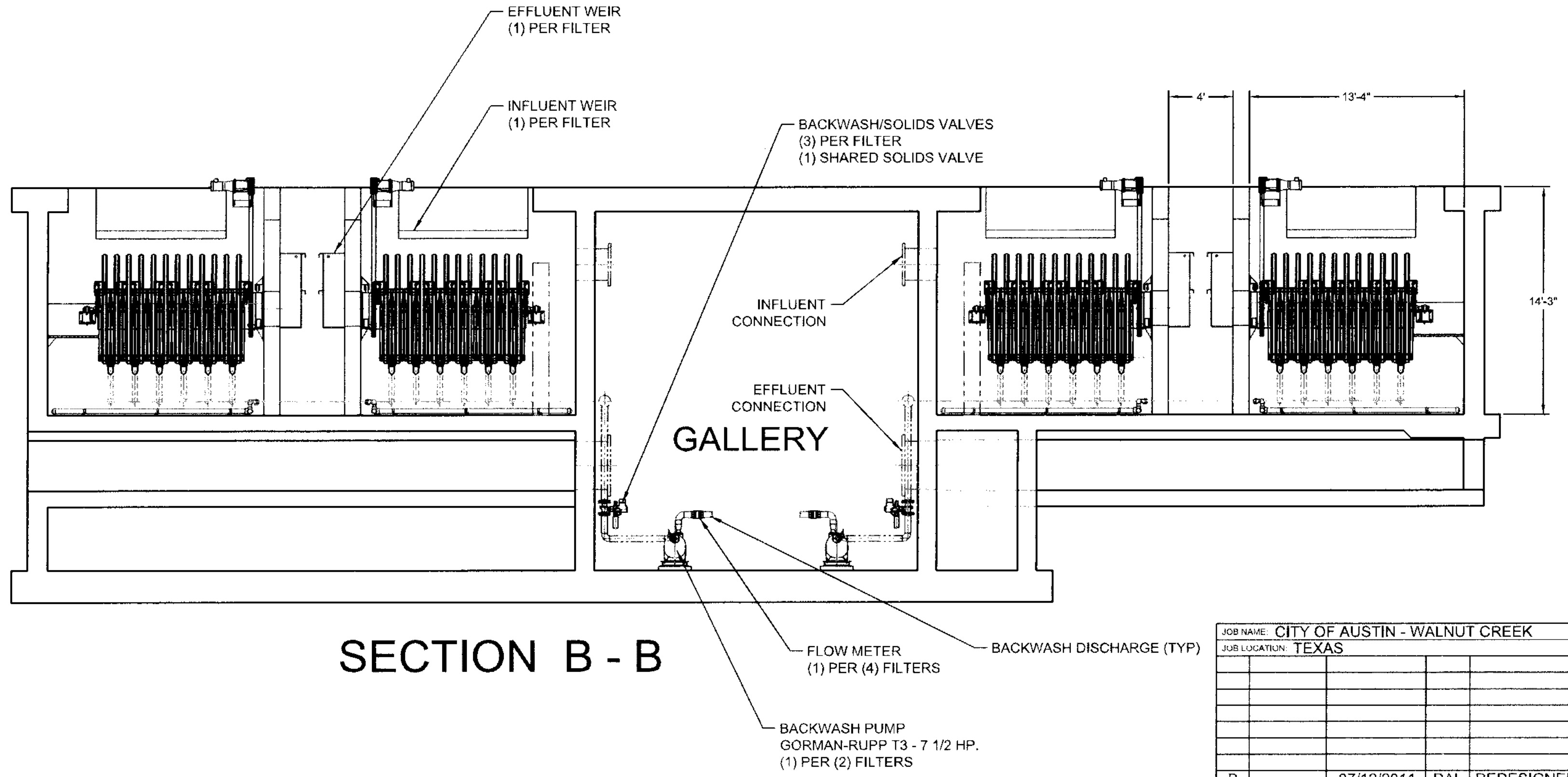
ANSI

MATERIAL:
SIMILAR TO: 2801942
TYPE: TYPE-S AQUADISK
DRAWN BY: DAL DATE: 06/21/2011
CHECKED BY: DATE:
WEIGHT: SHEET: 1 OF

DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 12E-PC RETRO-FIT DESIGN
DRAWING NUMBER: 81118076001
SCALE: 1:1
SIZE: D



SECTION A - A



SECTION B - B

JOB NAME: CITY OF AUSTIN - WALNUT CREEK
JOB LOCATION: TEXAS

AQUA-AEROBIC SYSTEMS, INC.

DO NOT SCALE DRAWING
UNLESS OTHERWISE SPECIFIED
ANSI

REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
B		07/12/2011	DAL	REDESIGNED PER CUSTOMER REQUEST
A		06/29/2011	DAL	WAS: (2) PUMPS / (7) VALVES

MATERIAL:
SIMILAR TO: 2801942
TYPE: TYPE-S AQUADISK
DRAWN BY: DAL DATE: 06/21/2011
CHECKED BY: DATE:
WEIGHT: SHEET: 1 OF
DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 12E-PC RETRO-FIT DESIGN
DRAWING NUMBER: 81118076002
SCALE: 1:1
SIZE: D

ATTACHMENT TM2-E
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

1.0 Overview

Engineer's Opinions of Probable Construction Cost (EOPC's) have been developed for the two alternative filtration technologies described within TM2 Alternative Filtration Technologies (TM2).

2.0 EOPC Methodology

The project improvements discussed in TM2 are at the conceptual level of development and as such, do not provide the level of design detail required for estimating on the basis of detailed quantities and unit pricing. However, the vendors who supply this equipment have provided detailed scopes of services with budget pricing. The proposals include drawings that describe the work required to implement each of these technologies. As a result, the estimates have been developed from a combination of the following estimating resources and references and adjusted, as appropriate, to provide results that represent a conservative level of cost relative to current pricing in the construction industry.

- Current budget price quotations from vendors for process equipment. In addition to the cost of equipment, the cost of equipment installation is accounted for based on a percentage of the equipment cost. In general, for all equipment except electrical equipment, the installation percentage used is 40 percent. This amount is adjusted up or down as appropriate for the amount of labor, materials and equipment anticipated for the installation.

- Allowance for electrical equipment installation has been developed based on 35 percent of the equipment and materials listed in Divisions 15 and 16. Electrical equipment cost represents an approximation of miscellaneous items electrical equipment and materials as well as the labor required to connect and start-up the equipment.

- Cost references for materials and commodities available from cost estimates for other water and wastewater related projects that have been prepared within the last several months.

- Cost references for labor and materials, equipment rental, construction aids, etc. available from building and heavy construction cost data published annually by RS Means.

- Where other references where not available, certain costs have been estimated based on previous experience and engineering judgment.

3.0 Estimate Components

The individual EOPCs have been organized and costs have been listed in accordance with the standard Construction Specification Institute (CSI) specification divisions. In addition to the base cost of equipment, labor and materials, contractors direct and indirect costs associated with contract and general requirements as well as overhead and profit have been accounted for as a single line item estimated at 20 percent of the base cost. Finally, given that the design is still in the conceptual stages of development, an overall project contingency of 40 percent has been applied to each of the cost estimates to conservatively account for the many unknowns inherent in a project in the early stages of development. The effective estimate date is July 2011.

Estimates for Operation and Maintenance Costs associated with the various alternatives have been prepared based on the assumptions given in TM2 and the anticipated operation of equipment when the facility is operating at capacity.

4.0 Attachments

The EOPCs for the two alternatives are attached as one page designated "Summary" in the footer. The Operation and Maintenance Costs for the various alternatives are attached as two pages following the EOPCs.

BLACK & VEATCH

CITY OF AUSTIN
WALNUT CREEK WWTP FILTER IMPROVEMENTS
ALTERNATIVE FILTRATION TECHNOLOGIES

APPENDIX TM2-E PROBABLE CONSTRUCTION COST
July 16, 2011

SUMMARY OF ALTERNATIVE COSTS

Description	$
Cloth Filter Alternative	
Division 2 - Sitework and Demolition	361,000
Division 3 - Concrete	606,900
Division 4 through 9 - Filter Superstructure & Misc Metals	1,065,500
Division 13 - Special Construction (Aqua Aerobics Equipment)	8,680,000
Division 15 - Mechanical	355,900
Division 16 - Electrical	159,900
Subtotal	**11,229,200**
General Conditions/Overhead and Profit (20%)	2,245,800
Contingency (40%)	5,390,000
Total Construction Cost	**18,865,000**
Cloth Filter Alternative	
Division 2 - Sitework and Demolition	361,000
Division 3 - Concrete	187,100
Division 4 through 9 - Filter Superstructure & Misc Metals	1,431,300
Division 13 - Special Construction (NOVA Equipment)	7,560,000
Division 15 - Mechanical	265,900
Division 16 - Electrical	123,800
Subtotal	**9,929,100**
General Conditions/Overhead and Profit (20%)	1,985,800
Contingency (40%)	4,766,000
Total Construction Cost	**16,680,900**

Annual Operation and Maintenance Costs
Cloth Media Filter Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation							
Total Volume of Backwash water	1.500		mgd				2% of 75 mgd
Electrical Costs							
Item	**Quantity**	**Size**	**Units**	**Demand Factor**	**Ave kW-hr**	**Annual Cost**	**Comments**
Backwash Pump	12	5.5	kw	25.0%	16.5	$14,900	Estimate from Aqua Aerobics
Disk Drive	12	0.9	kw	25.0%	2.7	$2,400	Estimate from Aqua Aerobics
Settled Water Pumping	1	1.500	mgd	100.0%	7.4	$6,700	Assumed head = 30 ft, Eff = 80%
Subtotal					27	$24,000	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	31	lb/day	$0.23	$2,600	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$26,600**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff	1460	$27.11	$39,600	4 hours per day split between shifts
Maintenance Staff - Routine	416	$27.11	$11,300	8 hours per day, 1 day per week
Maintenance Staff - Filter Media Cloth	63	$27.11	$1,700	42 disks/year at 1.5 hrs/disk
Maintenance Staff - Main V-ring Seal	10	$27.11	$300	2.5 units/year at 4 hrs/unit
Annual Labor Cost			**$52,900**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Filter Cloth Media	42	disks	$1,641.00	$68,900	Filter Cloth only
Filter Influent Valves	1%	percent	$233,000.00	$2,300	1% of new equipment cost each year
Main V-ring Seal	2.5	units	$1,000.00	$2,500	Material Only
Annual Replacement Parts and Materials				**$73,700**	
Total Annual Operation and Maintenance Costs				**$153,200**	

Annual Operation and Maintenance Costs
NOVA Ultrafilter Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Total Volume of Backwash water	0.750		mgd				1% of 75 mgd

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pump	14	7.5	kw	20.0%	21.0	$19,000	Estimate from NOVA
Disk Drive	14	9.0	kw	100.0%	126.0	$114,000	Estimate from NOVA
Settled Water Pumping	1	0.75	mgd	100.0%	3.7	$3,300	Assumed head = 30 ft, Eff = 80%
Subtotal					151	$136,300	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	16	lb/day	$0.23	$1,300	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$137,600**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff	1460	$27.11	$39,600	4 hours per day split between shifts
Maintenance Staff - Routine	416	$27.11	$11,300	8 hours per day, 1 day per week
Maintenance Staff - Filter Panel Replacement	88	$27.11	$2,400	22 disks/year at 4 hrs/disk
Maintenance Staff - Lateral Seal Replacement	68	$27.11	$1,800	34 sets/year at 2 hrs/set
Maintenance Staff - Spray Nozzles	275	$27.11	$7,500	550 units/year at 0.5 hrs/unit
Annual Labor Cost			**$62,600**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Filter Panel Replacement	22	disks	$2,400.00	$52,800	Stainless Steel Disks Complete
Filter Influent Valves	1%	percent	$233,000.00	$2,300	1% of new equipment cost each year
Filter Lateral Seals	34.0	units	$450.00	$15,300	Material Only
Filter Spray Nozzles	550.0	units	$30.00	$16,500	Material Only
Annual Replacement Parts and Materials				**$86,900**	
Total Annual Operation and Maintenance Costs				**$287,100**	

ATTACHMENT TM2-F
NOVA WATER TECHNOLOGIES PRELIMINARY DESIGN REPORT

Nova Water Technologies
Ultrascreen® Disk Filter

To:
Black & Veatch

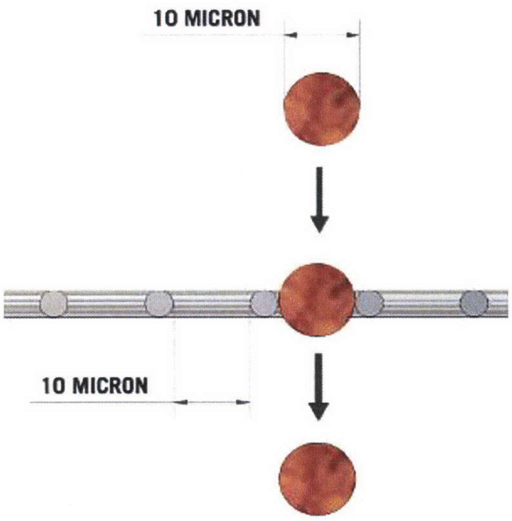
For:
Walnut Creek WWTP - Austin, TX

1.0 Introduction

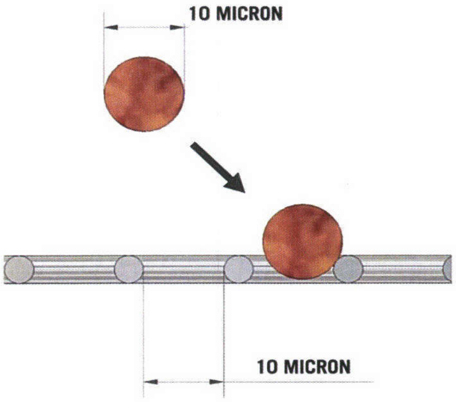
NOVA Water Technologies is pleased to offer equipment and services in accordance with our standard features. The basis of this proposal is compliant with the standard NOVA Water performance specifications and materials in 304 stainless steel. This proposal uses our Model UL1612CS disk filter.

2.0 Principle of Operation

The disks are always in slow rotation during normal operation. The water with TSS is fed at angles less than 90°, which is the basis for "dynamic tangential filtration." The rotation allows use of precision woven wire Stainless Steel micronic mesh, with micron ratings typically between 15 and 25 microns. The disk rotation presents these openings as if they were actually smaller than in a static orientation. This allows for the removal of particles smaller than 10 micron, while requiring minimal water for cleaning. This allows the unit to operate at higher loading rates and achieve equivalent effluent quality compared to static disk filters. This same principle has been proven consistently in the operation of rotatory drum screens, as on example.



Static Filtration – Particle Path



Dynamic Tangential Filtration – Particle Path

3.0 Mechanical Principles

The feed to the disks is introduced into a zone between, or "inside", each set of disks (see Figure No. 1 below). Each disk is sealed to the walls of the tank by long lasting EPDM rubber seals to maintain filtration integrity and to prevent any short-circuiting. The feed passes through the filter mesh and freely falls into the filtrate zone below (Figure No. 2) and flows out of the effluent outlet. As TSS is captured the liquid level in the feed zone rises until it reaches a pre-set level. A sensor then initiates operation of the wash water pump and the back of the screen mesh is sprayed by low pressure water at 2 to 4 bar for typically one minute. Once the mesh is cleaned the level in the feed zone recedes to another pre-set level where a second level sensor deactivates the wash water pump. All of the solids cleaned from the fine filtration mesh are collected in a simple trough between the disks and leaves the filter under gravity flow. The reject troughs are connected to a common outlet and the concentrated wash water (reject) is sent for further treatment.

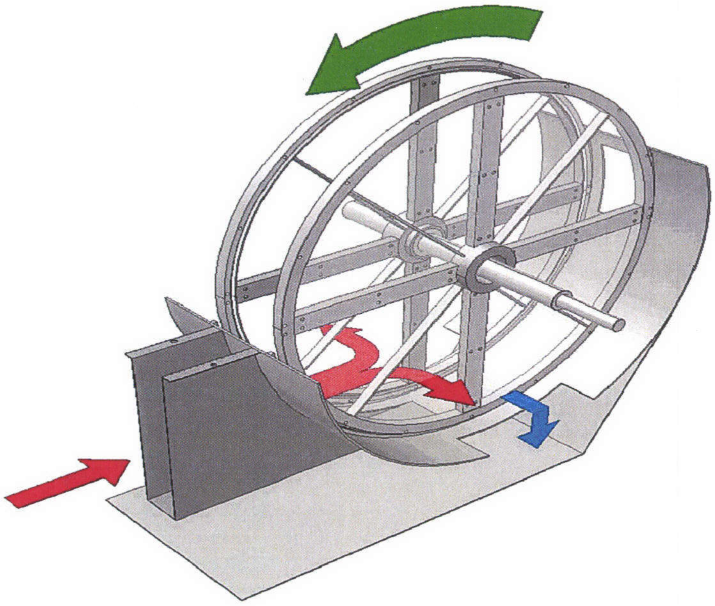


Figure No. 1
The filtration disks are arranged in pairs as show above

The level sensor is also used for turning the filter itself on and off. At low level the filter is de-energized and allowed to remain in a “filter ready” idle mode. This may occur in smaller plants during low flow periods of time. Once flow resumes the idle filter is energized and the normal filtration and wash cycles resume.

A level sensor will send a signal to the control panel when a high level condition or overflow situation occurs.

A situation such as this may occur when there is a significant upset in the plant or during a power outage.

The graphic below represents the typical flow condition during operation.

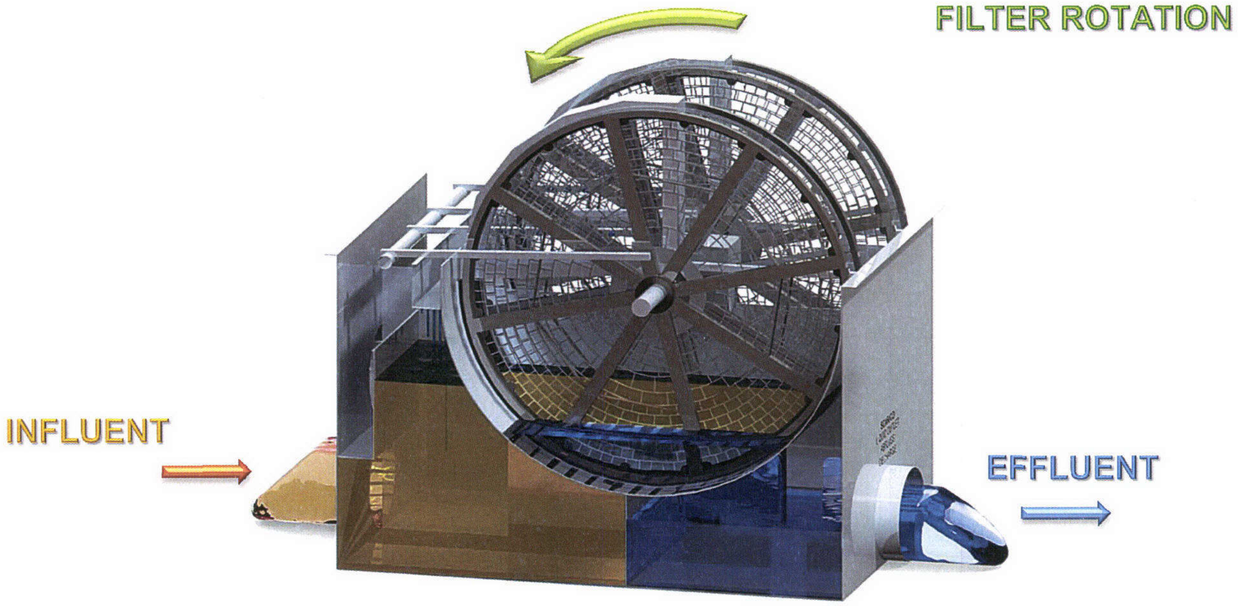


Figure No. 2
Improved filter design hydraulics results in significant increases in capacity

4.0 Plant Design Information

The filter is to be sized for:

	GPM	(MGD)
Average Daily Flow	52083	(75.00)
Peak Daily Flow	83333	(120.00)
Redundancy Flow	83333	(120.00)
Future Daily Flow	104167	(150.00)

4.1 Design Information for Filter: UL1612CS

Number of filters	14
Number of disks per filter	24
Area per disk	22.0 sq.ft.
Total area per filter	528.0 sq.ft.
Loading rate at avg per filter	7.05 gpm/sq ft
Loading rate at peak per filter	11.27 gpm/sq ft
Loading rate at redundancy per filter	12.14 gpm/sq ft
Loading rate at future flow per filter	14.09 gpm/sq ft
Filter Drive	(2) 5 hp
Wash Water pump	10.0 hp
Instantaneous Wash Water demand	345.0 gpm/unit
Wash water pressure	4 bar max
Total reject backwash wash water as % of the influent feed rate	0.5 - 1.0 %
Method of feeding filter	By Gravity or Pumped
Maximum Head requirement	25.6 inches

4.2 Filter Performance Characteristics:

	Influent	Effluent
TSS	Avg. 15 mg/L	Less than 5 mg/L
NTU	5	2

5.0 Scope of Supply: UL1612CS

Image of Four (4) Model UL-1606-CS shown

- Qty (14) UL1612CS Ultrascreen® Disk Filter
- 304 stainless steel tank
- 316L stainless steel filter mesh
- Qty (14) backwash pump (10 hp)
- Internal spray wash piping and nozzles
- Qty (14) Automatic sludge valve
- 304/304L stainless steel filter disks
- Ball valves and gauges as required
- NEMA compliant control panel with SS enclosure, 480 VAC, 3 Phase, 60 Hz
- Chain & Sprocket drive system
- Filter Level Control Sensor as required
- 304SS covers with two handles per section for easy removal
- Qty (1) year manufacturer's standard warranty

6.0 Budgetary Equipment Cost Estimate

Budgetary Price Estimate for the scope of equipment as shown above is $ 5,400,000 USD

Any taxes or fees are not included.

Equipment freight to the jobs site, engineering submittals, and start-up services are included in the budget pricing. Budgetary estimates are valid for 180 days.

7.0 Typical Drawings: See attached

Project: Walnut Creek WWTP - Austin, TX
Model : UL1612CS
Qty: 14

nova
water technologies llc

Operation & Maintenance Cost Breakdown

Electricity

Gear Drive
9.00 kW Hours / yr: 8760 hrs
*operating consumption is 60%, motor sizing is based on starting torque requirements

Backwash Pump
7.5 kW Hours / yr: 1752 hrs

Parts

Filter Lateral Seals
Expected Life Span: 5 yr
Cost per set: 450.00 USD
Sets of Seals per Unit: 12 sets

Filter Stainless Steel Mesh Panels
Expected Life Span: 15 yrs
per unit: 192 qty
Cost per Panel: 300.00 USD

Backwash Spray Nozzles
Expected Life Span: 11 yrs
per unit: 432 qty
Cost per Nozzle: 30.00 USD

Filter Bearings

Expected Life Span: 11 yrs
per unit 5 qty
Cost per Bearing 410.80 USD

Basket Strainer

Expected Life Span: 12 yrs
per unit: 1 qty
Cost per Stainer: 273.00 USD

Wash Pump

Expected Life Span: 12 yrs
per unit: 1 qty
Cost per Pump: 3,550.00 USD

Grease & Oil

Shaft Bearings: 5 qty
Gear Drive Anti-Friction Bearings: 1 qty
Gear Drive to be Oiled: 1 qty

Project : Walnut Creek WWTP - Austin, TX
Filter Model : UL1612CS
Qty : 14

nova
water technologies llc

Operation & Maintenance
Man Hours Breakdown

	Time			Time/year
1. Drive System:				
- Change fluid in the SEW gear reducer(2) every 2 years	2.0 hr	/	2 yr	1.0 hr
- Inspect Chain & Sprocket, and tensioner	1.0 hr	/	3 mon	4.0 hr
- Lubricate Chain	0.4 hr	/	3 mon	1.6 hr
- SEW Eurodrive MOVIMOT (20+ yr life)	0.0			0.0 hr
- Triple Chain & Sprocket (20+ yr life)	0.0			0.0 hr
2. Bearings:				
- Grease bearings(5) every 4 months	0.5 hr	/	4 mon	1.5 hr
- Filter bearings (11+ yr life)	10.0 hr	/	11 yr	0.9 hr
3. Spray Nozzles:				
- Inspect nozzles(432) every month for proper function. Signs of blockage/malfunction include low amounts of reject water, irregular spray patterns, frequent backwash, and overflow.	1.2 hr	/	1 mon	14.4 hr
- Replace & Clean Spray Nozzle (avg. 2yr between cleanings)	14.4 hr	/	2 yr	7.2 hr
4. Lateral Seals:				
- Inspect seals(24) every 6 months. Check for tears, puckering, or any damage. Signs of failure include increase strainer cleanings and higher TSS effluent levels	1.2 hr	/	6 mon	2.4 hr
- Lateral seal replacement (5+ yr life)	3.6 hr	/	5 yr	0.7 hr
5. Strainers:				
- Check pressure guage daily, optimal 50psi (+/-5)	5.0 min	/	1 day	30.4 hr
- Strainer blow-off for temporary cleaning	5.0 min	/	1 week	4.3 hr
- Replace & Clean Basket Strainer (3mon between cleanings)	15.0 min	/	3 mon	1.0 hr
6. Wash Pump:				
- Inspect pump every month for abnormal noise & vibration (gravelly sound "cavitation", metallic whining/humming "bearing failure")	0.2 hr	/	1 mon	2.4 hr
- General pump maintenance (wear plate, seal, bearings)	1.6 hr	/	1 yr	1.6 hr
- Wash pump replacement (12+ yr life)	3.0 hr	/	12 yr	0.3 hr
7. Pressure Transducer:				
- Should be rescaled annuall by plant integrator to guarantee accurate readings	1.0 hr	/	1 yr	1.0 hr
- Pressure transducer (20+ yr life)	0.0			0.0 hr

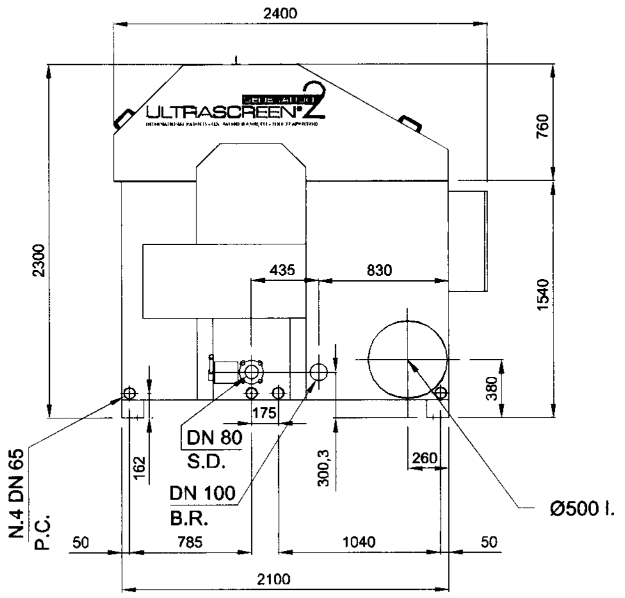
8. Control Panel:		
- The heater block and timers should be inspected annually for correct operation	1.0 hr / 1 yr	1.0 hr
9. Filter Media Panels:		
- Visual inspection of panels(192) from effluent side of filter	0.8 hr / 1 mon	9.6 hr
- Media Panel replacement (15+ yr life)	0.1 hr / panel / 15yr	1.3 hr

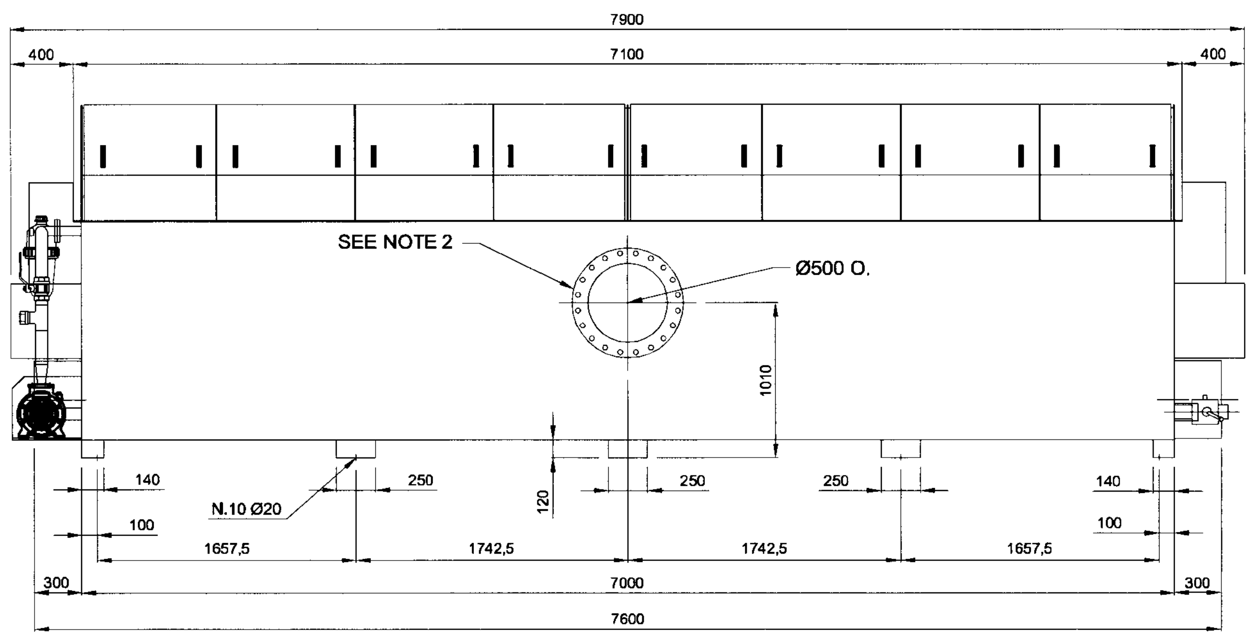
Total manhours per year per filter = 87 hr
Total manhours per year for (14) filters = 1213 hr

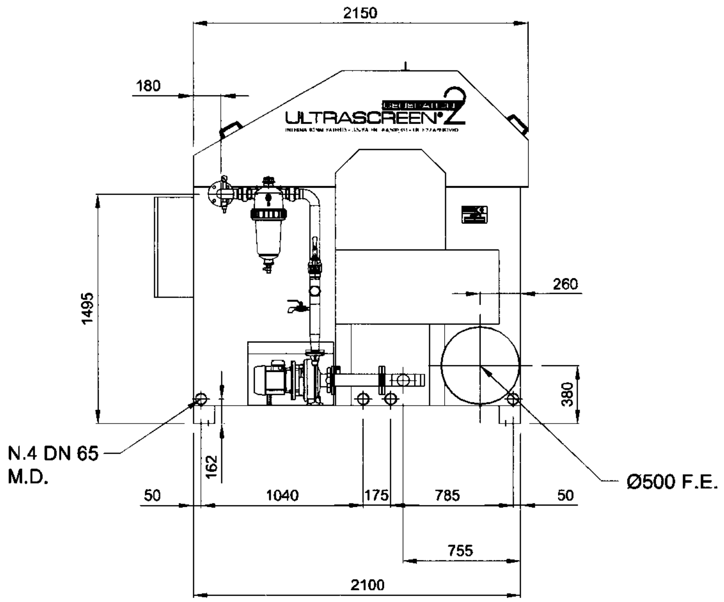
* The maintenance items listed above are standard for most filter technologies, except for the life of the media panels and drive system.

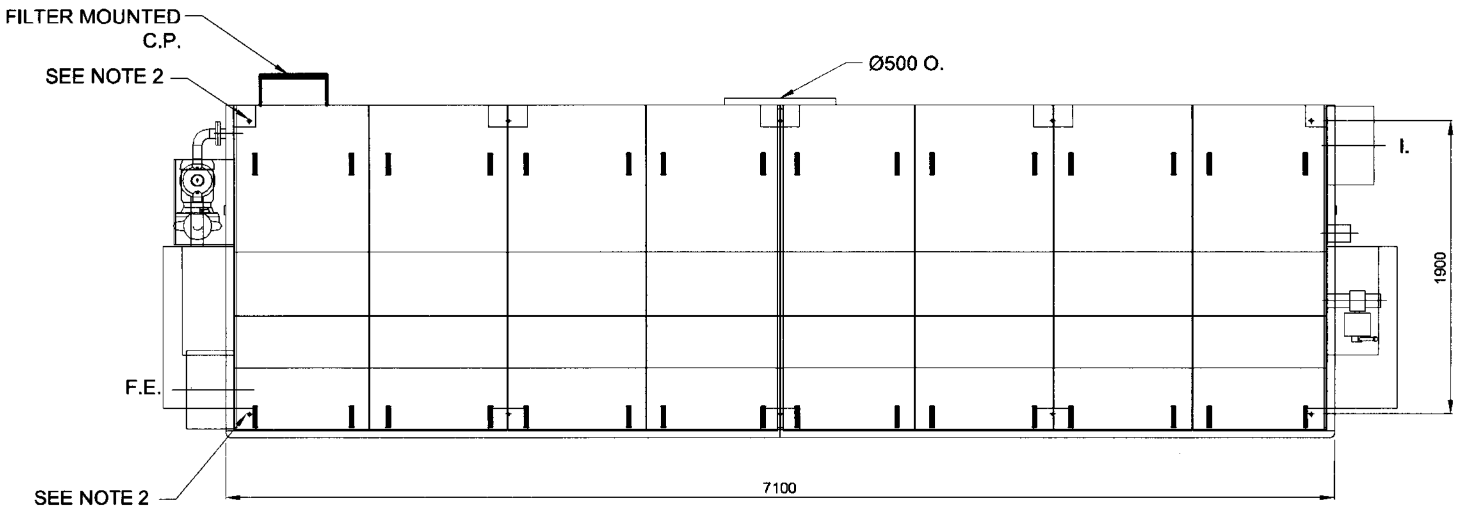
* NOVA's drive system uses the SEW Eurodrive MOVIMOT, which has an internal VFD and inverter duty motor. Both of these help provide a longer life especially since the motor only has start/stops for maintenance compared to other filter technologies that start/stop for every wash cycle.

* NOVA's media panels are provided in stainless steel frames with tensioned 316L stainless steel precision woven mesh, that is also microwelded to the frames and epoxied for longer life. Polyester blend meshes, common to Static Disk Filter Inside-Outside flow filters, are estimated to have a maximum 5yr life expectancy.









DRY WEIGHT: 7,200 kg
WORKING WEIGHT: 24,200 kg

ABBREVIATION SUMMARY

I.	INLET	B.R.	BACKWASH REJECT
N.F.	NOZZLE FEED	S.D.	SEDIMENT DRAIN
P.F.	PUMP FEED	O.	OVERFLOW
F.E.	FILTERED EFFLUENT	C.P.	CONTROL PANEL
M.D.	MAINTENANCE DRAIN		

NOTES:

1) ANCHOR BOLTS TO BE PROVIDED BY CONTRACTOR. GROUT AS NECESSARY TO ENSURE FILTER IS LEVEL AND PLUM.

2) BOLT INSTALLATION DETAILS:
FLANGE BOLT TYPE =M20x2.5 STAINLESS STEEL.
USE OF "SLIC-TITE" SEALANT OR EQUIVALENT REQUIRED.

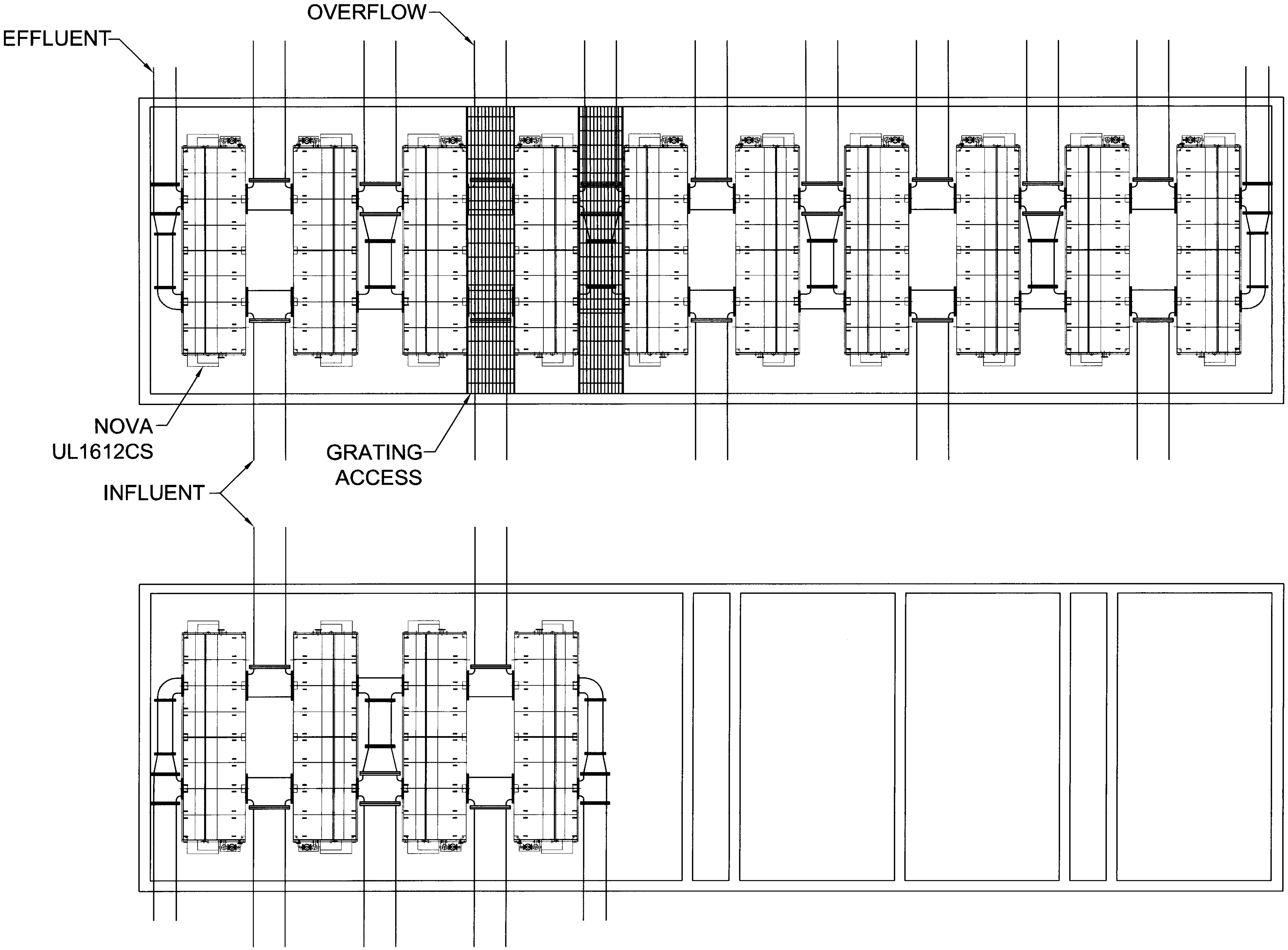
NOVA #: UL1612CS-S
DATE: 2/23/2011
DIMENSIONS: METRIC
PROJECT ENGINEER: B.L. & A.G.

UL1612CS
ULTRASCREEN MICROFILTER
GENERAL ARRANGEMENT DRAWING
FOR
NOVA WATER TECHNOLOGIES, LLC.

NUOVE ENERGIE
ADVANCED TECHNOLOGY

nova
water technologies llc
P.O. BOX 23523, TAMPA FL 33623
P: 813.288.0533, F: 813.289.3566

DRAWING NO.
1



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NOVA #:
DATE: 7/14/2011
DIMENSIONS: SAE
PROJECT ENGINEER: B.L.

UL1612CS
ULTRASCREEN DISK FILTER
PRELIMINARY LAYOUT
FOR
WALNUT CREEK WWTP

NUOVE® ENERGIE
ADVANCED TECHNOLOGY

nova
water technologies llc
P.O. BOX 23523, TAMPA FL 33623
P: 813.288.0333, F: 813.289.3566

DRAWING NO.

1

Austin SWIFT Loan Application
Part D, Item 54

CITY OF AUSTIN
WALNUT CREEK WWTP
TERTIARY FILTER REHABILITATION PROJECT

PRELIMINARY ENGINEERING REPORT

FINAL

CITY OF AUSTIN CIP ID: 3023.025
B&V PROJECT NO. 168622

FEBRUARY 24, 2012

BLACK & VEATCH
Building a world of difference.

BLACK & VEATCH TEXAS FIRM REGISTRATION NUMBER: F-258

STATE OF TEXAS EDGAR E PERREY III 87021 LICENSED PROFESSIONAL ENGINEER 2/24/12 Edgar E. Perrey III, P.E. Black & Veatch Corporation Executive Summary, Sections 1, 2, 3, 4, 6, 8.1, 11, and TMs 1 through 4.	Gary Stegeman STATE OF TEXAS GARY L. STEGEMAN 90596 LICENSED PROFESSIONAL ENGINEER 02/24/2012 Gary L. Stegeman, P.E. CAS Consulting and Services, Inc. Section 5
STATE OF TEXAS L. LEMAR PORTER 96832 REGISTERED PROFESSIONAL ENGINEER 2-24-12 L. Lemar Porter, P.E. Jose I. Guerra, Inc. Section 7	STATE OF TEXAS DAVID B. MITCHELL 87000 LICENSED PROFESSIONAL ENGINEER 2/21/12 David B. Mitchell, P.E. Encotech Engineering Consultants, Inc. Section 8.2 and 8.3
K. Harutunian STATE OF TEXAS K. A. HARUTUNIAN 59181 LICENSED PROFESSIONAL ENGINEER 2/24/2012 Kegham A. Harutunian, P.E. Harutunian Engineering, Inc. Sections 9 and 10	

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1701 DIRECTORS BLVD., SUITE 940, AUSTIN, TX 78744
+1 512-448-2503

February 22, 2012

Mr. Steven D. Parks, P.E.
City of Austin
Public Works Department
505 Barton Springs Road, Suite 900
Austin, TX 78704

Walnut Creek WWTP Tertiary
Filter Rehabilitation Project
B&V File 14.2100

RE: Quality Control Plan

Black & Veatch provides planning, design, engineering, procurement, construction, startup, and consulting services. The Black & Veatch Quality Management System (QMS) directs the processes that affect our quality of services and deliverables. The Black & Veatch QMS is based on the principles of ISO-9001:2000 edition. The system defines requirements and responsibilities of Black & Veatch professionals and the activities and processes they perform. The Project Manager has ensured the team follows the requirements of the Black & Veatch QMS and the project-specific Quality Control Plan (QCP). Key Black & Veatch Quality objectives include:

- Understand and adjust to current and future client and market needs
- Meet the client's contractual requirements
- Meet or exceed our client's expectations
- Deliver excellent projects
- Provide value creation
- Comply with regulatory, statutory, and agency requirements
- Uphold the Black & Veatch code of conduct, corporate policies, corporate instructions, and business practices
- Ensure supplier performance

Black & Veatch supports its commitment to quality, and to ensure the quality of the design products produced for this project, certifies the following:

- Black & Veatch is committing adequate manpower and resources.
- The Project Design Team (PDT) is accountable to the Independent Technical Review Team (ITRT).
- Black & Veatch Project Management and the PDT has emphasized quality control during the production of design documents.
- Black & Veatch Project Management and the PDT has established and completed internal quality checks and reviews.
- Black & Veatch Project Management and the PDT has assessed independent quality control's contribution to the quality of design documents.

By: ______________________________

Dave Anderson, P.E., D.WRE, CFM, CPESC
Principal-in-Charge

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Abbreviations	
AC	Alternating current
AC/HR	Air changes per hour
ACI	American Concrete Institute
AFD	Adjustable frequency drive
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASPE	American Society of Plumbing Engineers
ASTM	American Society for Testing and Materials
AWU	Austin Water Utility
COA	City of Austin
CCTV	Closed-circuit television
CFM	Cubic feet per minute
CMU	Concrete masonry unit
CPVC	Chlorinated polyvinylchloride
NPW	Non-Potable Water System
fps	Feet per second
GAC	Granular activated carbon
GOX	Gaseous oxygen
gpm	Gallons per minute
gpm/sf	Gallons per minute per square foot
HFS	Hydrofluosilicic acid
HGL	Hydraulic grade line
HMI	Human-machine interface
HMIS	Hazardous Material Inventory Statement
HMMP	Hazardous Materials Management Plan
HVAC	Heating, ventilation, and air-conditioning
I&C	Instrumentation and control
IBC	International Building Code
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineers Society
IFC	International Fire Code
ISA	Instrument Society of America
KVA	kilo-volt-amperes (power)
KW	kilowatt
LAN	Local area network

Abbreviations	
LEED	Leadership in Energy and Environmental Design
LOX	Liquid oxygen
MCC	Motor control center
MG	Million gallons
MGD	Million gallons per day
MV	Medium Voltage
MSJC	Masonry Standards Joint Committee
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NER	Normal evaporation rate
NESC	National Electrical Safety Code
NFPA	National Fire Protection Agency
O&M	Operations and maintenance
OIT	Operator Interface Terminal
OSHA	Occupational Safety and Health Act
PC	Personal Computer
PCS	Plant Control System
PLC	Programmable Logic Controller
ppd	Pounds per day
pph	Pounds per Hour
psf	Pounds per square foot
Psi	Pounds per square inch
PTFE	Polytetrafluoroethane
PVC	Polyvinylchloride
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
SEI	Structural Engineering Institute
SMACNA	Sheet Metal and Air Conditioning Contractor National Association
STC	Sound Transmission Classification
TM	Technical Memorandum
TMS	The Masonry Society
UL	Underwriters Laboratory
UPS	Uninterruptible power supply
UV	Ultraviolet light
VFD	Variable frequency drive
WWTP	Waste Water Treatment Plant
w/c	Water-to-cement ratio

Executive Summary

The City of Austin retained Black & Veatch to perform the *Phase A: Preliminary Design* tasks for the Walnut Creek WWTP Tertiary Filter Rehabilitation project. As part of the preliminary design Black & Veatch conducted a study to evaluate the existing tertiary filters at the Walnut Creek Wastewater Treatment Plant (WWTP) to (1) assist in determining the remaining useful life of the plant filter equipment and (2) review alternatives to replace or rehabilitate the existing filters. Four separate Technical Memoranda (TMs) were prepared to document the study findings regarding condition assessment, alternative filtration technology, granular media filter improvements, and a comparison of the alternatives. Design recommendations were developed for updating the existing filters to meet current and future treatment needs and regulatory requirements and are provided herein as part of this Preliminary Engineering Report (PER). Key deliverables prepared for throughout the project include the following:

- Project Procedures Manual (delivered under separate cover)
- Quality Control Plan (delivered under separate cover)
- Condition Assessment Technical Memorandum (included in attachments of the PER as *TM1: Condition Assessment*)
- Alternative Filtration Technology Technical Memorandum (included in attachments of the PER as *TM2: Alternative Filtration Technologies)*
- Alternative Granular Filter Improvements Technical Memorandum (included in attachments of the PER as *TM3: Alternative Granular Filter Improvement)*
- Preliminary Ranking of Alternatives Technical Memorandum (included in attachments of the PER as *TM4: Selection of Filtration Technology)*
- Cost Estimate (included in Section 11 of the PER)
- Preliminary Engineering Report (comprehensive document summarizing results and recommendations of the preliminary design work presented herein)
- Quality Control Plan Documentation (QC logs documenting specifics of project QC to be delivered separately upon completion of the PER)
- Report on LEED Activity (included in Section 6 of the PER.)

Technical Memoranda

Black & Veatch prepared a series of Technical Memoranda to document the findings of the filter evaluation study including:

- *TM1: Condition Assessment*
- *TM2: Alternative Filtration Technologies*
- *TM3: Alternative Granular Filter Improvements*
- *TM4: Selection of Filtration Technology*

TM1: Black & Veatch conducted a condition assessment of the tertiary filters and the related infrastructure. The purpose for this evaluation was to determine the condition of the structures and equipment related to the existing tertiary filter process, including appurtenances supporting the filters such as influent and effluent valves, meters and piping, and to determine the remaining useful life of the system components. The result of this work was presented in *TM1: Condition Assessment*.

TM2: Black & Veatch evaluated various alternative filtration technologies for incorporation into the existing filter complex at Walnut Creek WWTP as a replacement to the existing granular media filters. Two technologies were selected by the City for more detailed evaluation including Cloth Media Filters and Nova Ultrascreen Rotating Disk Filters. Black & Veatch prepared a conceptual design for both of these alternative technologies including conceptual design drawings, capital costs and operations and maintenance costs. The results of this alternative technology evaluation were presented in *TM2: Alternative Filtration Technologies*.

TM3: Black & Veatch reviewed alternatives for improvements to the existing filters that focused on utilizing granular media filtration technologies currently in use at the plant, and rehabilitating existing ancillary systems, including review of (1) the filter media and underdrains, (2) the low pressure air supply system, and (3) the backwash supply system. Conceptual design drawings were developed where applicable along with construction and operating costs. Each alternative was compared against three project goals: (1) complete the project on time and within budget, (2) improve control of the filters to minimize operating costs and (3) identify assets that are at the end of their useful life. A "do nothing" alternative was evaluated for each system, and a comparison of economic and non-economic factors was summarized. Preliminary recommendations were made for each system. In addition assets identified to be beyond their useful life and recommended for replacement from the condition assessment were summarized and capital costs were developed. These included major valves, flowmeters, piping improvements, as well as the filter control system. Capital and operating costs were summarized for all recommended improvements in order to compare the improvements required for the granular media filtration technology with the alternative technologies presented in TM2. The results on this evaluation were presented in *TM3: Alternative Granular Filter Improvements*.

TM4: The alternative filtration technologies evaluated in TM2 were compared against the recommended improvements required for the granular media filter technology in TM3. An economic comparison was performed including capital costs, operating and maintenance costs, and a present worth analysis. The granular media filter technology resulted in the lowest present worth cost and, therefore, was considered the most cost-effective solution based on the economic analysis. The technologies were compared based on non-economic factors including (1) flexibility for future expansion, (2) flexibility to meet future regulation, (3) reliability and complexity of O&M, and (4) sustainability. The non-economic factors were rated for each technology and assigned a weighting based on relative importance. A cost/benefit ratios was determined and the granular media filtration technology was selected based on having the best cost/benefit ratio. The results of this comparison were presented in *TM4: Selection of Filtration Technology*.

Preliminary Engineering Report

After the selection of the filtration technology, additional preliminary design evaluations were performed and a conceptual design was developed for the recommended filter improvements. The conceptual design is presented in the Preliminary Engineering Report to set the basis for the scope of design and budget required to complete the desired improvements for the Walnut Creek WWTP tertiary filters. The improvements will include:

- New valves, piping and meters leading to and coming out of the filters to the clearwell
- New nozzle-type underdrains and media for filters 1 through 4

- Additional media for filters 5 through 10
- New backwash pumps
- New non-potable water system
- New electrical and instrumentation controls
- New air blowers to feed the air portion of the filter backwash cycle
- Expanding the existing clearwell to provide more available backwash water
- The construction of a new clearwell at the northwest corner to assist with hydraulic operation

The PER was developed to present the design criteria for the project including all ancillary facilities and discipline areas such as underdrains and media, air supply and backwash facilities, non-potable water system improvements, HVAC improvements to the filter buildings, structural improvements, electrical system improvements, and improvements to the instrumentation and control systems. The main sections of the report are summarized as follows:

- Section 1 provides background on the project and Black & Veatch team.
- Section 2 provides the general requirements for the design.
- Section 3 provides the hydraulic design criteria and details the hydraulic improvements that will be realized as a result of the modifications to the filters and the clearwell.
- Section 4 provides the basis of design for the treatment facilities including the filter complex, underdrains and media, and the backwash supply system.
- Section 5 summarizes the civil design criteria and provides the basis of design for upgrades to the non-potable water (NPW) system. Four alternatives were evaluated. Alternative 1 was recommended and will include providing two 1,800 gpm NPW pumps, with provisions for a third identical pump, new pump pads, piping and valves for the pumps.
- Section 6 summarizes the general recommendations for architectural design. This section applies primarily to the proposed new structure above the proposed Southside Clearwell expansion to house the centrifugal blowers. This section also summarizes the results of the LEED evaluation performed for this project.
- Section 7 summarizes the structural design criteria and requirements for new structures included in the project, primarily the clearwell expansion(s) and new blower building. Criteria for improving the concrete surfaces in the existing filter complex is also included.
- Section 8 provides mechanical design criteria for (1) the new centrifugal air blowers to supply air to the backwash cycle, (2) HVAC systems, and (3) ventilation systems. The current HVAC issues and proposed improvements to the filter complex (Filter Building 1 and 2, and the sub-surface pipe gallery) are summarized including modifications to the duct work and HVAC systems to improve air flow to Filter Building 1 and 2, the pipe gallery and the air blower room.
- Section 9 summarizes the electrical design requirements for the project including recommended improvements for (1) the power distribution system design, (2) power quality issues, (3) power metering and protection issues, and (4) electrical sub systems such as lighting, receptacles, raceway systems, and wiring. An overview of the existing electrical system is provided and two alternative power distribution system designs are presented. The recommended design alternative provides distribution and motor starter equipment to support the loads associated with filter building process/mechanical. Under this design, the salvage value of the existing Filter Complex power distribution system is maximized and the existing WRI Electrical Building serves the backwash pumps.

- Section 10 summarizes the instrumentation and control (I&C) design criteria for the project. Three I&C design alternatives were evaluated and, in general, the City of Austin selected Alternative 2. This design will provide a dual-channel single-mode Ethernet fiber optic network at the Filter Complex to provide communication between the Filter Complex and the Top-end computer system with each filter having a local control panel (LCP) containing the programmable logic controller and other required I&C equipment for each filter, and an operator interface unit (OIU). The local PLC will monitor and control the filter operation. An additional LCP housing an OIU will be located in each of the Filter Buildings. A main control panel (MCP) will be provided in the control room level to house additional I&C equipment not contained in the other units but which are typically used by the filters. An OIU will be installed on this MCP to provide control and indication of selected points. Data receptacles will be provided at each LCP and the main control panel to facilitate the communication network for the mobile computer workstation. The existing fiber optic network will be used to establish the connection between the Filter Complex and the Top-end computer. The existing fiber network between the Filter Complex and the WRI electrical building will be used to establish a link between the new backwash pumps and the protective relays located in the WRI electrical building.
- Section 11 presents the Engineer's Opinion of Probable Construction Costs (EOPCC) for the project, including the various design alternatives that were considered for specific systems. Table ES-1 summarizes the costs of the selected project elements.

Table ES-1: Engineer's Opinion of Probable Construction Cost

Item	Estimated Cost
Nozzle Underdrain w/ Mono-Media Filter	$2,000,300
Air Supply Within New Structure	$713,800
NPW Alternative No. 1	$179,100
Backwash Storage in Expanded Clearwell	$3,274,400
Replace/Renovate Assets	$1,739,800
Power Distribution System Upgrades	$3,351,400
Filter System I&C Alternative No. 2	$3,098,800
HVAC Improvements	$176,000
Total	$14,533,600

Project Schedule

The Walnut Creek WWTP Tertiary Filter Rehabilitation Project is planned to be performed in several phases as follows:

- Phase A: Preliminary Design
- Phase B: Design
- Phase C: Bid/Award/Execution
- Phase D: Construction

The Preliminary Design tasks were initiated in April 2011, and are considered complete with the delivery of the final PER in February 2012. The Design phase scope and fee development is anticipated to begin in March 2012 with a goal of initiating design in June 2012. The Design phase duration is anticipated to be approximately 12 months, with final design completion planned for approximately July 2013. The construction phase for this size and type of project is anticipated to be approximately 12 months. The project could potentially complete by the end of 2014.

1.0 Introduction

Black & Veatch (B&V) was retained by the City of Austin to conduct evaluations and make recommendations for improving the Filter Complex at the Walnut Creek Wastewater Treatment Plant (WWTP). At the onset of the project Black & Veatch conducted site visits to the Walnut Creek WWTP Filter Complex to document the condition of the filters and the associated piping, valves, meters and other appurtenances. Black & Veatch also evaluated alternative filter technologies to be considered by the City of Austin as possible replacement technologies to the existing granular filters. Improvements to the granular filters were also evaluated in order to compare to the alternative technologies. This work was presented to the City of Austin in four separate technical memoranda. Based on this preliminary work, the City of Austin selected the granular filter media technology for plant, and the improvements associated with upgrading the plant systems will be incorporated into the design for this project.

1.1 Purpose

The purpose of this Preliminary Engineering Report (PER) is to (a) summarize the research conducted and the decisions made with regard to improving the existing filters at the Walnut Creek WWTP and (b) provide design criteria for filter improvements. Process, civil, architectural, structural, mechanical, electrical and instrumentation information is presented in this PER. This report will be used in the final design stage to prepare detailed design drawings and specifications.

1.2 Background

Black & Veatch has prepared four technical memorandums (TM) leading to this PER. A condition assessment of the existing filter facility was conducted and summarized in *TM1: Condition Assessment*. Alternative filter technologies were evaluated and the results of this evaluation were presented in *TM2: Alternative Filtration Technologies*. Additionally, potential improvements to the existing granular filters were evaluated and presented in *TM3: Alternative Granular Filter Improvements*. Finally, a technical memorandum, *TM4: Selection of Filtration Technology*, was prepared to compare the filtration technologies discussed in TM2 and TM3 and assist the City of Austin in selecting the alternative to evaluate further in this PER. All four technical memoranda are provided as appendices to this report.

1.3 Team Structure

The Walnut Creek WWTP Preliminary Design Team is comprised of the following consultants.

Table 1-1 Preliminary Design Team

Consultant Name	Role
Black & Veatch Corporation	Prime Consultant
AECOM	Quality Assurance/Quality Control
All-Points Inspections Services, Inc.	Inspection Services
CAS Consulting and Services, Inc.	Non-Potable Water Preliminary Design
ENCOTECH Engineering Consultants	HVAC Preliminary Design
Jose I. Guerra, Inc.	Structural Preliminary Design
Harutunian Engineering, Inc.	Electrical and Instrumentation and Controls Preliminary Design

1.4 Treatment Process

The overall existing treatment process will not be modified as part of this project. Only the filtration technology will be modified and improvements performed to upgrade the existing filter system.

1.5 Project Schedule

The Walnut Creek WWTP Tertiary Filter Rehabilitation Project is planned to be performed in several phases as follows:

- Phase A: Preliminary Design
- Phase B: Design
- Phase C: Bid/Award/Execution
- Phase D: Construction

The Preliminary Design tasks were initiated in April 2011, and are considered complete with the delivery of the final PER in February 2012. The Design phase scope and fee development is anticipated to begin in March 2012 with a goal of initiating design in June 2012. The Design phase duration is anticipated to be approximately 12 months, with final design completion planned for approximately July 2013. The construction phase for this size and type of project is anticipated to be approximately 12 months. The project could potentially complete by the end of 2014.

2.0 General Requirements

2.1 Project Description

The Walnut Creek WWTP treats commercial and residential wastewater for the City of Austin and discharges the treated water to the Colorado River. The filter improvements will consist of:

- New valves, piping and meters leading to and coming out of the filters to the clearwell
- New underdrains and media for filters 1 through 4
- Additional media for filters 5 through 10
- New backwash pumps
- New non-potable water system
- New electrical and instrumentation controls
- New air blowers to feed the air portion of the filter backwash cycle
- Expanding the existing clearwell to provide more available backwash water
- The construction of a new clearwell at the northwest corner to assist with hydraulic operation

2.2 Project Site

The Walnut Creek WWTP is located in east Austin on FM 969, approximately one mile east of Highway 183. An aerial photo of the site is shown below in Figure 2-1 and the overall site is shown on attachment 2-1. The filter buildings are located east of the main plant building and north of the final clarifiers.

Figure 2-1 – Aerial Photo of the Walnut Creek WWTP Site

2.3 Datum and Site Control

Survey control established by the City of Austin will be used for this project during final design and construction.

2.4 Geotechnical Data

A geotechnical investigation was not conducted as part of the preliminary engineering effort. It is anticipated that geotechnical data will be collected during the final design phase. This effort will focus on the area of the proposed Southside Clearwell, to the south of filters 1 and 3, and the proposed Northwest Clearwell, west of Filter Building 2, if necessary.

2.5 Regulatory Agencies, Codes, and Permits

The following sections summarize the anticipated codes and standards to be used during final design and the review and approval process the City of Austin will requires.

2.5.1 Codes and Standards

The codes and standards used by the City of Austin are listed in Table 2-1 below.

Table 2-1 Current Applicable Codes

Title	Acronym
Austin City Code	-
2009 International Building Code	IBC
American Concrete Institute 318: Building Code Requirements for Structural Concrete	ACI 318
American Concrete Institute 350: Code Requirements for Environmental Engineering Concrete Structures	ACI 350
American Institute of Steel Construction: Steel Construction Manual	AISC
American Society of Civil Engineers/Structural Engineering Institute: Minimum Design Loads for Buildings and Other Structures	ASCE/SEI 7-05
Occupational Safety and Health Administration (OSHA): Code of Federal Regulations (CFR), 29 CFR Part 1910	-
American Concrete Institute 350.3: Seismic Design of Liquid-Containing Concrete Structures	ACI 350.3
American Concrete Institute 350.4R: Design Considerations for Environmental Engineering Concrete	ACI 350.4R
International Code Council-Evaluation Services: Evaluation reports for specific products	ICC-ES
American Association of State Highway and Transportation Officials: Standard	AASHTO

Table 2-1 Current Applicable Codes

Title	Acronym
Specifications for Highway Bridges	
National Fire Protection Association Volume No. 70, National Electric Code	NEC
Institute of Electrical and Electronics Engineers	IEEE
Instrument Society of America Standards	ISA

2.5.2 City of Austin/Regulatory Agencies and Permits

Agency coordination will be required throughout the design and construction process for various approvals, reviews and permits. Table 2-2 summarizes the agencies that will require coordination.

Table 2-2 Key Review Agencies and Utilities

Agency/Utility	Key Review/Permit
Texas Commission on Environmental Quality	Send letter outlining project
City of Austin Quality & Standards Management Division	Review of PER, 30%, 60%, 90% and 100% submittals
City of Austin General Permit	Review of 30%, 60%, 90% submittal and sign 100% submittal
Austin Water Utility/ Walnut Creek Wastewater Treatment Plant	Review of all submittals

2.6 Drafting Standards and Procedures

Black & Veatch drafting standards and procedures will be implemented and followed by the design team during the final design stage. Full size drawings will be prepared with a 22” X 34” border, so 11” X 17” half size drawings can also be produced, as needed. AutoCAD software will be utilized during the design process.

2.7 Work by Others/Coordination

The City of Austin either has ongoing projects at the plant or anticipates the beginning of projects at the plant in the near future. Table 2-3 is a list of these projects and their status.

Table 2-3: Work By Others

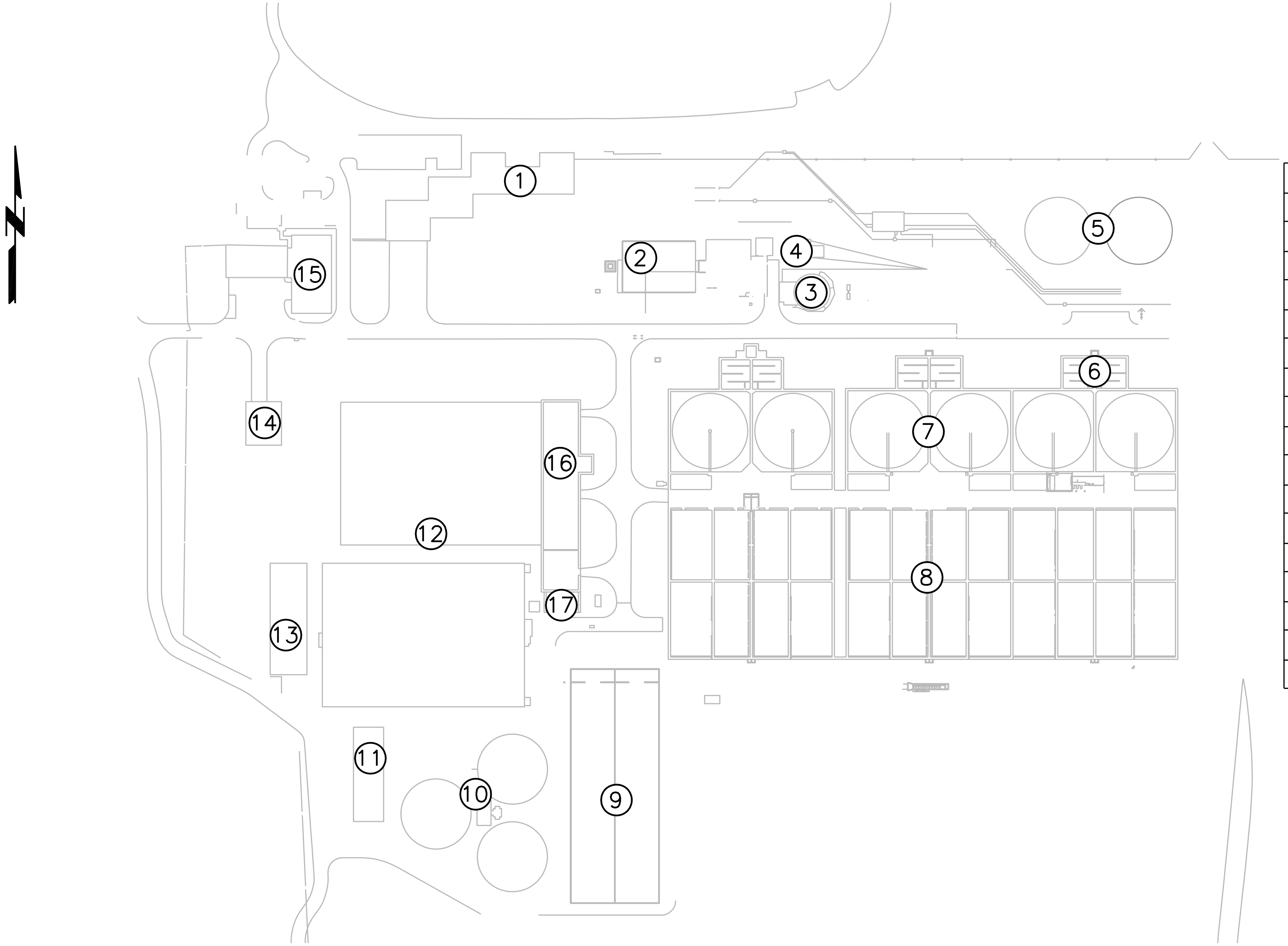
Project Name	Status
Walnut Creek Plant Electrical Distribution Improvements, Phase II	Under construction. Project estimated to be complete early 2013.
Walnut Creek Influent Flow Improvements and Equipment Rehabilitation	Construction begins February 2012 and will take one year to complete.
Walnut Creek Outfall Bank Erosion, Phase II	Notice to proceed effective January 23, 2012. Project will take one year to complete.
Walnut Creek Basin Odor and Corrosion Improvements	Under construction, estimated complete in May 2012.

2.8 Construction Material Requirements

Construction materials will be selected to provide adequate and reliable service when subjected to the various water and chemical characteristics encountered at the Walnut Creek WWTP. All selected materials will meet or exceed City of Austin material requirements for wastewater treatment plants.

Construction materials and coatings recommended for the Walnut Creek WWTP will provide additional protection against metal corrosion as a result of exposure to the wastewater treatment plant process flows. Materials which will be submerged all or in part will be specified to be resistant to the treated water and chemicals added to the water in the filtration process. In addition, only coatings or chemicals that meet NSF standards will be used for the filtration process.

City of Austin standards will be followed and material submittals will be reviewed in final design.



Number	Name
1	Administration Building
2	Filter Building Complex (1 & 2)
3	Dissolved Air Flotation (DAF) Thickener
4	DAF Pressurization Pump Station
5	Water Reclamation Initiative
6	Chlorine Contact Basins
7	Final Clarifiers
8	Aeration Basins
9	Interim Aeration Basins
10	Clarifiers
11	Chlorine Contact Basin
12	Primary Treatment Complex (1 & 2)
13	Odor Control Building
14	Headworks Building
15	Maintenance Building
16	Operations Building
17	Electrical Substation

SCALE: 1" = 200'

Austin WATER

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Building a world of difference

PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER REHABILITATION PROJECT

WALNUT CREEK WWTP OVERALL SITE PLAN

3.0 Hydraulic Design Criteria

Preliminary hydraulic modeling was performed under, and the results were previously reported in *TM3: Alternative Granular Filter Improvements*. That modeling effort defined twelve flow cases for analysis which encompassed a variety of Colorado River water levels, total effluent flows to the River, and flows through the Filter Complex. Those analyses indicated that filter production of 120 mgd (full rated capacity of the Filter Complex) is problematic, in general, and not sustainable when the Colorado River is at the 100-year flood stage elevation of 432. Informal filter performance testing was conducted which indicated that a filter can produce its rated flow if the available filter headloss is between three feet (clean filter media) and 10 feet (dirty filter media). For the purposes of this discussion, 6.5 feet of available head for filter headloss (average of the range presented) was identified as a minimum desirable target in order to allow reasonable filter backwash intervals.

Additionally, it was concluded that the total filter backwash volume stored in the existing clearwell/effluent conduit system of the Filter Complex should be increased to a total of approximately 350,000 to 400,000 gallons. That volume is adequate for two successive individual filter backwash cycles.

The recommendations discussed below are based on increasing total clearwell volume, improving operational flexibility, and reducing effluent system headloss in order to better allow the filter system to reach the 120 mgd capacity target at high river levels.

3.1 Filter System Improvements and Plant Production Hydraulics

The configuration of the Filter Complex is conducive to cost-effective construction of contiguous clearwell volume along the south side, where the existing Primary Clearwell is located, and at the northwest corner near the junction box. Attachments 3-1 and 3-2 depict the proposed Southside Clearwell expansion and Northwest Clearwell addition.

The Southside Clearwell Expansion incorporates a diversion cell with sluice gates to provide segregation control, whereby the Primary Clearwell and the Southside Clearwell expansion supply flows can operate either separately or in unison with each other. Discharges from the two clearwells are combined in order to utilize the existing 72-inch effluent pipeline.

The proposed Northwest Clearwell addition shares only the existing 66-inch effluent line with the existing junction box, and the proposed configuration preserves the functionality of the junction box. The existing junction box is comprised of inner and outer cells. Normally the inner cell directs filter influent flow to the Filter Complex pipe gallery. If the influent flowrate exceeds what the filters can handle, the excess flow spills over the perimeter wall between the cells and into the outer cell. Overflowing is not a common occurrence, and the 66-inch effluent line is generally unused. However if overflowing of the junction box were to occur while the Northwest Clearwell is operating, the two flow streams would simply comingle in the Northwest Clearwell before discharging. From the outer cell a 66-inch pipe directs the overflow to the river outfall. A sluice gate is provided to isolate the filtered water feed from the Filter Complex effluent conduit to the Northwest Clearwell if/when desired.

These two clearwell improvements were conceived to operate together for maximum benefit, however construction can be phased with either structure being initially constructed. However, the Southside Clearwell expansion better addresses the need to increase clearwell storage, and the Northwest Clearwell addition addresses the need to filter water at a greater rate at high river levels.

3.1.1 Clearwell Volume Increase

Table 3-1 summarizes the total increase in clearwell storage volume that results from the proposed improvements.

Table 3-1 Clearwell Storage Volume Summary

Storage Facility	Maximum Storage Volume, gal
Existing North, South, and East Effluent Conduits	104,000
Existing Pump Clearwell	32,000
Existing Primary Clearwell	116,000
Existing Subtotal =	***252,000***
Proposed Southside Clearwell Expansion	113,000
Subtotal =	***365,000***
Proposed Northwest Clearwell Addition	56,000
Grand Total =	***421,000***

Hydraulic issues associated with backwash pump suction piping, which take suction from the small Pump Clearwell at the northeast corner of the Filter Complex, constrain utilizing the clearwell storage volume in its entirety. In particular the Pump Clearwell and backwash pump suction piping are not configured for optimal net positive suction head available (NPSHa) to the pumps (i.e. long suction piping under a static lift condition when liquid level in the Effluent Conduit is not surcharging, pumps may require supplemental priming, pipe air-binding potential, and a clearwell vent to atmosphere that visually appears undersized and should be checked). The two proposed clearwells will increase the existing filtered water volume in storage by approximately 75 percent. Each proposed clearwell addition operates independently, allowing either concurrent or staged construction as noted.

3.1.2 Clearwell Operational Improvements

The clearwells store filtered water for various purposes, including filter backwashing and irrigation. The operational flexibility of the proposed expanded clearwell system is constrained by the following factors which exist in the current Filter Complex configuration. Relevant aspects of the existing facility configuration are as follows:

- The majority of the clearwell storage volume can be found in the existing Primary Clearwell, which is located under filters 1 and 3. Considerably smaller storage volumes exist in the filter effluent conduit and in the Pump Clearwell. The Pump Clearwell serves as the suction point for the filter backwash pumping system. Under normal operation all of the clearwell areas are interconnected and available. The Primary Clearwell is the discharge point for excess liquid to be directed from the Filter Complex to the Colorado River.
- Dedicated filter effluent conduits exist for conveying the filtered water to the Primary Clearwell. Filters 2, 4, 6, 8, and 10 share a conduit along the north, east, and south sides of the Filter Complex. Filters 5, 7, and 9 share an effluent conduit that enters the Primary Clearwell at its

northwest corner. Filters 1 and 3 discharge directly into the Primary Clearwell, without the need for (or existence of) an effluent conduit.

- The proposed Southside Clearwell begins at the south wall of the existing Primary Clearwell and extends farther to the south. The proposed Northwest Clearwell addition is adjacent to the existing junction box at the northwest corner of the Filter Complex. In a sense these two clearwells are located diagonally opposite of each other when viewing a plan of the Filter Complex.
- The effluent conduits are interconnected only through the Primary Clearwell, and are not looped (but probably could be through the proposed Northwest Clearwell). Consequently when the Primary Clearwell is out-of-service, the ability to move water between the various filters and clearwells is diminished, and the water volume available for sequential filter backwashing is inadequate. A Primary Clearwell outage eventually renders the Filter Complex unable to operate at anything above minimal capacity. The proposed two new clearwells (Southside and Northwest) will significantly improve operational flexibility when the existing Primary Clearwell in not operational. The proposed clearwells also increase the Filter Complex usable filtration capacity when the Colorado River is at its 100-year flood stage.

Table 3-2 summarizes the relationship between filter production and available clearwell storage volumes. Fundamentally, the best operational scenario is always to use as much of the constructed clearwell storage volume as available.

As indicated in the table, construction of the two proposed clearwells achieves the following objectives:

- Service loss from the Primary Clearwell no longer requires that all filtration cease, half the filtration capacity can now remain in service. Additional filtration capacity would be realized by connecting the north and south effluent conduits at the west end of the Filter Complex provided that the south effluent conduit could be isolated at the connection point to the Primary Clearwell.
- The Primary Clearwell, Southside Clearwell expansion, and Northwest Clearwell addition can be individually taken out-of-service for inspection and repair, while maintaining from 50 percent to 100 percent of the filtration capacity (depending on which clearwells remain in service). A portion of the total filtration capacity is temporarily lost when a filter is dedicated to a certain clearwell that is out of service.
- When all clearwells are online, the total water storage volume achieves that needed for backwashing two filters in succession.
- As discussed below in detail, the proposed improvements increase the maximum capacity of the Filter Complex at all high water stages in the Colorado River.

The proposed clearwells would be of reinforced concrete construction with concrete roofs at, or preferably slightly above, grade to preclude vehicle loadings. Roof simplification or elimination, particularly for the smaller Northwest Clearwell addition, which is not hydraulically needed at lower Filter Complex flow rates and river levels below 100-year flood stage, can be considered to reduce costs.

Addition to and/or extension of the dechlorination chemical feed system discharge points will be necessary for each new clearwell discharge point.

3.1.3 Clearwell Hydraulic Operation

Initial hydraulic modeling performed under TM3 indicated that the average required head consumed in producing the full rated flow through a filter cell is approximately 6.5 feet. If the head available is less than the required average, and/or if the solids load in the filter media is greater than average, the flow rate through a filter can be significantly reduced due to shortened filter backwash intervals. Consequently, improvements which reduce the headloss in the system (system meaning the piping to the Filter Complex, the Filter Complex itself, and the piping and structures discharging to the Colorado River) effectively increase the allowable filter headloss, and result in the following benefits:

- Filter flows will remain at rated capacity for longer periods of time before the trapped solids reduce filter throughput.
- Filters can maintain rated capacity at higher river stage levels, resulting in a higher average filtered water quantity.
- The length of time between filter backwashing cycles can increase.

Table 3-2 Filter/Clearwell Operational Scenarios Summary

Scenario ID #	Filter Complex Clearwell Combination Scenario Descriptions	Flow Possible from any combination of Filter Nos. 1,3,5,7, & 9	Flow Possible from any combination of Filter Nos. 2,4,6,8, & 10	Flow Possible from any combination of Filter Nos. 1 through 10	Comments
1	Existing Primary Clearwell operating alone	yes	yes	yes	Not a scenario of interest w/o Pump Clearwell.
2	Existing Pump Clearwell operating alone	no	yes	no	The Pump Clearwell is supplied directly from the effluent conduit from Filters #2, 4, 6, 8, & 10. It can be supplied by Filters #1, 3, 5, 7, & 9 only by backflow from the existing Primary Clearwell when it is operating. This scenario has insufficient backwash water storage volume, and is not a recommended operational mode.
3	Proposed Southside Clearwell expansion operating alone	no	yes	no	The odd numbered filters only discharge either directly or indirectly into the existing Primary Clearwell. Need Pump Clearwell for backwashing.
4	Proposed Northwest Clearwell addition operating alone	no	yes	no	In order for water from Filters #5, 7, & 9 to reach the NW Clearwell addition, the effluent conduit for the filters would need to be isolatable at the Primary Clearwell and the west end of the effluent conduit would need to be extended either to the Northwest Clearwell or to the effluent conduit for the even numbered filters. Pump Clearwell needed for filter backwashing.
5	Existing Primary + Pump Clearwells	yes	yes	yes	This is the current operational baseline.
6	Existing Pump + Proposed Southside Exp + Proposed Northwest Addition Clearwells	no	yes	no	The odd numbered filters presently discharge, either directly or indirectly, only into the existing Primary Clearwell.
7	Existing Primary & Pump + Proposed Southside Expansion Clearwells	yes	yes	yes	Future operational baseline if only superior clearwell for backwashing is constructed.
8	Existing Primary & Pump + Proposed Northwest Addition Clearwells	yes	yes	yes	Future operational baseline if only superior clearwell for filter production is constructed.
9	Existing Primary & Pump + Both Proposed Clearwells	yes	yes	yes	This would be the future operational baseline if both proposed Clearwells are constructed.

Headloss from liquid flowing in a segment of infrastructure is exponentially proportional to the flowrate (velocity), which can alternatively be stated as “higher flow rates result in disproportionately higher headloss”. Therefore reducing the system headloss by reducing the flow/velocity in the system will result in an increase in the volume of filtered water produced, and/or the percentage of the volume produced that can be discharged into the Colorado River, etc. Reducing headloss is about the only option for cost-effectively increasing filter production. This is because solutions which add energy into the system by mechanical means (i.e. pumping) require significant amounts of additional piping and have additional long-term operating costs. In order to reduce headloss in the system, the flow rate through existing segments of the system need to be reduced, this fundamental concept is the basis for the configurations and locations of the proposed clearwells.

For the PER, the Filter Complex hydraulic model was revised to increase the accuracy of the results when evaluating the proposed clearwell additions. Previous hydraulic modeling performed in TM3 indicated that the most challenging flow cases to meet were those pairing the highest flow rates and the highest river levels [specifically Case 5 (total flow of 165 mgd, 120 mgd through the filters, and Colorado River at the 100-year flood stage elevation of 432) and Case 6 (total flow of 200 mgd, 120 mgd through the filters, and the Colorado River at the 100-year flood stage)]. These are the “worst case” modeling scenarios and will be used to evaluate the proposed clearwell additions. Prior Cases 1 through 4 are all lower flow cases and do not appreciably reduce current filter backwash intervals. The existing system is able to adequately perform at the flow cases with reduced flows and lower river levels. Note that because both worst cases are based on the full Filter Complex rated production of 120 mgd, they are differentiated in their hydraulic performance by the additional headloss of Case 6 associated with discharging 40 mgd of additional bypass flow to the river. The new hydraulic modeling results for these two scenarios are summarized in Table 3-3. The existing case is based on all flow going through only the existing Primary Clearwell and is the baseline for performance comparison.

Alternative 1 is based on 50 percent of the total flow (that from filters 1, 3, 5, 7, and 9) being routed through the existing Primary Clearwell. The remaining half of the flow (from filters 2, 4, 6, 8, and 10) is routed through the new Southside Clearwell expansion. The two flow streams are combined at the existing 72-inch outlet from the expanded Primary/Southside Clearwell complex. The reduction in headloss results from reducing the flow through the Primary Clearwell by half. However, because the flow velocity in the clearwells is generally low, and headloss is exponentially proportional to flowrate, the reduction in headloss is relatively modest.

Alternative 2 involves construction of a smaller supplemental clearwell, the Northwest Clearwell addition, adjacent to the existing junction box. The clearwell volume associated with the Northwest Clearwell addition is modest, and not adequate for two filter backwashes when combined only with the Primary Clearwell. Therefore, it is not a true stand alone alternative for the primary objective of clearwell volume increase. Rather, Alternative 2 is most useful when combined with Alternative 1. This alternative cost effectively achieves a moderate, but important, reduction in system headloss to improve filter production because it uses the already existing (but unused) hydraulic capacity of the 66-inch bypass line from the junction box. The effluent routed to the Northwest Clearwell addition does not flow through either the Primary Clearwell or the proposed Southside Clearwell expansion, resulting in less flow and lower headloss through the existing discharge route.

The combination of Alternatives 1 and 2 routes 50 percent of the total flow (total from Filter Nos. 2, 4, 6, 8, and 10) westward to the proposed Northwest Clearwell addition and then to the existing 66-inch bypass line from the junction box. The remaining 50 percent of the filter water flow (from filters 1, 3, 5, 7, and 9) is split between the combination of the existing Primary Clearwell and new Southside Clearwell. The two south flow streams re-combine at the outlet of the expanded Primary/Southside Clearwell complex, but constitute only 50 percent of the flow associated with that route and analyzed in Alternative 1.

Table 3-3 Flow Case Hydraulic Analysis Update

Case	Alternative Combinations	Flood Stage River Elevation	Total Effluent Flow to River	Total Filter Complex Flow	Available Filter Headloss (1)
		(ft)	(mgd)	(mgd)	(ft)
5	Existing Facility	432	165	120	6.35
	1 (2, 3)	432	165	120	6.55
	1 & 2 (Filters 1,3,5,7,9) (2)	432	165	120	8.80
	1 & 2 (Filters 2,4,6,8,10) (4)	432	165	120	6.45
6	Existing Facility	432	200	120	1.50
	1 (2, 3)	432	200	120	1.70
	1 & 2 (Filters 1,3,5,7,9) (2)	432	200	120	3.95
	1 & 2 (Filters 2,4,6,8,10) (4)	432	200	120	2.80

(1) Available headloss of at least 6.5 feet is recommended to prevent the need for shortening the filter backwash interval to half the typical time. If the available headloss is less than 6.5 feet, the full 120 mgd capacity of the Filter Complex cannot be maintained without a reduction in the bypass flow rate and/or the natural lowering of the Colorado River stage elevation.

(2) Odd numbered filters discharge through the existing primary clearwell and/or through the proposed Southside Clearwell Expansion, but not through the proposed proposed Northwest Clearwell addition.

(3) Even numbered filters discharge either through the existing primary clearwell and/or through the proposed Southside Clearwell Expansion as applicable.

(4) Even numbered filters discharge only through the proposed Northwest Clearwell addition.

The information presented in Table 3-3 allows drawing the following conclusions related to Case 5 (total flow of 165 mgd, 120 mgd through the filters, and Colorado River at the 100-year flood stage elevation of 432):

- With a minimum target available filter headloss of 6.5 feet (average of the actual range of filter headloss experienced of 3 to 10 feet), the existing facility case available headloss of 6.35 feet is slightly less than the minimum recommended to achieve the full 120 mgd Filter Complex flow without significantly more frequent (twice as often) backwashing of the filters.
- Constructing only the Southside Clearwell expansion (Alt. 1) provides a substantial increase in water storage volume (113,000 gallons), but only a modest increase in available filter headloss (a 0.20 foot increase to a total of 6.55 feet). The available head is only the minimum recommended to achieve the full 120 mgd Filter Complex flow at the 100-year river flood stage with backwashing of the filters at approximately half the usual interval. This addition provides a significant improvement in storage volume, but not filtration sustainability.
- Constructing both Alternatives 1 and 2 results in 8.80 feet of available filter headloss for filters 1, 3, 5, 7,and 9), which begins to approximate a full filter run cycle between backwashing.
- For the north half of the Filter Complex, combining Alternatives 1 and 2 results in 6.45 feet of available filter headloss for filters 2, 4, 6, 8,and 10), which again means backwashing the filters approximately twice as often.
- Further reduction in the headloss, in order to consistently achieve the 120 mgd flow rate, and current filter backwashing cycle times would require infrastructure expenditures considerably higher than that associated with the proposed clearwell structures. The necessary additional headloss reduction could only be achieved by reducing the flow in the existing outfall line. This can be accomplished by adding parallel pipelines, either a gravity flow outfall line or a smaller pumped line.

The information presented in Table 3-3 allows drawing the following conclusions related to Case 6 (total flow of 200 mgd, 120 mgd through the filters, and Colorado River at the 100-year flood stage elevation of 432):

- With a minimum target available filter headloss of 6.5 feet (average of the actual range of filter headloss experienced of 3 to 10 feet); the existing case available headloss of 1.50 feet is significantly below the minimum recommended to achieve the full 120 mgd Filter Complex flowrate. Consequently, either impossibly short filter backwash cycles must occur, or the total output from the Filter Complex will need to be reduced.
- Constructing the Southside Clearwell expansion provides a substantial increase in water storage volume (113,000 gallons) as previously discussed. However, once again only a modest increase in available filter headloss (0.20 foot increase to a total of 1.70 feet); still inadequate as discussed in the previous item.
- Constructing both Alternatives 1 and 2 results in 3.95 feet of available filter headloss for filters 1, 3, 5, 7, and 9. While a significant improvement in allowable filter headloss, it is never-the-less only 1 foot above the 3-foot minimum required by a clean filter, and far below the average minimum target of 6.5 feet.
- For the filters on the north half of the Filter Complex, combining Alternatives 1 and 2 results in 2.80 feet of available filter headloss for filters 2, 4, 6, 8,and 10, which does not even meet the minimum requirement of 3-feet for a clean filter.

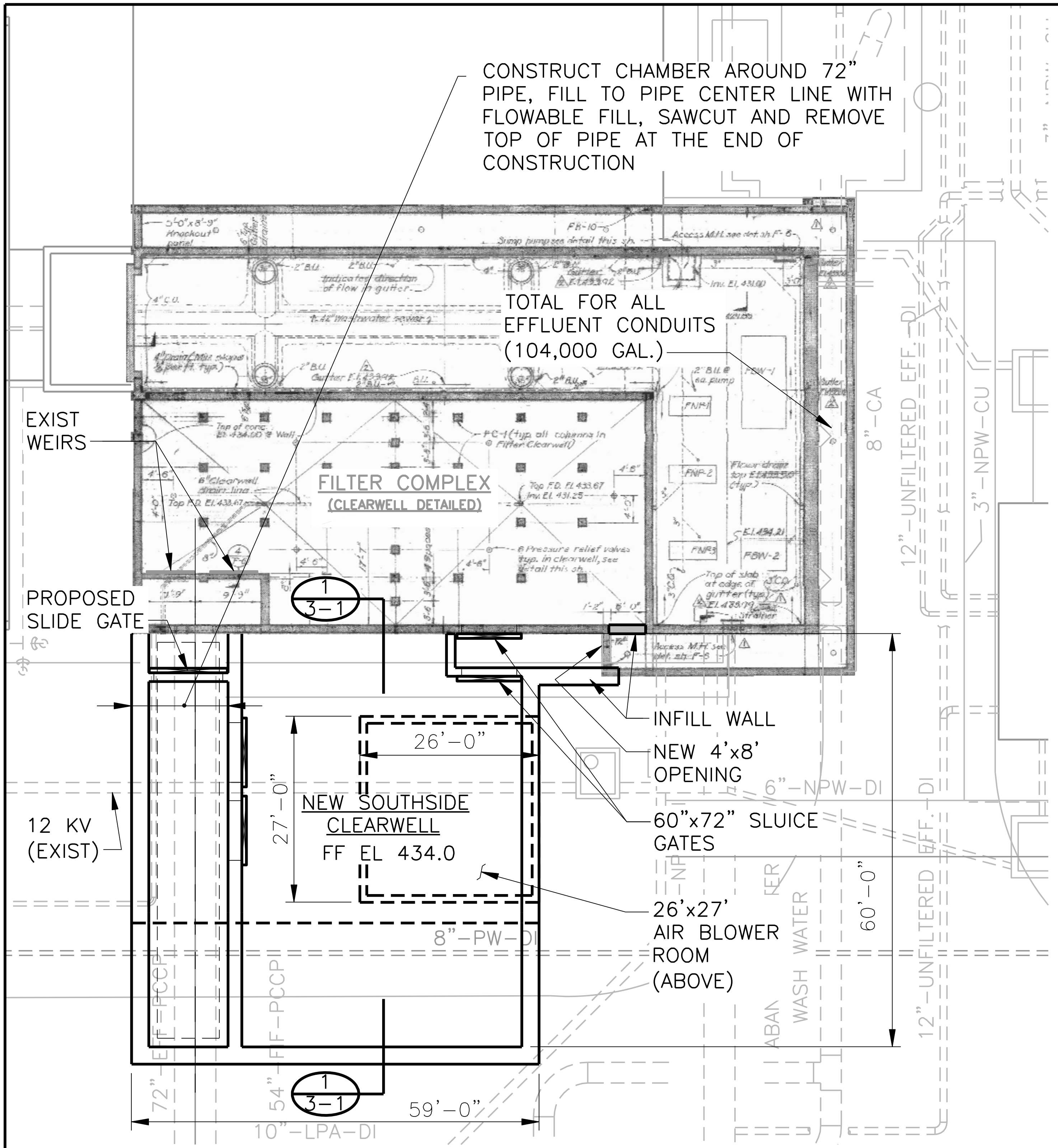
- The proposed clearwell improvements are not sufficient under any circumstances to meet a full Filter Complex flowrate of 120 mgd when the total flow to the river outfall is 200 mgd. The Filter Complex must operate at a reduced filtration rate.
- Further reduction in the headloss in order to consistently achieve the 120 mgd flow rate under the most severe performance conditions of Case 6 would require infrastructure expenditures of the types discussed above, but which are at even higher cost than those required for Case 5.

3.2 Miscellaneous Clearwell Systems

The following miscellaneous systems and appurtenances should be developed with plant staff early during the final design phase for inclusion in the final facility:

- Ingress and egress means to all constructed clearwell areas.
- Confined space entry appurtenances (temporary ventilation, fall prevention, etc.).
- Safety railing systems along edges of change in floor levels exceeding approximately 18-inches.
- Venting capacity adequate for the maximum rate of volume change in the stored liquid.
- Facility drainage (likely pumped) systems.
- Dechlorination chemical feed to the Northwest Clearwell addition, as well as possible mixing.
- Flow metering for pacing all dechlorination chemical feed points.
- Additional process flow monitoring equipment as desired.
- Others as subsequently identified.

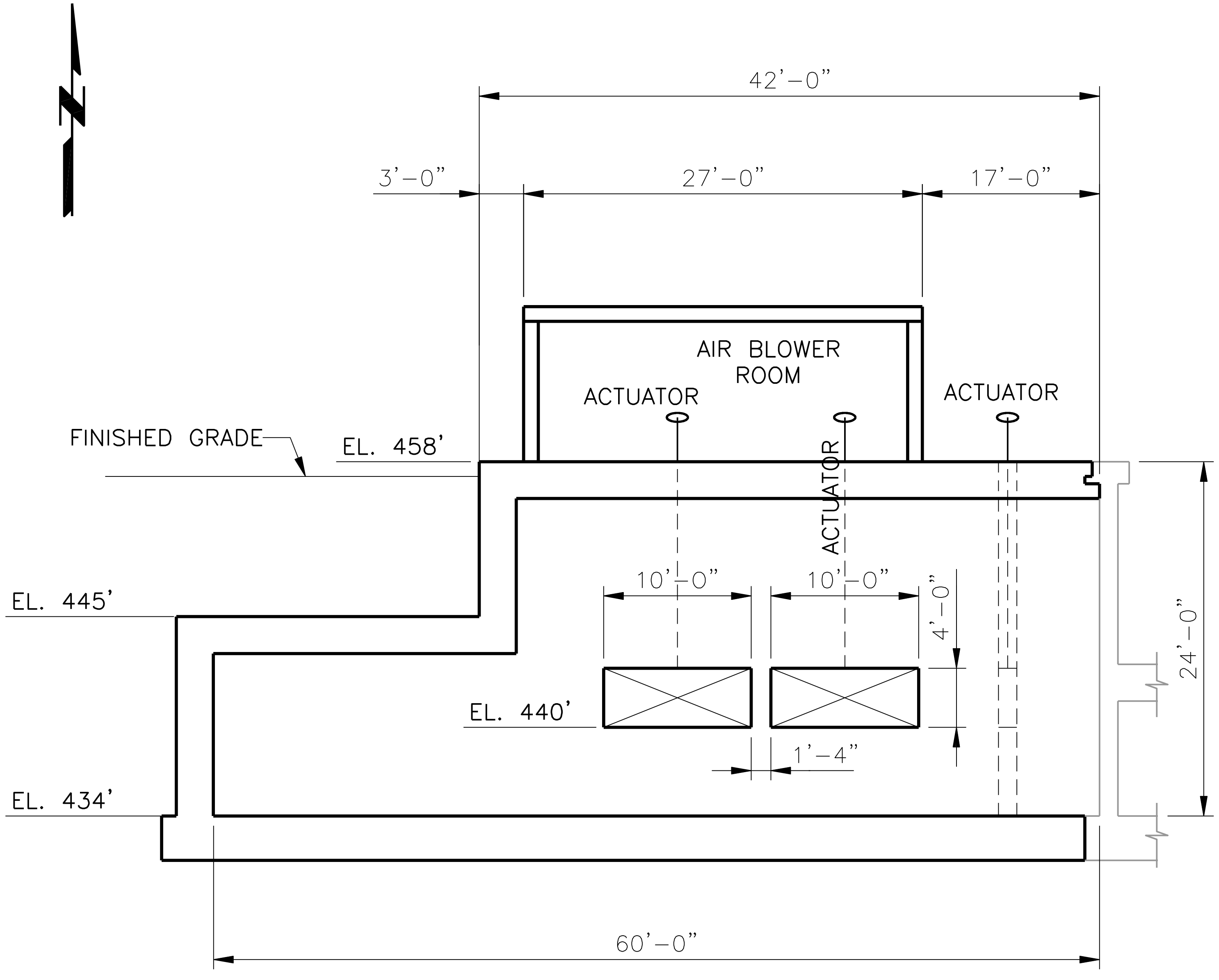
168622-Walunt Creek Filter Rehab/40.0000-Preliminary Design/47.0000-Preliminary Graphics/Fig_3-1.dwg



ALTERNATIVE 1

ADDITIONAL CLEARWELL
VOLUME: 133,000 GAL.

20' 10' 0 20' 40'
1"=20'



SECTION

SCALE: 3/32"= 1'-0"

1
3-1

Austin WATER

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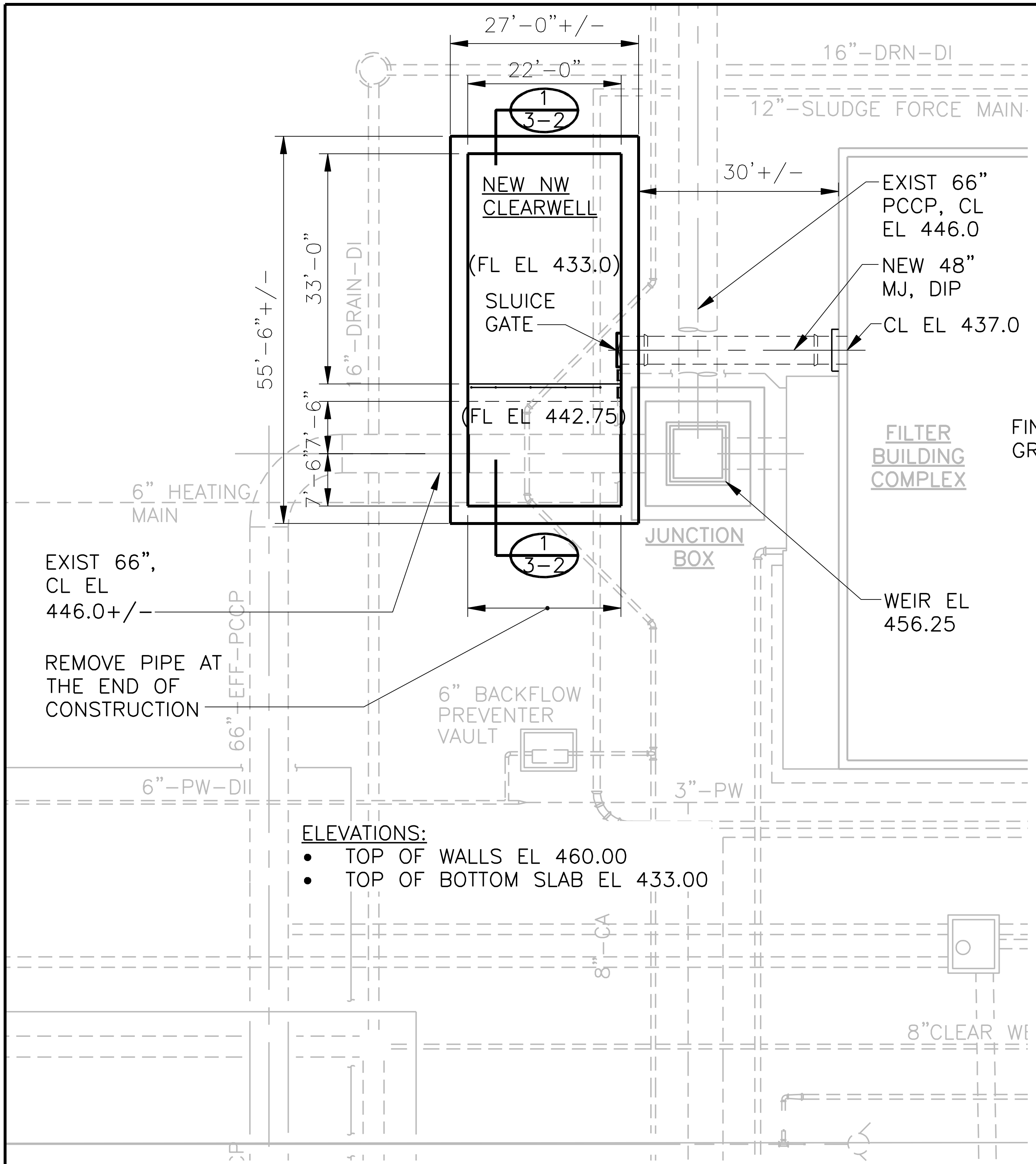
PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER REHABILITATION PROJECT

SOUTHSIDE CLEARWELL ADDITION

168622-Walunt Creek Filter Rehab/40.0000-Preliminary Design/47.0000-Preliminary Graphics/Fig_3-2.dwg



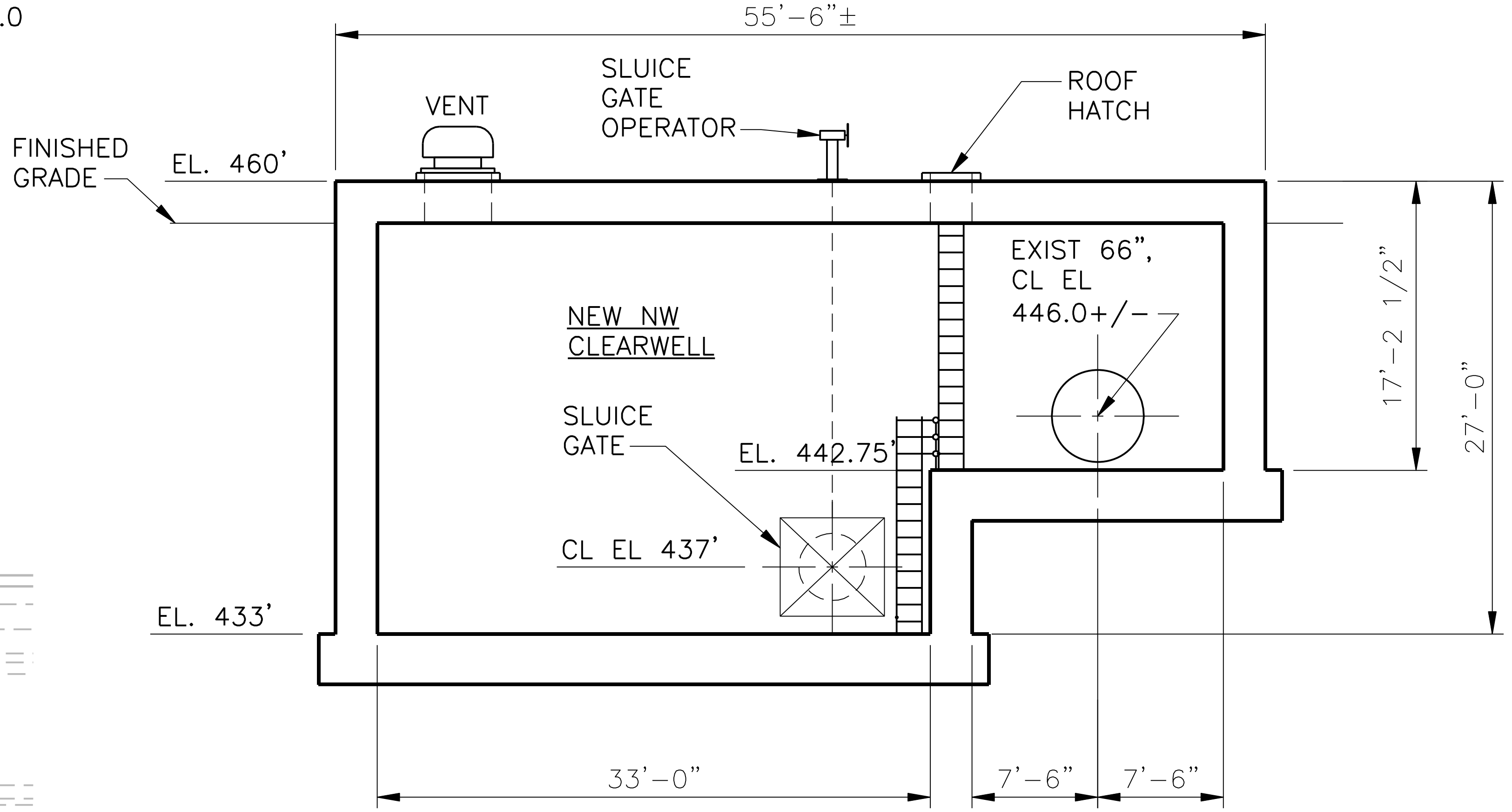
ELEVATIONS:
- TOP OF WALLS EL 460.00
- TOP OF BOTTOM SLAB EL 433.00

20' 10' 0 20' 40'

1"=20'

ALTERNATIVE 2

ADDITIONAL CLEARWELL
VOLUME: 56,000 GAL.



SECTION 1/3-2

SCALE: 3/32"= 1'-0"

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PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER REHABILITATION PROJECT

NORTHWEST CLEARWELL ADDITION

3-2

4.0 Treatment Facilities

This section summarizes the physical parameters of the filter process which will be modified as a result of this design project. Civil design criteria and materials selections are discussed in Section 5. Filter improvements were selected based on the results presented in TM1 through TM3, included as an appendix to this PER. TM1 and TM3 are most applicable to this section, TM1 is a condition assessment of the existing plant and TM3 focuses on the proposed improvements to the granular filters, providing justification for the proposed changes.

4.1 Filters

Ten filters exist at the Walnut Creek WWTP. The first four filters were constructed as part of the original plant in 1979 and filters 5 through 10 were constructed as part of the plant expansion in 1990. Filters 1 through 4 were constructed with a clay tile underdrain system without the capability of providing air for the air scour portion of the backwash. These four filters also were constructed with a surface wash system that is no longer used by plant staff due to the age of the system. The dual media in these four filters is also below design levels. For these reasons filters 1 through 4 are recommended to be modified to be more similar in configuration and operation to filters 5 through 10. Filters 5 through 10 are not being modified except for the addition of anthracite media to bring the media level up to the design depth of 48” and the re-introduction of air supply for the combination air/water backwash. Filters 1 through 4 will be as indicated in Table 4-1.

Table 4-1: Filters 1 through 4

Description	Value
Number of filters	4
Type of filters	Single cell, center gullet
Filter configuration	
Cell length, ft	30
Cell width, ft	36
Effective filter area, sq. ft.	1080
Nominal filter capacity at 5 gpm/sf, mgd	7.8
Filter loading rate, gpm/sf at 75 mgd	
9 filters in service (average)	5.31
10 filters in service (average)	4.78
9 filters in service (peak)	8.51
10 filters in service (peak)	7.65
Design unit filter run volume, gal/sf	7,200 (24 hr @ 5 gpm/sf)
Filter media (Anthracite)	
Effective size, millimeter (mm)	1 to 1.2
Uniformity coefficient	<1.6
Passing #8 sieve, percent, minimum	93.5
Passing #25 sieve, percent, minimum	1.2
Depth, inches	48
Media support	
Support layer	3” gravel

Table 4-1: Filters 1 through 4	
Description	**Value**
Underdrain type	Nozzle type with combined air/water backwash, to be determined.

4.2 Filter Backwash System

The Walnut Creek WWTP currently backwashes all ten filters using one of the two existing backwash pumps located at the east end of the pipe gallery. The existing backwash pumps are at the end of their useful life, not capable of pumping at their design point. Therefore, new backwash pumps will be installed. Plant staff is forced to conduct backwash operations manually. There are several reasons for this. First, automated backwash control from the main control panel was lost several years ago, forcing plant staff to operate the backwash cycle at each control panel. Second, plant staff cannot close the filter effluent valve from the control panel, requiring the valve to be shut manually in the pipe gallery. Third, the only panel capable of modulating backwash pump flow is filter control panel 1. The alternative method for modulating flow is in the pipe gallery at the pumps. The backwash operation will be automated to increase filter efficiency. A new flow meter and modulating valve will be installed on the pump discharge to the filters.

Additionally, the installation of two new air blowers will allow, for the first time, an air component in filters 1 through 4. The existing air supply lines from the Operations Building to Filter Building 2 – filters 5 through 10 - are in disrepair and are not capable of providing a reliable air supply; they have not been used to provide air to filters 5 through 10 for some time. For this reason the new air blowers will be located immediately to the south of Filter Building 1 and new air supply lines will be installed to provide a reliable source of air to all ten filters.

Table 4-2 describes the proposed backwash system.

Table 4-2: Backwash Systems	
Description	**Value**
Backwash Flow Rate, gpm/sf	20
Backwash supply pumps	
Number of units	2 (1 duty, 1 standby)
Type	Centrifugal
Pump flow rate, gpm	22,000
Rated head, ft	48
Motor size, hp	350
Air scour blowers	See Section 8

4.3 Replacement and Renovation of Assets With Less than 20 Years Useful Life

Each of the 10 filters has the following appurtenances that will be replaced due to these items no longer able to provide reliable, low maintenance service: effluent valve, effluent flow meter, influent valve, backwash supply valve and filter backwash drain valve.

- The new effluent valves on all 10 filters will be 20-inch diameter full-body butterfly valves with electronic actuators specifically designed for modulating service.
- The new effluent flow meters for each filter will be electromagnetic flow meters, also 20-inch diameter, installed upstream of the new effluent valves. The existing effluent piping from each filter will be modified to accommodate the new valves and flow meters.
- All of the existing 36” filter influent valves will be replaced with new 36” full-body butterfly valves with open-close actuators. A new platform with access ladder, tie-off points and hoisting provisions will be constructed to improve access to these valves and actuators. Each valve stem will be rotated and include extended shafts as required to improve access to the actuator. The access platform will straddle the existing backwash piping in filters 1 through 4 and the platform and ladder will straddle the existing backwash waste piping for filters 5 through 10. New local-remote open-close control stations will be mounted to the access platform supports so the valve can be manipulated from the gallery floor. The existing 30” backwash supply valves will be replaced with new 30” full-body butterfly valves with open-close actuators. Piping modifications will be made to improve access to the actuators from the gallery floor using a scissors lift. New local-remote open-close control stations will be installed adjacent to each valve so that they can be positioned from the gallery floor.
- The 36” backwash drain valves will be replaced with new full-body butterfly valves with open-close actuators. The corroded pipe harness mechanisms below these valves will be replaced, as well. New local-remote open-close control stations will be installed adjacent to each valve so that they can be positioned from the gallery floor.
- All existing and new piping, valves and appurtenances will be recoated as part of these improvements.

The following items are associated with the filters but are not part of each individual filter, necessarily. Each of these items will be replaced:

- Three of the four sump pumps will be replaced as part of these improvements. One of the sump pumps was recently replaced.
- The Cla-Val valve will also be replaced.
- The vacuum prime system will be evaluated and rehabilitated. If necessary the system will be replaced. For the purposes of the Engineer’s Opinion of Probable Construction Cost, this cost is included.
- The existing surface wash system in filters 1 through 4 will be removed.

The City of Austin requires each item retired from service to be documented in their Computerized Maintenance Management System (CMMS). Therefore, construction specifications will require the contractor to work with the City of Austin to document through the CMMS all items retired as part of construction.

5.0 Civil Design Criteria

Most work associated with this filter improvements project is to improve on existing conditions, and those various tasks are covered under other sections throughout this report. It is anticipated the clearwell expansion to the south will create some civil design issues. Those issues are covered in the following sections.

5.1 Existing Utilities

The proposed air blower building will be constructed on top of the proposed Southside Clearwell. The construction of the expanded clearwell will require the relocation of existing utilities. Black & Veatch used the record drawings to determine which utilities will be affected by the construction, but we strongly encourage the City of Austin to conduct sub-surface utilities investigations to determine the exact location of all utilities in the vicinity of the proposed clearwell. The Black & Veatch Team is aware of a 12KV electrical duct bank that runs east to west just south of filters 1 and 3. This duct bank will have to be rerouted, as well, during construction of the proposed Southside Clearwell. We are also aware of the 16-inch ductile iron non potable water (NPW) pipe that extends southward from the pipe gallery Filter Building Pump Room and an 8-inch ductile iron potable water main that runs east-west approximately 40-feet south of the Filter Complex.

5.2 Plant Roads

Also as a result of the proposed Southside Clearwell construction, the plant road immediately to the south of the Filter Complex will be affected. It is anticipated this road will be reconstructed to match existing.

5.3 Non-Potable Water

The NPW supply is obtained from one of two sources, either from the discharge of the high service pumps on the reclaimed water system or from the non-potable pumps that are located in the pipe gallery under Filter Building 1. This system is utilized for general wash-down service but also feeds the eductors in the chlorine and sulfur dioxide systems on the plant site. The required pressure in this system is 80 psi and the required flow is approximately 1,800 gpm. The quality of this water is important, as it supplies equipment that can plug if there are too many solids in the system. The plant would violate their permit condition for disinfection if the non-potable system were to fail.

5.3.1 Non-Potable Water (Pump History

The three existing NPW pumps are horizontal split case, double suction pumps and are designated using the label FNP on record drawings, which stands for *Filter Building Non-Potable Water Pumps.* Information for each of the existing NPW pumps is as follows:

<u>Pump FNP-1:</u>

In-Service Date: 1979	*Capacity*: 1200 gpm	*Motor*: 125 hp
Manufacturer: Patterson Pump Co.	*Serial #:* Unknown	*Model*: 6 x 5 M

This pump was originally installed as FNP-3, then moved to surface wash duty. Currently the plant does not use surface wash in their operation of the filters.

Pump FNP-2:

In-Service Date: 1979 *Capacity*: 1500 gpm *Motor*: 125 hp
Manufacturer: Patterson Pump Co. *Serial #:* 74PT-781-A5 *Model*: 6 x 5 M
A new rotating assembly for this pump was shipped in 1998, according to Patterson Pump Co.

Pump FNP-3:

In-Service Date: 1979 *Capacity*: 1500 gpm *Motor*: 125 hp
Manufacturer: Patterson Pump Co. *Serial #:* 74PT-782-A5 *Model*: 6 x 5 M
This pump only ran for a short period of time. This unit will not deliver the same pressure as FNP-2 and is not backed up with standby power.

5.3.2 Purpose

It should also be noted that just downstream of the pumps is a 6-inch Zurn automatic self-cleaning strainer. This strainer is looped into the system by a 6-inch line to the 16-inch NPW line leaving the Filter Complex. We have been unable to locate data on the Zurn Model 595 Series strainer. The original design specifications required a cast iron vessel with stainless steel strainer having a 20 x 20 mesh (880 microns) screen. The drive motor for the strainer was to be 460 volt, 60 Hz 3 phase. The flow capacity of the unit is also unknown. The purpose of the NPW pumps is to provide non-potable water to be used for the following primary applications:

a. Chlorination System
b. De-chlorination System
c. Heat Exchangers for Blowers
d. Pump Seal Water
e. Equipment Washdown and Hose Bibs/Hydrants
f. Make-up water for the pond in front of the Administration Building
g. Primary basin scum wells and the stilling wells in the flow equalization basins
h. Seal water for the scum and waste pumps in the basin tunnel
i. Grit removal for flushing grit from the bearings and bearing lubrication, bucket cleaning sprays, cleaning the grit loading area and aerated grit basin wall, and for flushing the measuring flume sitting wells in the Headwork’s Building
j. Miscellaneous small volume uses throughout the plant

5.3.3 Source Of Non-Potable Water

The existing NPW system is capable of using several different resources as a supply for NPW water.

At the present time, the primary source for NPW is the Walnut Creek Ground Storage Tank approximately 400 feet east of the Filter Complex. When the high pressure pumps are not in operation, the static head pressure is supplied from the 51st Street Elevated Storage. NPW is supplied to the plant through a 16-inch ductile iron pipe from the Walnut Creek Ground Storage Tank. Upon leaving the Walnut Creek Ground Storage Tank system the NPW first passes through a pressure reducing valve and a Panametrics flow meter located in a manhole just southwest of the Walnut Creek Ground Storage Tank. The NPW is then distributed to the rest of the plant. A site visit was conducted on December 9, 2011 and observed the flow meter reading 1,762 gallons per minute (gpm).

If the Walnut Creek Ground Storage Tank system should fail to provide NPW to the plant, the Pump Clearwell and NPW Pumps located in the Filter Complex can provide a secondary source of NPW. The NPW 12-inch suction line to the NPW pumps in the Filter Complex comes from the Pump Clearwell located just north of the Filter Complex. Each NPW pump originally pulled filtered water from the Primary Clearwell beneath filter No. 1, but the shallow depth of the clearwell and the location of the suction lines lead to the potential for cavitation of the pumps. Thus, the new 12-inch suction line in the Pump Clearwell north of the Filter Complex was constructed and is now the existing secondary source of NPW.

According to the City of Austin "Operator Pocket Guide #3: *Blowers and Plant Auxiliary Systems*" written by CDM Inc., another alternate source (third source) of NPW is provided by the 54-inch filter influent line. This unfiltered water is introduced into the NPW system on the suction side of the pumps. When this filter influent is used as the alternate source of NPW the existing Zurn strainer would be used to strain the unfiltered water for use as seal water for the filter backwash pumps. See Figure 5-1 for a schematic diagram of the existing NPW system in the filter building.

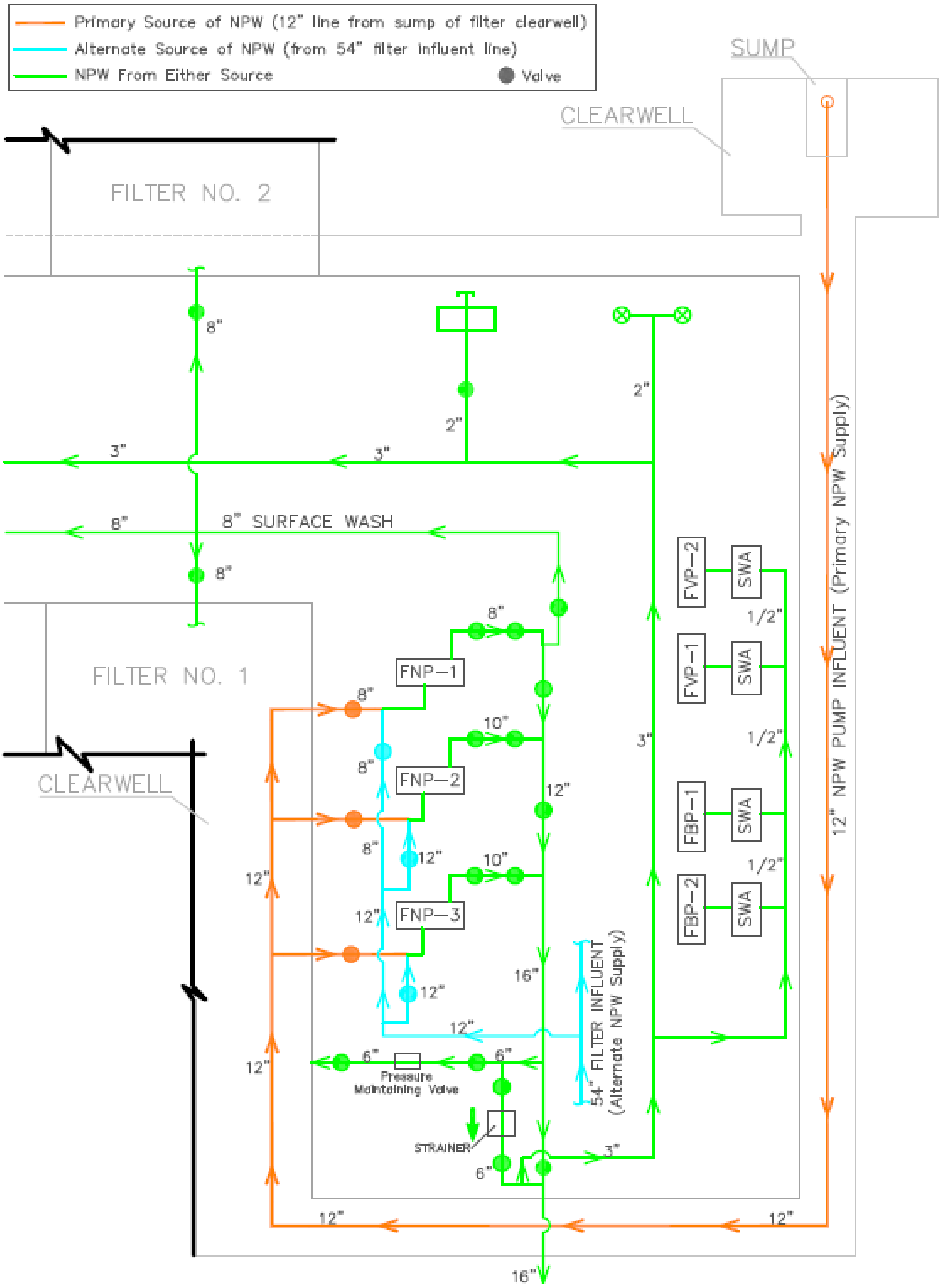


Figure 5-1 Existing NPW Pump System
(Primary & Alternate NPW Sources Shown)

5.3.4 *Importance Of System*

The following text is also from the COA "Operator Pocket Guide #3: *Blowers and Plant Auxiliary Systems*" written by CDM Inc.:

"*Non-potable water supplied to the Headworks Building is used in the grit removal area for flushing grit from the bearings and bearing lubrication, bucket cleaning sprays, cleaning the grit loading area and aerated grit basin wall, and for flushing the measuring flume stilling wells.*

The pond in front of the Administration Building uses non-potable water for makeup. Non-potable water is also used as seal water from APR-1 and APR-2, the pond water recirculation pumps in the Administration Building pump room.

The non-potable water is used to flush the primary basin scum wells and the stilling wells in the flow equalization basins. Non-potable water is used as seal water for the scum and waste pumps in the basin tunnel. The hose bibs at the primary basins and in the basin tunnel are connected to the non-potable system.

In the Operations Building, the non-potable water is used in the chlorine injectors, in the seal water system for pumps OSW-1 through OSW-8 and pumps ORW-1 and ORW-2, and as cleanup water for the raw wastewater pumping station. Non-potable water is also used as the cooling medium in the heat exchangers of the cooling water system, which supplies cooling water for the blowers and other equipment.

At the Activated Sludge Complex, non-potable water is used as seal water for pumps BWP-1 through BWP-9 and pumps BSP-1 through BSP-6. Non-potable water is also supplied to the various hose bibs and to the water spray system for foam control in the flocculation basins.

At the Filter Building, non-potable water is used as seal water for FNP-1 and FNP-2, for the surface wash of Filters 1 through 4, and to supply the hose bibs and hydrants at the filters.

Non-potable water is used at the DAF thickener for washdown, seal water for pumps, flush water for air lift pumps, polymer system, and at the spray bar on the thickened sludge beach plate.

At the DAF pump pressurization station, non-potable water is used for pump seal water, flushing the air release valve, and washdown."

5.3.5 *Technical Memorandum 1 (TM1)– Condition Assessment & Performance Ranking*

According to TM1 each of the existing NPW pumps and strainer were ranked using tables TM1-1 and TM1-2 as seen below.

Table TM1-1. Condition Ranking Scale

Ranking	Condition Level
1	Excellent
2	Slight Visible Degradation
3	Visible Degradation
4	Integrity of Component Moderately Compromised
5	Integrity of Component Severely Compromised

Table TM1-2. Asset Performance Ranking Scale

Ranking	Performance Level
1	Component Functioning as Intended
2	In-service, but Higher than Expected Operations and Maintenance
3	In-service, but Function is Impaired
4	In-service, but Function is Highly Impaired
5	Component is not Functioning as Intended

The condition and performance ranking for each of the NPW pumps and strainer, as well as the associated quantitative risk and response recommendation determined by TM1 is as follows:

Table TM1-3. NPW System Condition, Performance & Risk Summary

Equipment	Condition	Performance	Risk	Recommended Response
Pump FNP-1	4	5	Extreme	Replace/Refurbish
Pump FNP-2	2	4	Major	Near-term Corrective Action Required
Pump FNP-3	2	4	Major	Near-term Corrective Action Required
Strainer	3	5	Extreme	Replace/Refurbish

5.3.6 Existing NPW Pump Data

Attachment 5-1 and attachment 5-2 show the pump curves provided by Patterson Pump Co. for the existing NPW pumps FNP-2 and FNP-3. A pump serial number for pump FNP-1 is not available.

5.4 Future NPW Design Issues

5.4.1 Future NPW Uses

There are no future NPW uses planned. The existing and proposed NPW system will not be adequate to serve the entire needs of a possible future 25 MGD plant expansion.

5.4.2 Future Capacity Requirements

A design capacity of 1,800 gpm at 80 psi has been selected. This is based on the current usage as measured by the Walnut Creek Ground Storage Tank flow meter and as recommended by the plant staff.

5.4.3 Identification of Alternatives

There are four proposed alternatives for the new NPW pumping system, which are as follows:

> <u>Alternative 1</u>: Install (2)-1,800 gpm Pumps for Manual Operation (Figure 5-2), including concrete pads, new piping and valves for the pumps. Though this alternative only includes two pumps, plant staff has requested that, if selected, three concrete pump pads along with necessary power and controls for three pumps, should a third 1,800 gpm pump be needed, to be provided in the future. The pumps could be converted to a lead/lag control system if a third pump is added to the system.

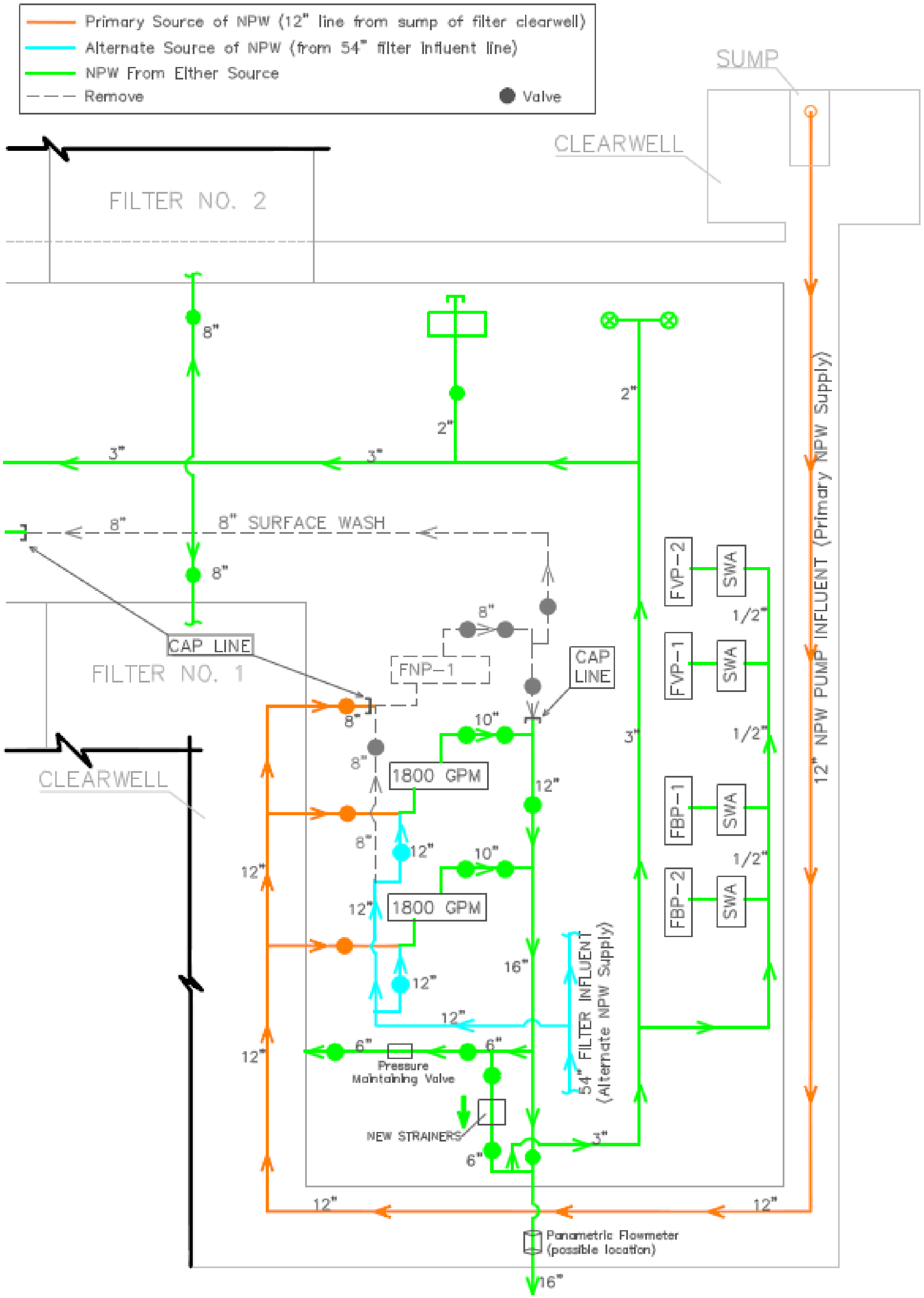


Figure 5-2 Alternative 1: (2)–1,800 GPM Pumps

Alternative 2: Install (1)-900 gpm Pump and (2)-1,800 gpm Pumps for Manual Operation (Figure 5-3), including concrete pads, new piping and valves for the pumps.

Alternative 3: Install (3)-900 gpm Pumps for Automatic Lead/Lag Operation (Figure 5-4), including concrete pads, new piping and valves for the pumps.

Alternative 4: Install a 6-inch backflow preventer (BFP) and tie 6-inch potable water line exiting the south end of the Administration Building to the NPW system by connecting to the 6-inch NPW line south of the Administration Building. This option would serve as an emergency source of water for the NPW system. Note that there is another 6-inch potable water line in the area that is a fire line, and both potable water lines discussed here are supplied by the same 12-inch water main. Whether cross-connecting the potable and NPW systems is viable would be verified during design.

The original pump manufacturer for the existing NPW pumps was Patterson Pump Co. The models originally installed were the 8X6 MI models. Cut sheets for a 1,800 gpm (80 psi) 8x6 MI split case pump that Patterson Pump Co. currently has available is shown in attachment 5-3. Cut sheets for a 900 gpm (80 psi) split case pump that Patterson Pump Co. has available are shown in attachment 5-4.

Note that there was discussion of adding variable frequency drives (VFD's) to the pump motors in order to conserve energy, but it was determined that there is not enough space available for the equipment.

5.4.4 Flow Meter Requirements

Currently there are no flow meters assigned to monitor flow from the NPW pumps in the Filter Complex. Discussion with the City of Austin and Walnut Creek WWTP staff resulted in a recommendation that a flow meter be placed on the 16-inch NPW line just prior to where the 16-inch effluent exits the Filter Complex. This is dependent on space requirements for the flow meter. Plant staff prefers that a strap-on ultrasonic Panametrics flow meter be used. Figure 5-5 shows the flow meter, which includes a 4–20 milliamp transmitter and clamp-on transducers, with coaxial cables. The flow indicator and totalizer signal will be sent to the plants control room for monitoring.

5.4.5 Standby Power Requirements

Standby power for the new NPW pumps should be capable of supplying power to (2)-1,800 gpm NPW pumps. The plant prefers to use a dedicated generator as opposed to a portable generator stored on site.

5.4.6 Piping And Appurtenances Modifications Required

Replacing of the NPW pumps will most likely result in some pump and base, piping and valve replacements or modifications, as the new pumps will have differing dimensions than the existing pumps.

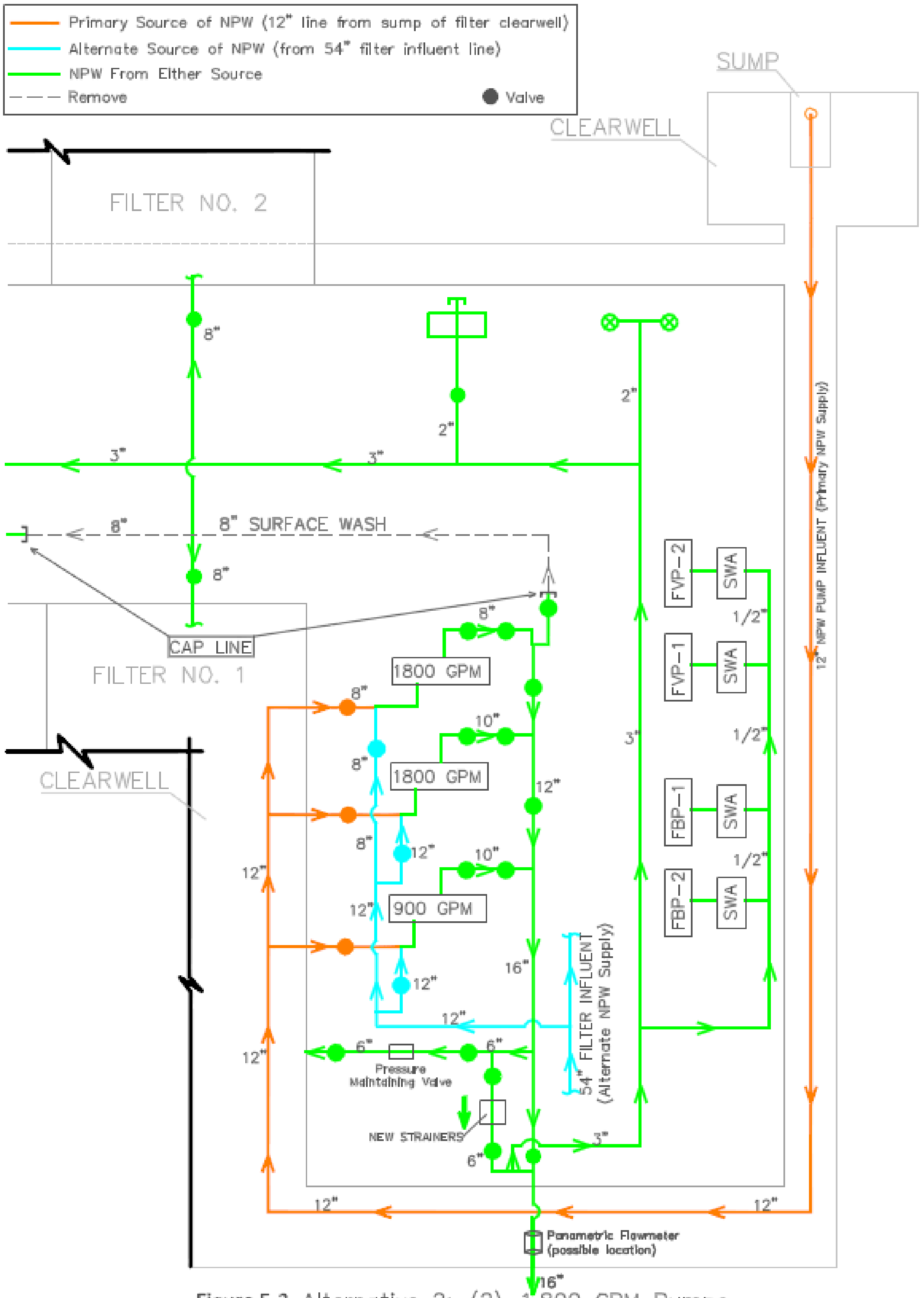


Figure 5-3 Alternative 2: (2)–1,800 GPM Pumps & (1)–900 GPM Pump

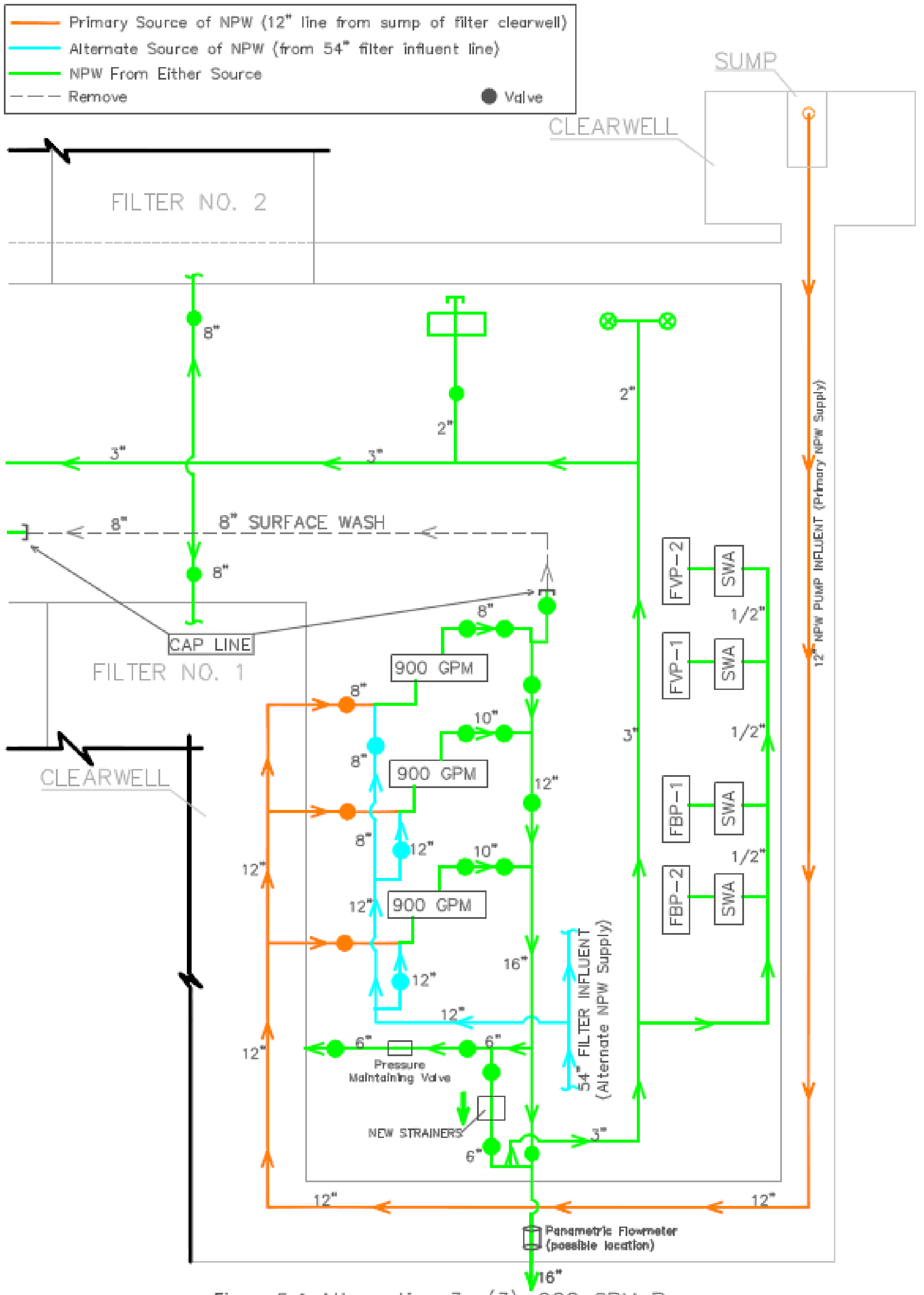


Figure 5-4 Alternative 3: (3)-900 GPM Pumps (with Lead/Lag Operation)

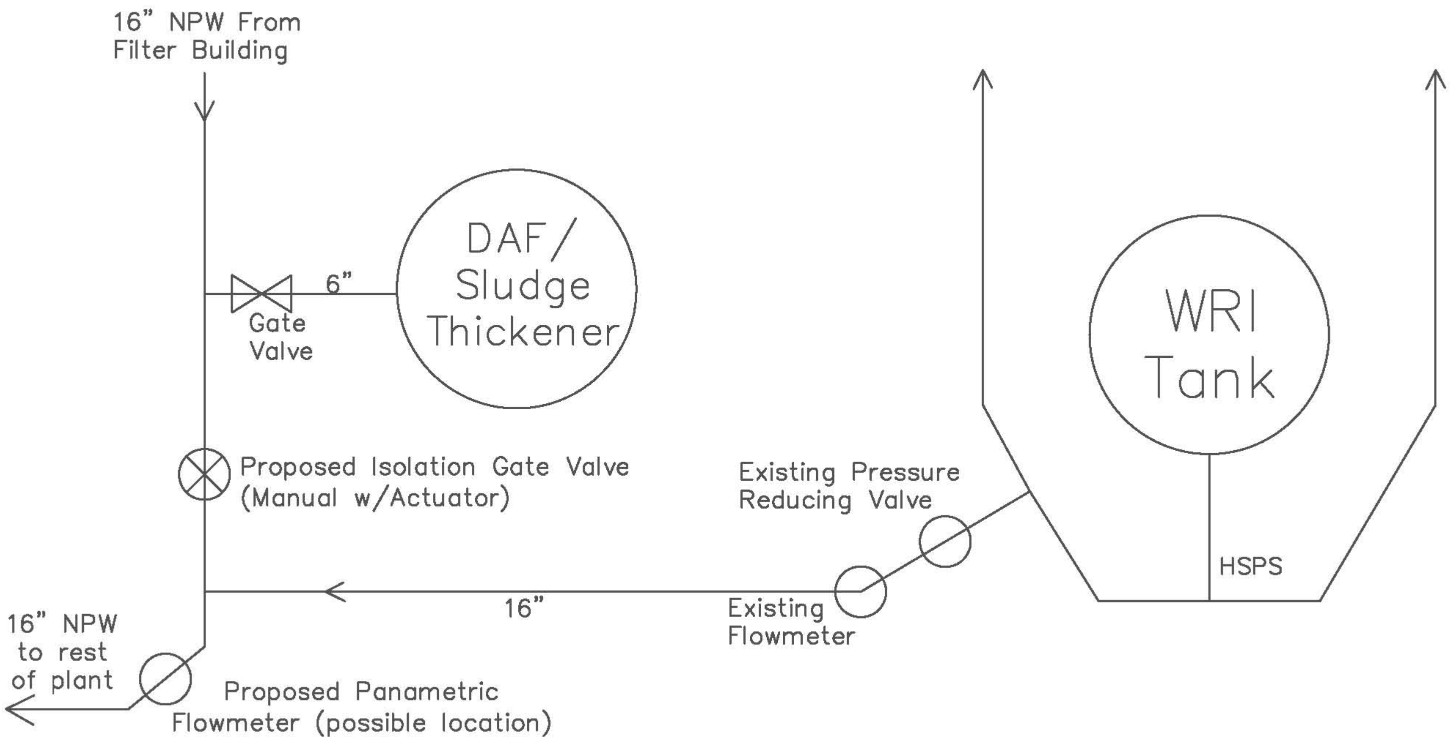


Figure 5-5 Proposed Flow Meter and Isolation Valve

It is estimated that the available flow capacity of the existing strainer, assuming a velocity of 10 feet/second is 800-900 gpm meaning that use of the strainer lacks the capacity to meet minimum flow requirements. However, the plant staff has asked that the existing strainer be replaced and an additional strainer be added so it can provide a portion of the NPW flow. The final design should investigate replacing the existing strainer with two (2) Amiad self-cleaning Model SAF 3000 carbon steel body strainers. The strainers have a capacity of 600 gpm each and would be installed in parallel. The stainless steel strainers will be sized to remove 300 micron particles compared to the existing 880 microns, providing a higher quality of water than that of the existing strainer. Refer to attachment 5-5 for the Amiad SAF3000 data sheets.

A new 16-inch isolation gate valve should be added to the existing 16-inch NPW line just downstream of where the filtered NPW piping and 6" DAF/Sludge Thickener piping connect to the 16" pipe. This valve shall include a manual actuator with a valve position indicator.

The existing 8" Surface Wash system is no longer used and can be disconnected from the 12" NPW pump discharge piping in the Filter Complex pipe gallery.

5.4.7 Interface With Walnut Creek Ground Storage Tank System

There currently exists an interconnection between the Walnut Creek Ground Storage Tank System and a Panametrics AT868 flow meter, with a digital read-out above grade next to the Walnut Creek Ground Storage Tank high service pumps. No modifications to this system are recommended.

5.4.8 System Control Requirements

The proposed NPW pumps, depending on the chosen alternative, will be controlled by either manual operation or lead/lag operation via pressure control.

The proposed NPW flow meter (all-digital AquaTrans AT868) has no moving parts and requires minimal maintenance. An onboard microprocessor uses patented Correlation Transit-Time™ technology for long-term, drift-free operation. Automatic adjustment to changing fluid properties and dynamically configured operating software simplify programming. The LCD display is configurable to display up to four measurement parameters in sequence and has a six-button internal keypad. The standard power supply needed is 85-265 VAC (50/60 Hz) or it is optional to use 12-28 VDC, ± 5%. Maximum power consumption of the system is 20W. Refer to attachment 5-6 for the Panametrics AT868 data sheets.

5.4.9 Alternative Evaluation And Recommendations

<u>Alternative 1:</u> Install (2)-1,800 gpm Pumps for Manual Operation. (Figure 5-2) An advantage of this option is that if one NPW pump is out of service the other pump is capable of supplying the minimum flow capacity of 1,200 gpm. Both pumps should be equipped with standby power connections. The ability to add a future third 1,800 gpm pump will be provided should the plant decide to rely less on the WRI system and more on the NPW system in the future. This additional capacity will not be sufficient for a future 25 MGD plant expansion.

<u>Alternative 2:</u> Install (1)-900 gpm Pump & (2)-1,800 gpm Pumps for Manual Operation (Figure 5-3)

It is not necessary to install a 900 gpm pump that cannot provide for the minimum demand. The installation of two 1,800 gpm pumps that can meet the required flow with one pump out of service is all that is required to meet the demand and provide for a factor of safety. There is no need for the 900 gpm pump.

Alternative 3: Install (3)-900 gpm Pumps for Automatic Lead/Lag Operation (Figure 5-4)
This option is the cheapest; however, two pumps would more than likely be in service at all times as one pump cannot provide the minimum 1,200 gpm demand of the NPW system alone.

Alternative 4: Install 6-inch backflow preventer and tie 6-inch potable line into 6-inch NPW system
The capacity of the existing 6-inch water line just south of the Administration Building is unknown but not capable of providing a minimum capacity of 1,200 gpm. A backflow preventer would be necessary to protect the onsite potable water system. Since this supply of potable water is directly linked to the plants total supply of potable water, its use could jeopardize the plant's fire flow requirements. The risk associated with this alternative prohibits it from being considered further.

It is recommended that Alternative 1 be used. Either of the two 1,800 gpm pumps could handle the demand of NPW water system for the plant and if one pump is out of service, the other can be used while repairs are made. If the budget allows, a third 1,800 gpm pump can be added.

Attachment 5-1 Pump Curve for Existing Pump FNP-2

PATTERSON PUMP DIVISION

BRUNING 40-8403 TOCCOA, GEORGIA MADE IN U.S.A.

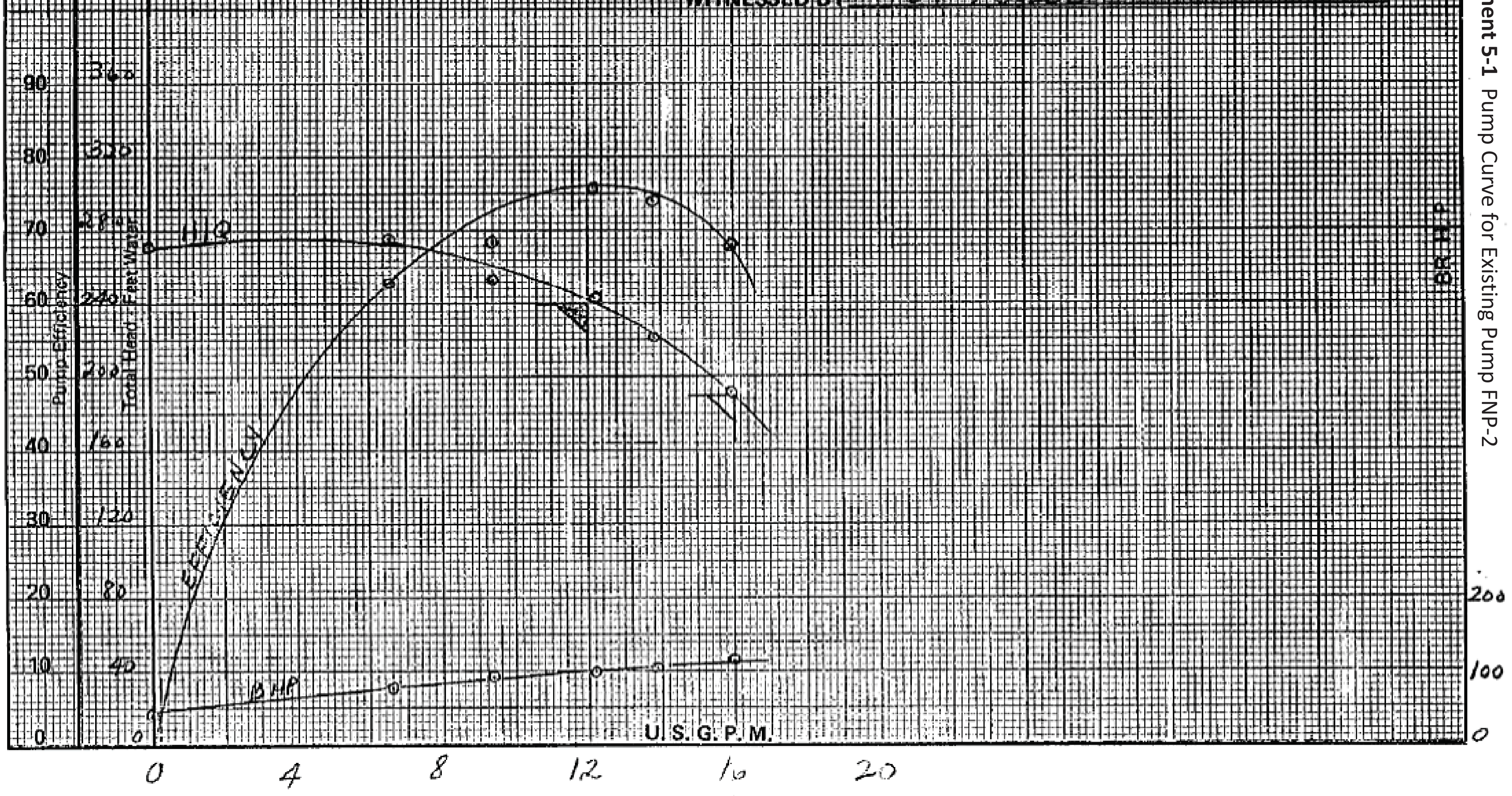
Sold To: Smith Pump Company Date 12-16-75 Tested By RW Serial No. 74PT 781-A5

Job Driver:	HP	Motor Turbine Engine	GPM 1200	Imp. Patt.	C-1862-A	Pump Type	M
Test Driver 150 HP Westinghouse		[✓ Motor] Dyn.	Ft. Hd. 240	Imp. Diam	15¾	Size	6x5
Motor Eff'y 92%	Test Speed 1790 RPM		Rated Speed 1770	No. Stages	1	Test No	1

CERTIFIED TEST BY WESTMORELAND

APPROVED BY

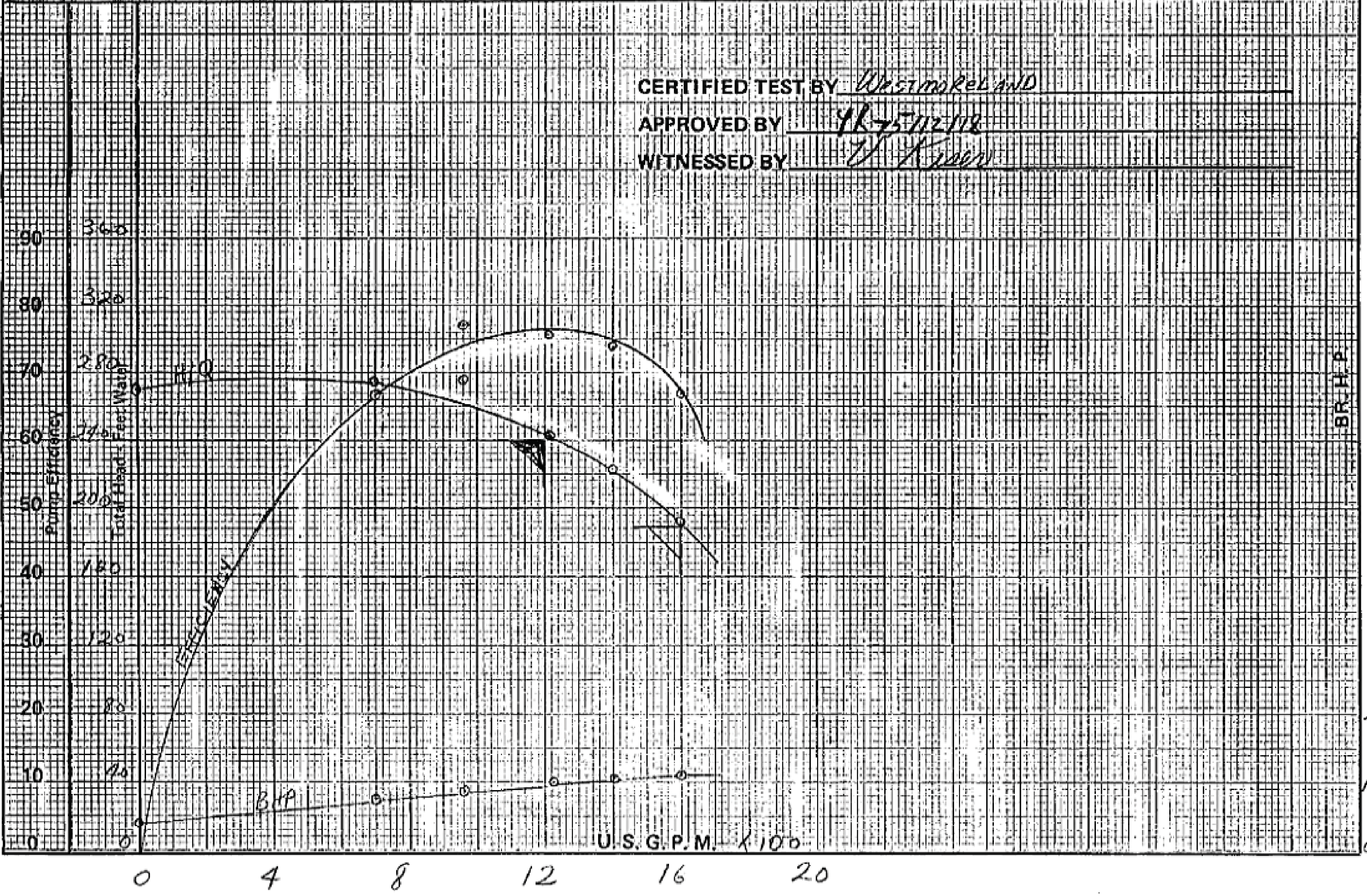
WITNESSED BY



Attachment 5-2 Pump Curve for Existing Pump FNP-3

Sold To: Smith Pump Company Date 12-16-75 Tested By RD Serial No. 74P-782-CS

Job Driver: HP Motor Turbine Engine	GPM 1200	Imp. Patt. C1862A	Pump Type M
Test Driver: 150 HP Westinghouse (Motor) Dyn.	Ft. Hd. 240	Imp. Diam. 15 3/4"	Size 6 X 5
Motor Eff'y. 92% Test Speed 1790	Rated Speed 1770	No. Stages 1	Test No. 1



CERTIFIED TEST BY Westmoreland

APPROVED BY

WITNESSED BY

Patterson
Toccoa, Georgia
U.S.A.

8 x 6 MI
SPLIT CASE PUMP

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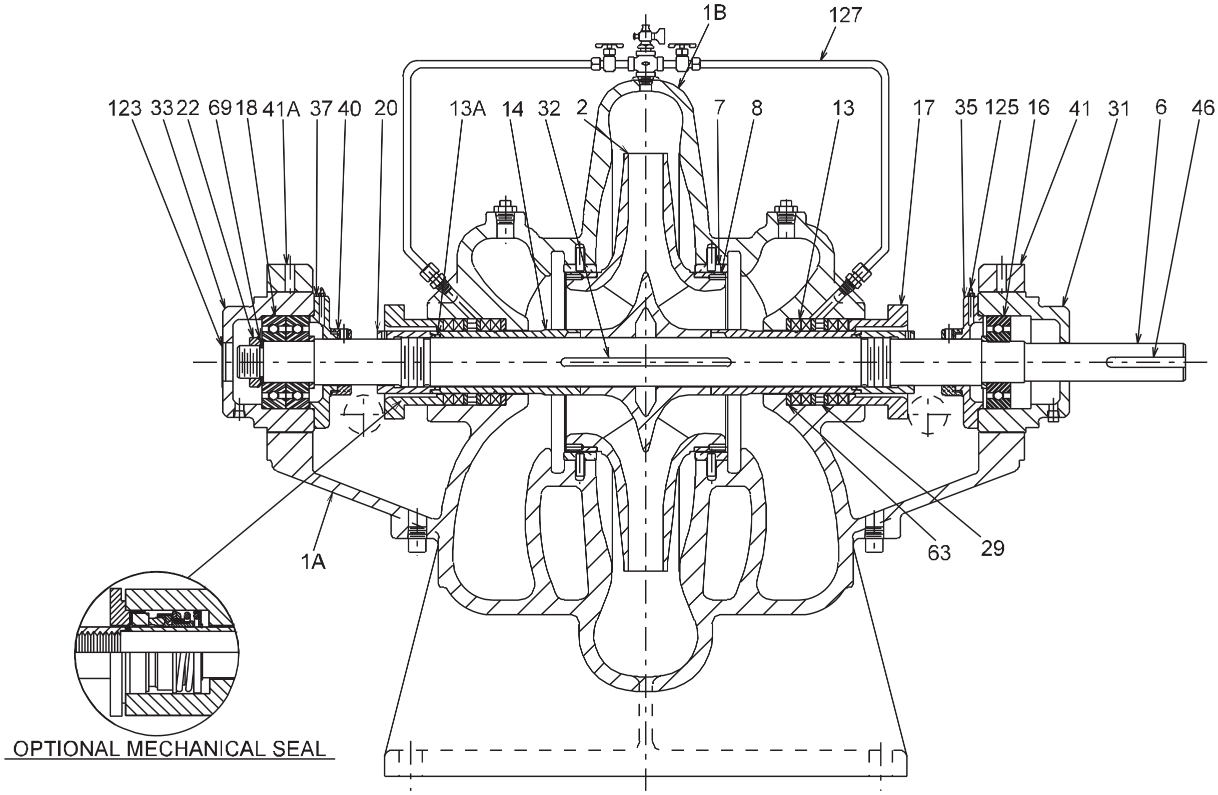

FEATURES:

- REPLACEABLE PACKING BOX BUSHING PROVIDED TO PROTECT CASING FROM PACKING WEAR
- MACHINED MOUNTING SURFACES
- DEFLECTORS PROVIDED TO PREVENT PRODUCT FROM ENTERING BEARING HOUSINGS
- CASING RINGS PROVIDED TO PROTECT CASING FROM WEAR
- HYDROSTATICALLY TESTED TO 1 1/2 TIMES SHUT-OFF
- INTEGRALLY CAST BEARING SUPPORTS
- CONVERSION FROM PACKING TO MECHANICAL SEALS WITHOUT ADDITIONAL MACHINING
- INTEGRALLY CAST PACKING BOXES
- PREDRILLED AND TAPPED PACKING BOX DRIP POCKETS FOR REMOVAL OF PACKING BOX LEAKAGE
- DYNAMICALLY BALANCED IMPELLER
- SHAFT SLEEVES LOCKED AGAINST ROTATION BY IMPELLER KEY

ITEM	DESCRIPTION	MATERIAL	ITEM	DESCRIPTION	MATERIAL
1A	LOWER CASING	Cast Iron - ASTM A48-CL40	31	INBOARD BRG HOUSING	Cast Iron - ASTM A48-CL30
1B	UPPER CASING	Cast Iron - ASTM A48-CL40	32	IMPELLER KEY	Stainless Steel - AISI 304
2	IMPELLER	Bronze - ASTM B584-836	33	OUTBOARD BRG HSG	Cast Iron - ASTM A48-C30
6	SHAFT	Alloy Steel - AISI 1141	35	INBOARD BRG COVER	Cast Iron - ASTM A48-C30
7	CASING RING	Bronze - ASTM B505-927	37	OUTBOARD BRG COVER	Cast Iron - ASTM A48-CL30
8	IMPELLER RING	Bronze - ASTM B505-932	40	DEFLECTOR	Aluminum
13	PACKING	Graphite Impregnated Fiber	41	INBOARD BEARING CAP	Cast Iron - ASTM A48-CL30
13A	SHAFT SLEEVE O-RING	Nitrile	41A	OUTBOARD BEARING CAP	Cast Iron - ASTM A48-CL30
14	SHAFT SLEEVE	Bronze - ASTM B505-954	46	COUPLING KEY	Steel - ASTM A108-1018
16	INBOARD BEARING	Single Row Ball - Mfg. Standard	63	STUFFING BOX BUSHING	Bronze - ASTM B505-932
17	PACKING GLAND	Bronze - ASTM B584-836	68	SHAFT COLLAR	Steel - ASTM A108-1018
18	OUTBOARD BEARING	Back-to-Back Ball - Mfg. Standard	69	BEARING LOCKWASHER	Steel - Mfg. Standard
20	SHAFT SLEEVE NUT	Bronze - ASTM B505-932	123	BEARING END COVER	Steel - Mfg. Standard
22	BEARING LOCKNUT	Steel - Mfg. Standard	125	GREASE FITTING	Steel - Mfg. Standard
29	LANTERN RING	Teflon	127	SEAL WATER PIPING	Copper Tubing

Toccoa, Georgia
U.S.A.

8 x 6 MI
SPLIT CASE PUMP

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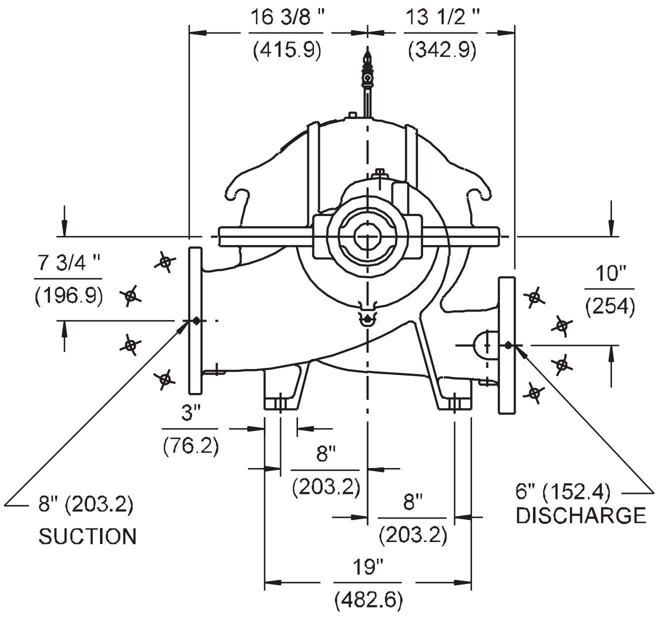
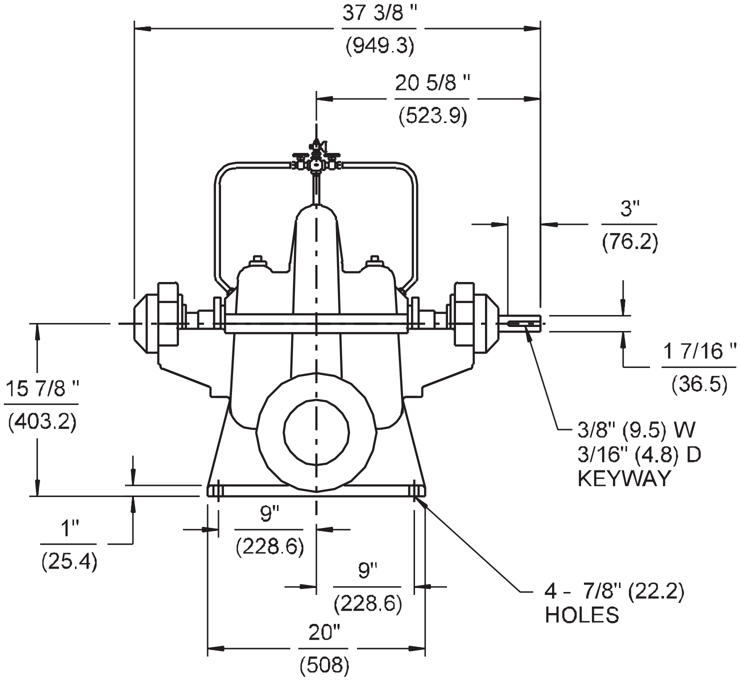
	SUCTION					DISCHARGE				
HOLES	O.D.	THK.	HOLES	SIZE	D.B.C.	O.D.	THK.	HOLES	SIZE	D.B.C.
125# FLANGE	13 1/2" (342.9)	1 1/8" (28.6)	8	7/8" (22.2)	11 3/4" (298.5)	11 1/4" (285.8)	1" (25.4)	8	7/8" (22.2)	9 1/2" (241.3)
250# FLANGE						12 1/2" (317.5)	1 7/16" (36.5)	12	7/8" (22.2)	10 5/8" (269.9)





Attachment 5-3 1,800 GPM Pump

UNIT ______ OUR ORDER No. ______

JOB ______ CUSTOMER ORDER No. ______

PUMP ______ CAPACITY ______ G.P.M. @ ______ FT. HD.

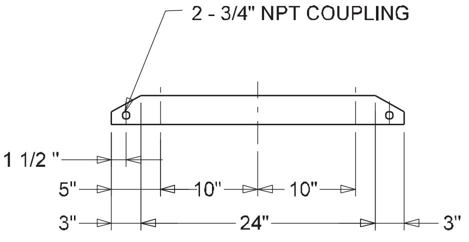
MOTOR ______ MAKE ______ FRAME ______

______ H.P. ______ PHASE ______ CYCLE ______ VOLT ______ R.P.M.

CERTIFIED BY: ______ DATE ______

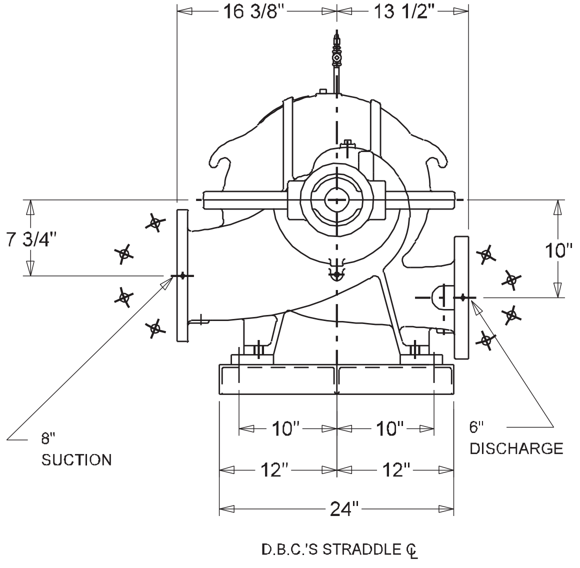
NOTE: 1) FOR CW ROT. SUCT. ON RIGHT, DISCH. ON LEFT
FOR CCW ROT. SUCT. ON LEFT, DISCH. ON RIGHT
WHEN VIEWED FROM DRIVER END.

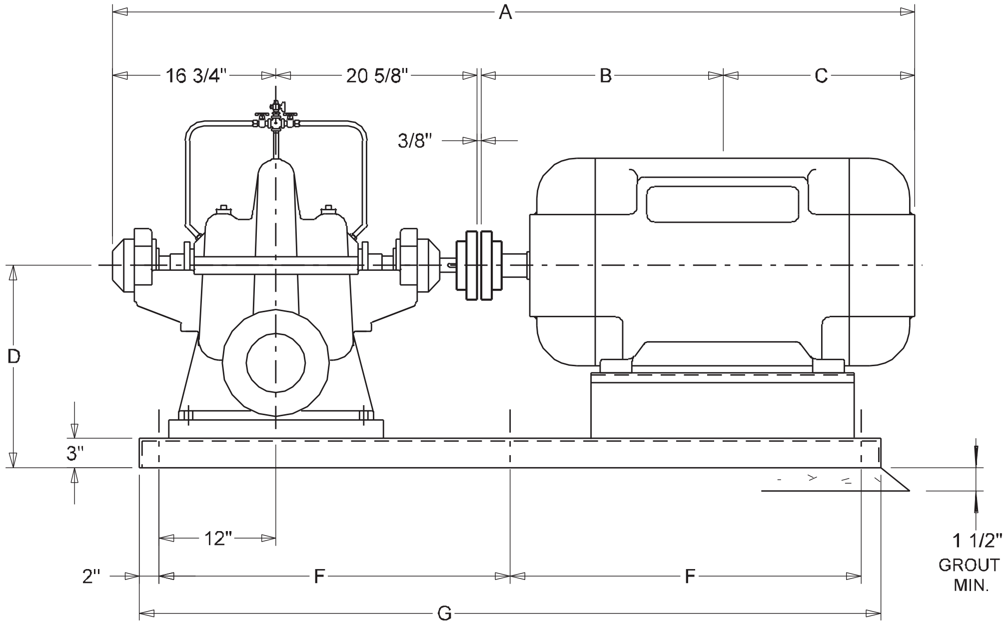
2) 5" GROUT HOLES ARE PROVIDED



DRIP RIM BASE (OPTIONAL)

MOTOR FRAME	A	B	C	D	F	G
326 T	65.9/32"	16.1/2"	11.1/32"	19.3/4"	32"	68"
326 TS	63.3/4"	15"	11.3/4"	19.3/4"	32"	68"
364 T	66.9/32"	17.3/8"	11.5/32"	19.3/4"	32"	68"
365 T	67.3/8"	17.7/8"	11.3/4"	19.3/4"	32"	68"
365 TS	65.5/32"	15.3/4"	11.21/32"	19.3/4"	32"	68"
404 TS	67.3/32"	17"	12.11/32"	19.3/4"	32"	68"
405 T	75.3/4"	20.3/4"	17.1/4"	20.3/4"	34"	72"
405 TS	68.19/32"	17.3/4"	13.3/32"	19.3/4"	34"	72"
444 TS	71.1/2"	19.1/2"	14.1/4"	20.3/4"	34"	72"
445 TS	73.1/2"	20.1/2"	15.1/4"	20.3/4"	34"	72"
447 TS	77.1/4"	22.1/4"	17.1/4"	20.3/4"	36"	76"
364 TS	64.3/8"	15.1/4"	11.3/8"	19.3/4"	32"	68"





HOLES	SUCTION					DISCHARGE				
	O.D.	THK.	HOLES	SIZE	D.B.C.	O.D.	THK.	HOLES	SIZE	D.B.C.
125# FLANGE	13 1/2"	1 1/8"	8	7/8"	11 3/4"	11 1/4"	1"	8	7/8"	9 1/2"
250# FLANGE						12 1/2"	1 7/16"	12	7/8"	10 5/8"

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

OUTLINE DIMENSIONS
for
8x6 MI/YS BARE PUMP

DWG. NO. B02 - 73485
DRAWN ROYAL
DATE 1- 18 - 00
SCALE NONE
APPRVD. A.P.

Toccoa, Georgia
U.S.A.

8 x 6 MI
SPLIT CASE PUMP

SECTION A6
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ENGINEERING DATA:

GENERAL	
BARE PUMP WEIGHT	920#
MAXIMUM OPERATING TEMPERATURE - F °	200
MAXIMUM WORKING PRESSURE	150
HYDROSTATIC TEST PRESSURE	225

CASING	
CASING MATERIAL	CAST IRON
STANDARD DISCHARGE FLANGE RATING	125# - FF
STANDARD SUCTION FLANGE RATING	125# - FF
CASING WALL THICKNESS	9/16"
VENT/PRIMING NPT	3/4"
GAUGE NPT	1/4"
DRAIN NPT	1/2"

IMPELLER	C-3463	C-3463A	C-2889A	C-8705	C-1862A
MAXIMUM DIAMETER	15 3/8"	15 3/8"	12"	16"	16 1/2"
MINIMUM DIAMETER	12"	12"	9"	12 1/2"	12"
MAXIMUM SHPERE	1 1/4"	1 1/4"	1 1/4"	7/8"	1 1/4"
NUMBER OF VANES	7	7	8	7	6
EYE AREA SQ. IN.	36.4	36.4	36.7	36.6	29.5
WEIGHT	62#	62#	59#	95#	117#
WR ^2 for MAXIMUM DIAMETER (LBS-FT^2)	12.9	12.9	7.1	17.8	23.4
NOMINAL DIAMETRICAL WEAR RING CLEARANCE	.022"	.022"	.022"	.022"	.022"

SHAFT AND BEARING		
SHAFT DIAMETER	AT COUPLING	1 7/16"
	AT IMPELLER	1 7/8"
	AT SHAFT SLEEVE	1 7/8"
CENTER TO CENTER OF BEARINGS		27 1/4"
KEYWAYS	AT COUPLING	3/8" X 3/16"
	AT IMPELLER	5/16" X 5/32"
INBOARD BEARING		6308
OUTBOARD BEARING		7308 BYG

PACKING BOX		
SLEEVE O.D.		2 3/8"
PACKING BOX BORE		3 5/16"
PACKING BOX DEPTH		3"
BOX INLET NPT		1/4"
PACKING	SIZE	7/16"
	NUMBER OF RINGS	5
	WATER SEAL RING WIDTH	5/8"

[redacted] **Attachment 5-3** 1,800 GPM Pump [redacted]

Company: Patterson Pumps Company
Name:
Date: 10/21/2011

Pumping Technology for Tomorrow's World
Patterson
A Subsidiary of The Gorman-Rupp Company

Pump:

Size: 8x6 MI-G

Exhibit 5-4 1,800 GPM Pump

Ty 1750 rpm

Synch speed: 1800 rpm	Dia: 13.9375 in
Curve: 6MI-G	Impeller: C-3463A
Specific Speeds:	Ns: 1370 Nss: ---
Dimensions:	Suction: 8 in Discharge: 6 in

Pump Limits:

Temperature: 200 °F	Power: ---
Pressure: 150 psi g	Eye area: ---
Sphere size: 1.25 in	

Search Criteria:

Flow: 1800 US gpm
Head: 80 psi

Fluid:

Water	Temperature: 68 °F
Density: 62.32 lb/ft³	Vapor pressure: 0.3391 psi a
Viscosity: 0.9946 cP	Atm pressure: 14.7 psi a
NPSHa: ---	

Motor:

Standard: NEMA	Size: 125 hp
Enclosure: TEFC	Speed: 1800
	Frame: 444T

Sizing criteria: Max Power on Design Curve

---- Data Point ----

Flow:	1800 US gpm
Head:	80.5 psi
Eff:	88.2%
Power:	95.7 hp
NPSHr:	10 ft

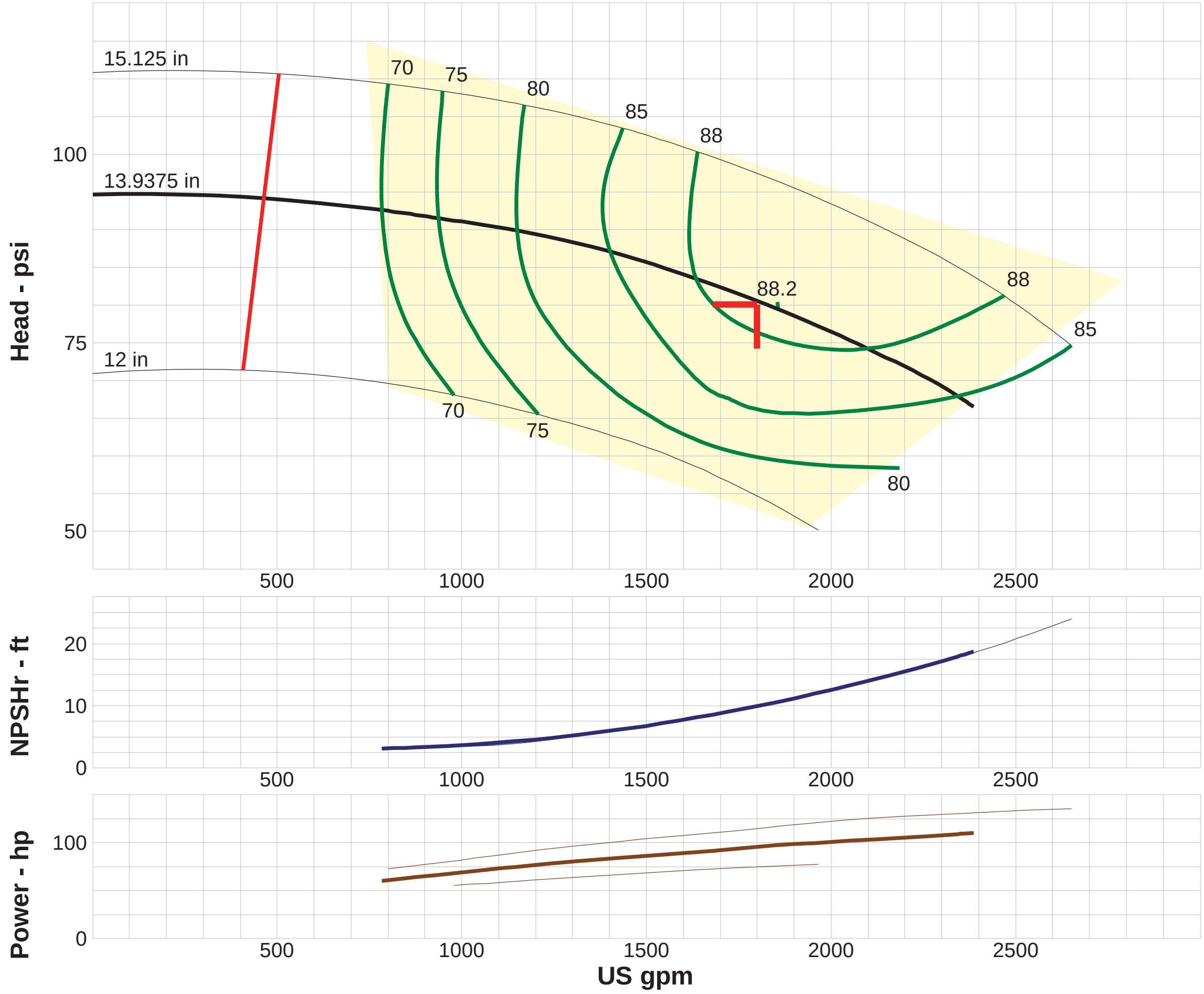
---- Design Curve ----

Shutoff head:	94.7 psi
Shutoff dP:	94.7 psi
Min flow:	464 US gpm

BEP: 88.2% @ 1854 US gpm
NOL power:
111 hp @ 2385 US gpm

-- Max Curve --

Max power:
136 hp @ 2650 US gpm



In accordance with the Hydraulic Institute Standards, pump is guaranteed for one set of conditions. Performance guarantees are based on shop test and when handling clear, cold, fresh water at sea level and at a temperature no greater than 85 degrees F. Suction lift must not exceed that shown on curve.

Performance Evaluation:

Flow US gpm	Speed rpm	Head psi	Efficiency %	Power hp	NPSHr ft
2160	1750	72.6	87.2	105	15
1800	1750	80.5	88.2	95.7	10
1440	1750	86.5	85.5	84.9	6.34
1080	1750	90.4	78.4	72.5	4.05
720	1750	92.8	68	57.8	3.05

Attachment 5-4 900 GPM Pump

Patterson
Toccoa, Georgia
U.S.A.

6 x 5 MAA
SPLIT CASE PUMP

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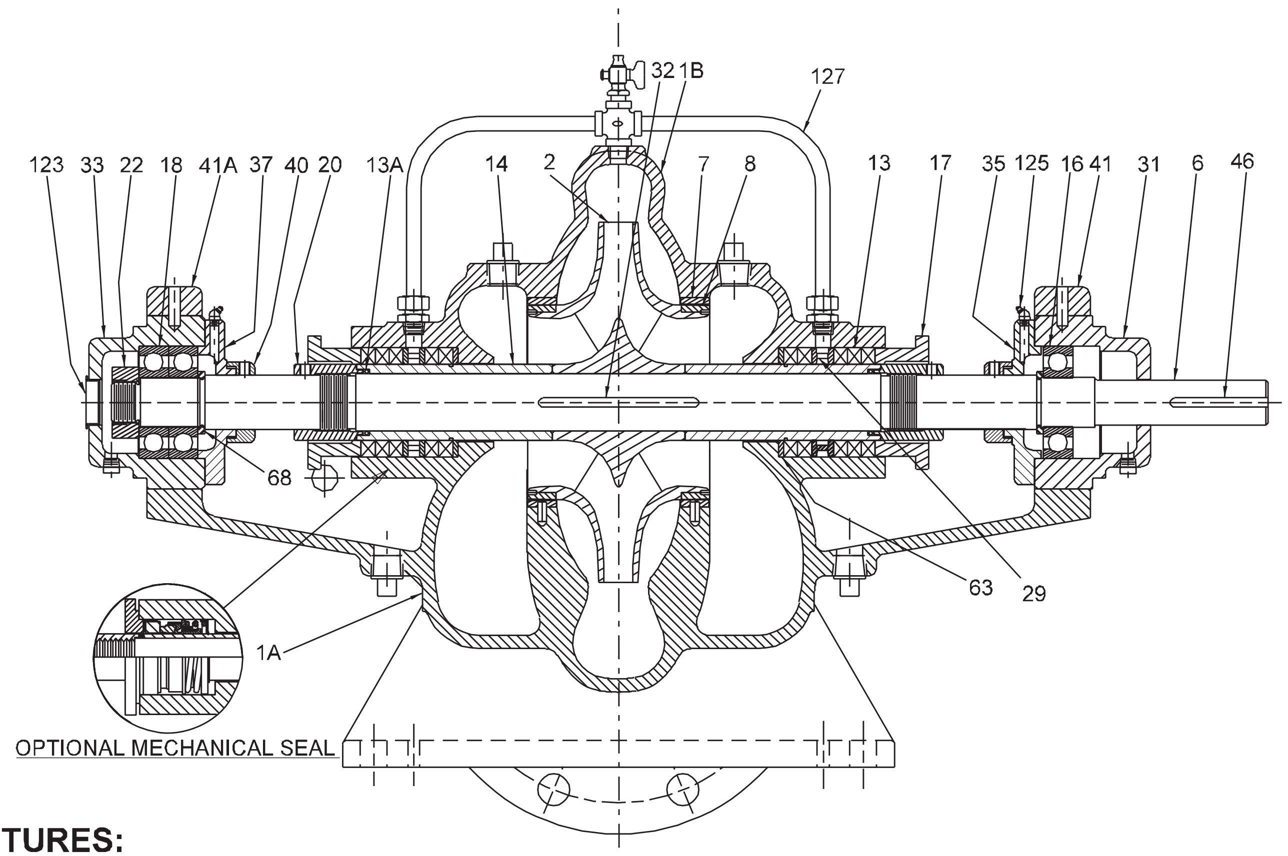

FEATURES:

- REPLACEABLE PACKING BOX BUSHING PROVIDED TO PROTECT CASING FROM PACKING WEAR
- MACHINED MOUNTING SURFACES
- DEFLECTORS PROVIDED TO PREVENT PRODUCT FROM ENTERING BEARING HOUSINGS
- CASING RINGS PROVIDED TO PROTECT CASING FROM WEAR
- HYDROSTATICALLY TESTED TO 1 1/2 TIMES SHUT-OFF
- INTEGRALLY CAST BEARING SUPPORTS
- CONVERSION FROM PACKING TO MECHANICAL SEALS WITHOUT ADDITIONAL MACHINING
- INTEGRALLY CAST PACKING BOXES
- PREDRILLED AND TAPPED PACKING BOX DRIP POCKETS FOR REMOVAL OF PACKING BOX LEAKAGE
- DYNAMICALLY BALANCED IMPELLER
- SHAFT SLEEVES LOCKED AGAINST ROTATION BY IMPELLER KEY

ITEM	DESCRIPTION	MATERIAL	ITEM	DESCRIPTION	MATERIAL
1A	LOWER CASING	Cast Iron - ASTM A48-CL40	31	INBOARD BRG HOUSING	Cast Iron - ASTM A48-CL30
1B	UPPER CASING	Cast Iron - ASTM A48-CL40	32	IMPELLER KEY	Stainless Steel - AISI 304
2	IMPELLER	Bronze - ASTM B584-836	33	OUTBOARD BRG HSG	Cast Iron - ASTM A48-C30
6	SHAFT	Alloy Steel - AISI 1141	35	INBOARD BRG COVER	Cast Iron - ASTM A48-C30
7	CASING RING	Bronze - ASTM B505-927	37	OUTBOARD BRG COVER	Cast Iron - ASTM A48-CL30
8	IMPELLER RING	Bronze - ASTM B505-932	40	DEFLECTOR	Aluminum - Mfg. Standard
13	PACKING	Graphite Impregnated Fiber	41	INBOARD BEARING CAP	Cast Iron - ASTM A48-CL30
13A	SHAFT SLEEVE O-RING	Nitrile	41A	OUTBOARD BEARING CAP	Cast Iron - ASTM A48-CL30
14	SHAFT SLEEVE	Bronze - ASTM B505-954	46	COUPLING KEY	Steel - ASTM A108-1018
16	INBOARD BEARING	Single Row Ball - Mfg. Standard	63	PACKING BOX BUSHING	Bronze - ASTM B505-932
17	PACKING GLAND	Bronze - ASTM B584-836	68	SHAFT COLLAR	Steel - ASTM A108-1018
18	OUTBOARD BEARING	Single Row Ball - Mfg. Standard	123	BEARING END COVER	Steel - Mfg. Standard
20	SHAFT SLEEVE NUT	Bronze - ASTM B505-932	125	GREASE FITTING	Steel - Mfg. Standard
22	BEARING LOCKNUT	Steel - Mfg. Standard	127	SEAL WATER PIPING	Copper Tubing
29	LANTERN RING	Teflon			

Attachment 5-4 900 GPM Pump

Toccoa, Georgia
U.S.A.

6 x 5 MAA
SPLIT CASE PUMP

SECTION	A5
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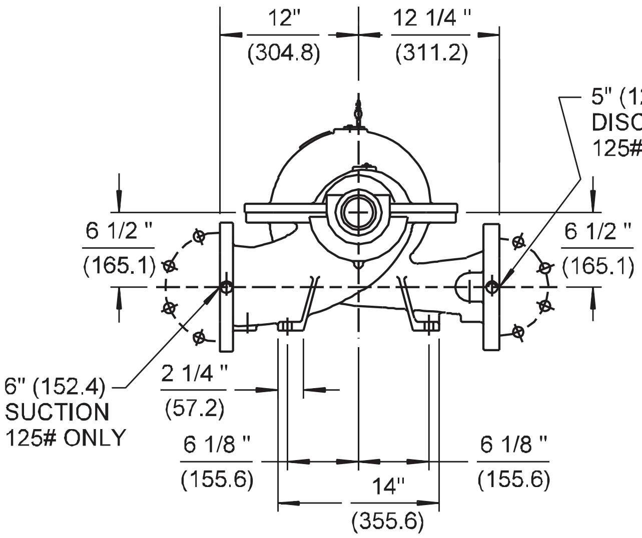
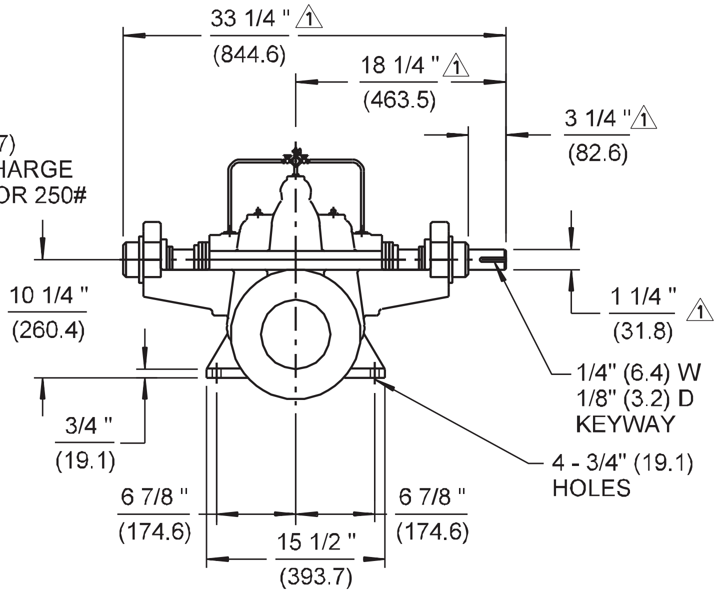
DATE:	JAN. 2,2000

	SUCTION					DISCHARGE				
HOLES	O.D.	THK	HOLES	SIZE	D.B.C.	O.D.	THK	HOLES	SIZE	D.B.C.
125# FLANGE	11 1/4" (285.8)	1 1/8" (28.6)	8	7/8" (22.2)	9 1/2" (241.3)	11" (279.4)	1 3/8" (34.9)	8	7/8" (22.2)	8 1/2" (215.9)
250# FLANGE						11" (279.4)	1 3/8" (34.9)	8	7/8" (22.2)	9 1/4" (235)





Attachment 5-4 900 GPM Pump

UNIT ____________ OUR ORDER No. ____________

JOB ____________ CUSTOMER ORDER No. ____________

PUMP ________ CAPACITY ________ G.P.M. @ ________ FT. HD.

MOTOR ________ MAKE ________ FRAME ________

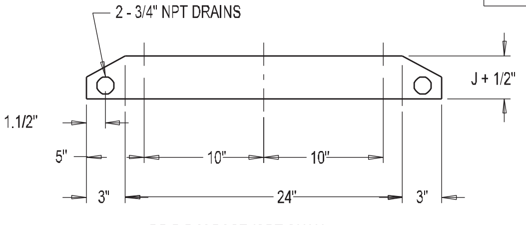
________ H.P. ________ PHASE ________ CYCLE ________ VOLT ________ R.P.M.

CERTIFIED BY: ____________ DATE ________

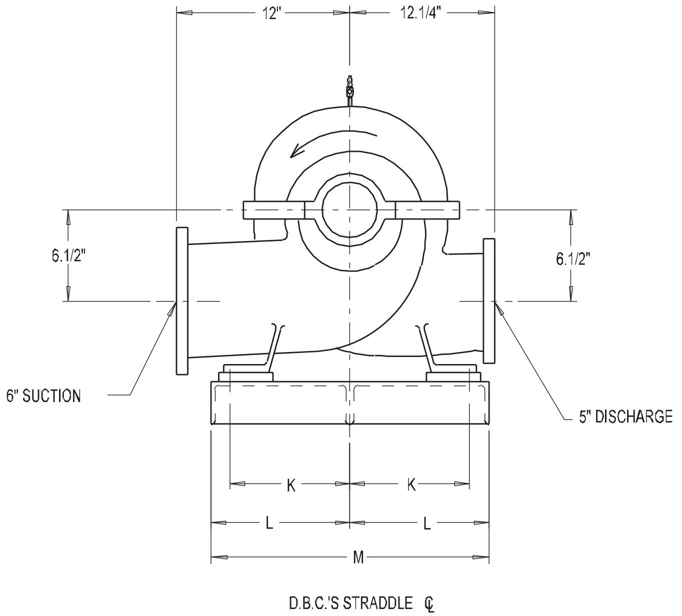
MOTOR FRAME	A	B	C	D	F	G	J	K	L	M
324 TS	58.5/32"	14.1/4"	10.9/32"	14.1/4"	27"	58"	4"	7"	9"	18"
326 TS	59.21/32"	15"	11.1/32"	14.1/4"	27"	58"	4"	7"	9"	18"
364 TS	60.1/32"	15.1/4"	11.5/32"	16"	29.1/2"	63"	3"	10"	12"	24"
365 TS	61.1/32"	15.3/4"	11.21/32"	16"	29.1/2"	63"	3"	10"	12"	24"
404 TS	62.31/32"	17"	12.11/32"	16.1/4"	29.1/2"	63"	3"	10"	12"	24"
405 TS	64.15/32"	17.3/4"	13.3/32"	16.1/4"	29.1/2"	63"	3"	10"	12"	24"

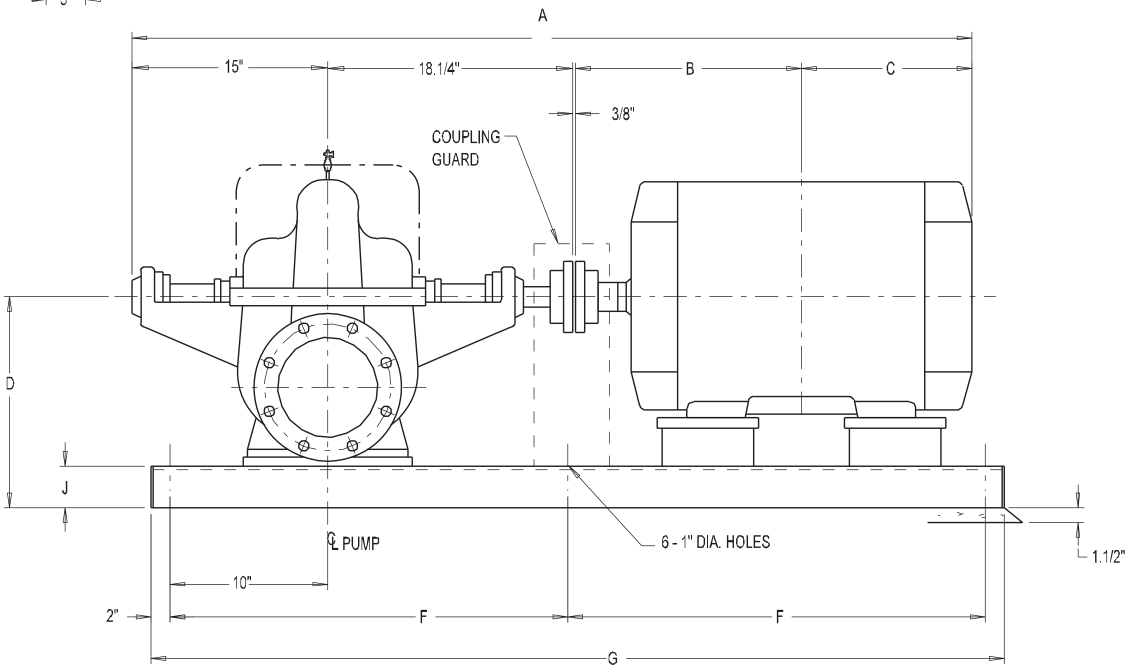
NOTE: 1) FOR CW ROT. SUCT. ON RIGHT, DISCH. ON LEFT
FOR CCW ROT. SUCT. ON LEFT, DISCH. ON RIGHT
WHEN VIEWED FROM DRIVER END.

2) 5" DIA. GROUT HOLES ARE PROVIDED



DRIP RIM BASE (OPTIONAL)





HOLES	SUCTION					DISCHARGE				
	O.D.	THK	HOLES	SIZE	D.B.C.	O.D.	THK	HOLES	SIZE	D.B.C.
125# FLANGE	11 1/4"	1 1/8"	8	7/8"	9 1/2"	11"	1 3/8"	8	7/8"	8 1/2"
250# FLANGE						11"	1 3/8"	8	7/8"	9 1/4"

PATTERSON PUMP COMPANY
A SUBSIDIARY OF THE GORMAN-RUPP COMPANY

OUTLINE DIMENSIONS
for
6 X 5 MAA

DWG. NO. B02-76318
DRAWN JST
DATE 1-21-00
SCALE NONE
APPRVD. AP

Toccoa, Georgia
U.S.A.

6 x 5 MAA
SPLIT CASE PUMP

ENGINEERING DATA:

GENERAL	
BARE PUMP WEIGHT	415#
MAXIMUM OPERATING TEMPERATURE - F °	200
MAXIMUM WORKING PRESSURE	175
HYDROSTATIC TEST PRESSURE	263

CASING	
CASING MATERIAL	CAST IRON
STANDARD DISCHARGE FLANGE RATING	125# - FF
STANDARD SUCTION FLANGE RATING	125# - FF
CASING WALL THICKNESS	3/8"
VENT/PRIMING NPT	1/2"
GAUGE NPT	1/4"
DRAIN NPT	1/2"

IMPELLER	B-11312	B-11313B
MAXIMUM DIAMETER	10"	11"
MINIMUM DIAMETER	7"	7"
MAXIMUM SHPERE	3/4"	3/4"
NUMBER OF VANES	7	7
EYE AREA SQ. IN.	15	23
WEIGHT	33#	38#
WR ^2 for MAXIMUM DIAMETER (LBS-FT^2)	2.6	3.3
NOMINAL DIAMETRICAL WEAR RING CLEARANCE	.015"	.015"

SHAFT AND BEARING		
SHAFT DIAMETER	AT COUPLING	1 1/4"
	AT IMPELLER	1 5/8"
	AT SHAFT SLEEVE	1 5/8"
CENTER TO CENTER OF BEARINGS		25"
KEYWAYS	AT COUPLING	1/4" X 1/8"
	AT IMPELLER	1/4" X 1/8"
INBOARD BEARING		6307
OUTBOARD BEARING		7307 BYG

PACKING BOX		
SLEEVE O.D.		2 1/8"
PACKING BOX BORE		3 1/16"
PACKING BOX DEPTH		3"
BOX INLET NPT		1/4"
PACKING	SIZE	7/16"
	NUMBER OF RINGS	5
	WATER SEAL RING WIDTH	5/8"

[redacted] **Attachment 5-4** 900 GPM Pump [redacted]

Company: Patterson Pumps Company
Name:
Date: 11/11/2011

Patterson
Pumping Technology for Tomorrow's World
A Subsidiary of The Gorman-Rupp Company

Pump:

Size: 6x5 MAA-B

Type: HSC
Synch speed: 3600 rpm

Speed: 3560 rpm
Dia: 7.25 in

Curve: 5MAA-B

Impeller: B-11313

Specific Speeds:

Ns: 1586
Nss: ---

Dimensions:

Suction: 6 in
Discharge: 5 in

Pump Limits:

Temperature: 200 °F
Pressure: 175 psi g
Sphere size: 0.75 in

Power: ---
Eye area: ---

Search Criteria:

Flow: 900 US gpm

Head: 80 psi

Fluid:

Water
Density: 62.32 lb/ft³
Viscosity: 0.9946 cP

Temperature: 68 °F
Vapor pressure: 0.3391 psi a
Atm pressure: 14.7 psi a

NPSHa: ---

Motor:

Standard: NEMA
Enclosure: TEFC

Size: 60 hp
Speed: 3600
Frame: 364TS

Sizing criteria: Max Power on Design Curve

---- Data Point ----

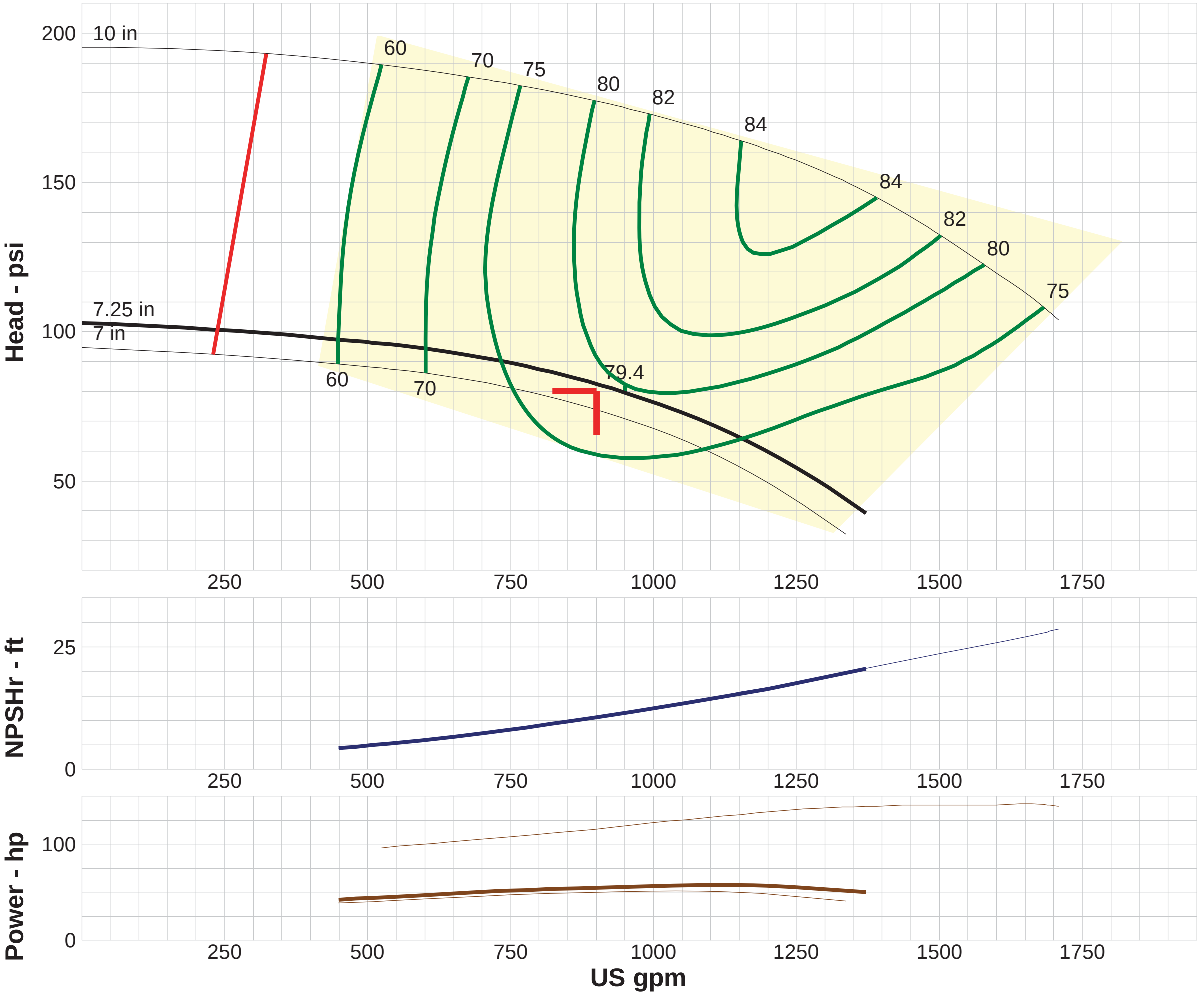
Flow: 900 US gpm
Head: 82 psi
Eff: 78.4%
Power: 54.6 hp
NPSHr: 10.7 ft

---- Design Curve ----

Shutoff head: 103 psi
Shutoff dP: 103 psi
Min flow: 237 US gpm
BEP: 79.4% @ 949 US gpm
NOL power:
57.6 hp @ 1154 US gpm

-- Max Curve --

Max power:
142 hp @ 1682 US gpm



In accordance with the Hydraulic Institute Standards, pump is guaranteed for one set of conditions. Performance guarantees are based on shop test and when handling clear, cold, fresh water at sea level and at a temperature no greater than 85 degrees F. Suction lift must not exceed that shown on curve.

Performance Evaluation:

Flow US gpm	Speed rpm	Head psi	Efficiency %	Power hp	NPSHr ft
1080	3560	69.8	76.6	56.9	14.1
900	3560	82	78.4	54.6	10.7
720	3560	90.6	74.5	51	7.7
540	3560	95.5	66	45.3	5.38
360	3560	98.5	54.2	39.7	3.5

amiad
FILTRATION SYSTEMS

SAF Filters

flow rates	filtration degrees	water for cleaning	min. operating pressure
up to **400 m³/h** (1760 US gpm)	**800-10** micron	less than **1%** of the total flow	**2** bar (30 psi)

The automatic self-cleaning filter - suitable for more applications than ever.

features:

- Large filter area, reliable operating mechanism and simple construction make the SAF filter the ideal solution for filtration of poor quality water to very fine filtration degrees
- Automatic flushing according to pressure differential and/or according to time
- No interruption of downstream flow during flushing
- Robust and reliable Self-Cleaning mechanism even on marginal operation conditions.
- Minimal volume of reject water allows excellent operation in continuous flush mode
- Applications: Water supply systems, Irrigation systems, Cooling Water, Waste Water Treatment, Industrial Pre-Filtration, etc.
- Industries: manufacturing, mining, water and waste water treatment plant, turf and agriculture, etc.

amiad filtration solutions

How the SAF Filters work

General

The Amiad SAF Series are sophisticated, yet easy-to-operate, automatic filters, with a self-cleaning mechanism driven by an electric motor.
The "SAF" filters support flow-rates of up to 400 m³/h (1760 gpm), with various screens designed to cover a range of 800-10 micron filtration degree, and are available in inlet/outlet diameters of 2"-10".

The Filtering Process

Raw water enters the filter inlet (1) through the coarse screen (2) which protects the cleaning mechanism from large debris. The water passes through the fine screen (3), trapping dirt particles which accumulate inside the filter. Clean water flows through the filter outlet (4).
The gradual dirt buildup on the inner screen surface causes a filter cake to develop, with a corresponding increase in the pressure differential across the screen. A pressure differential switch senses the pressure differential and when it reaches a pre-set value, the cleaning process begins.

The Self-Cleaning Process

Cleaning of the filter is carried out by the suction scanner (5) which spirals across the screen; the open exhaust valve creates a high velocity suction stream at the nozzles tip which "vacuums" the filter cake from the screen. During the self-cleaning process, which takes between 20 to 40 seconds, filtered water continues to flow downstream.

The Control System

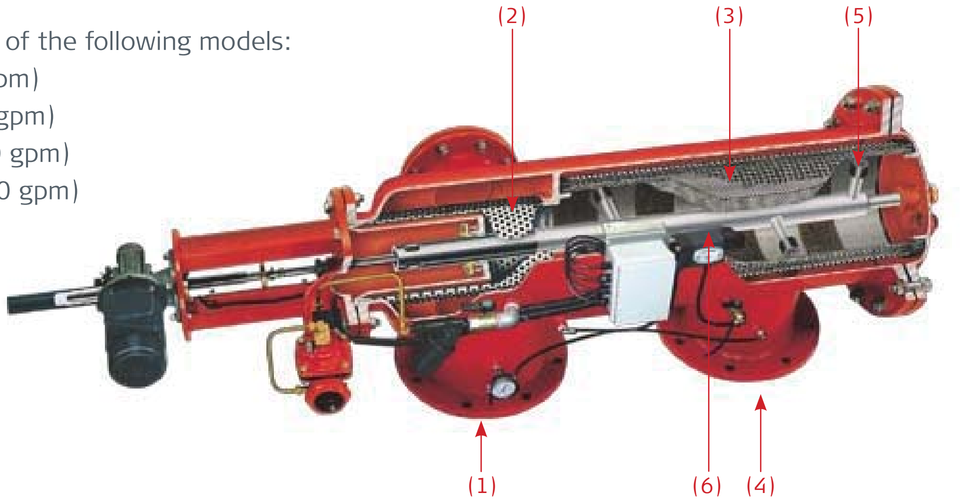
Two types of control boards are available for the SAF filters: PLC or Electro-Mechanical Relay and Timer.

The self-cleaning cycle begins under any one of the following conditions:
1. Receiving a signal from the Pressure Differential Switch (6)
2. Time interval parameter set at the control board
3. Manual Start

The control board also provides:
Optional continuous flush operation mode
Flush cycles counter
Alarm or an alternative reaction at malfunction mode; open a bypass, shut-off a pump, etc.

"SAF" Models

Amiad's "SAF" product-line consists of the following models:
SAF-1500 for up to 80 m³/h (352 gpm)
SAF-3000 for up to 150 m³/h (660 gpm)
SAF-4500 for up to 250 m³/h (1100 gpm)
SAF-6000 for up to 400 m³/h (1,760 gpm)



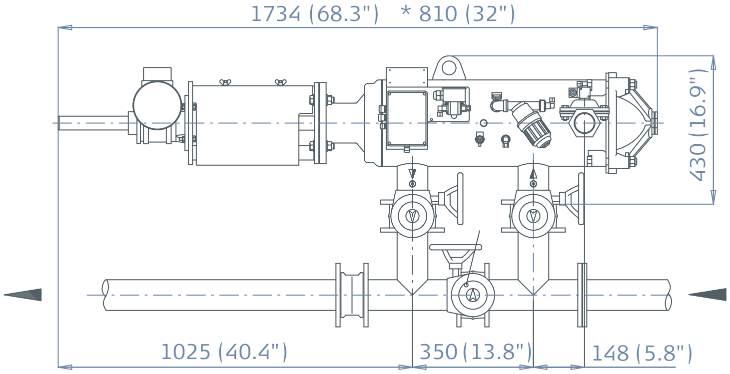
SAF 1500

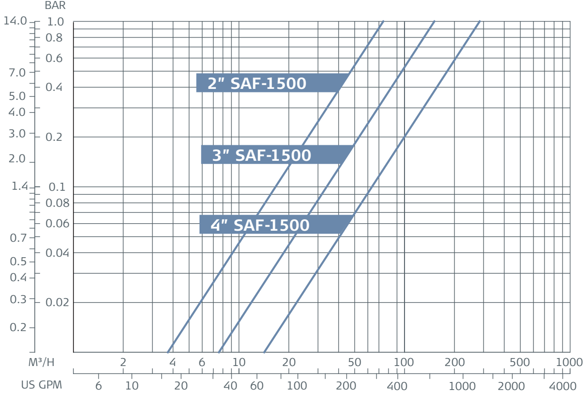
SAF 3000

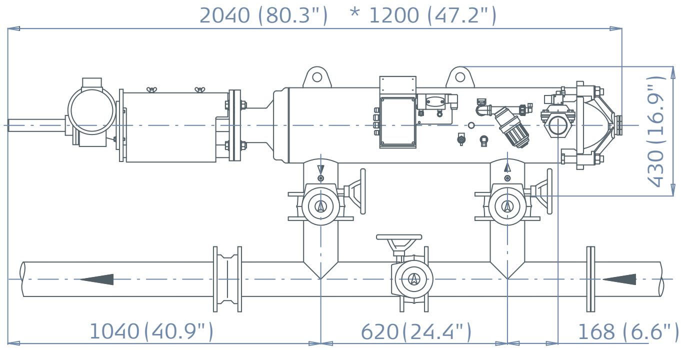
SAF 4500

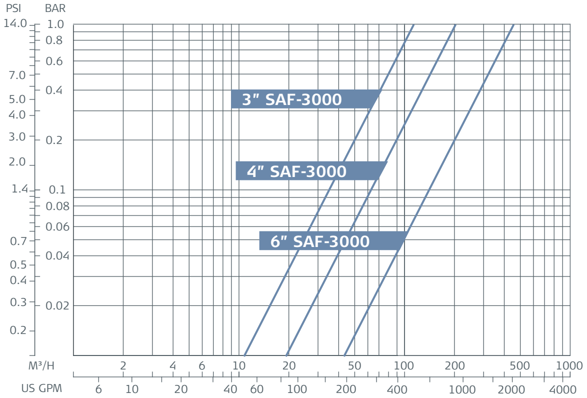
SAF 6000

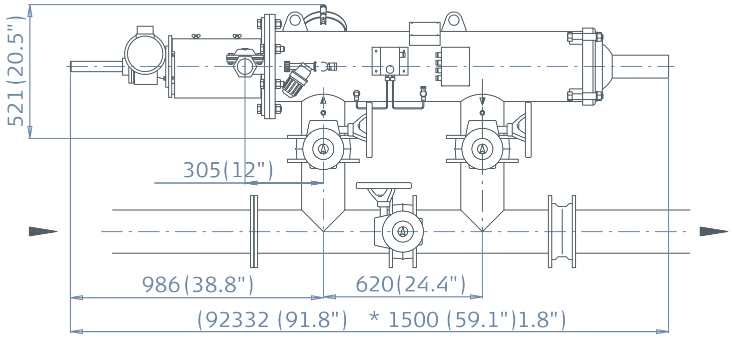
Pressure Loss Graphs

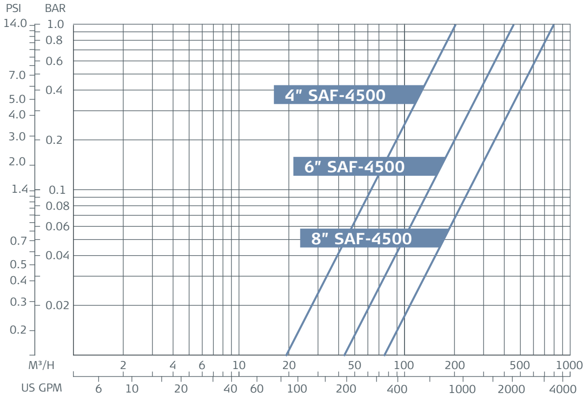


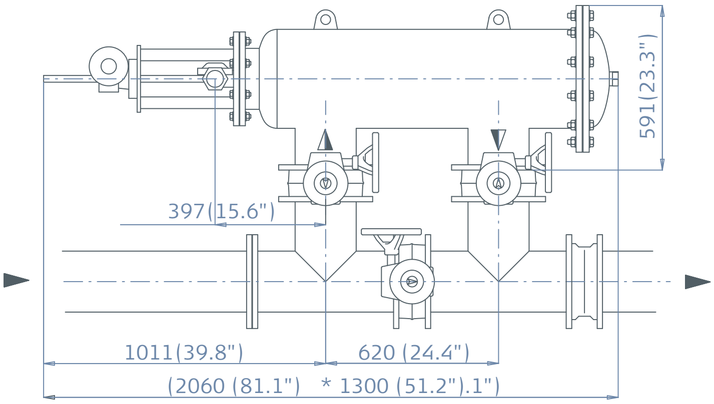


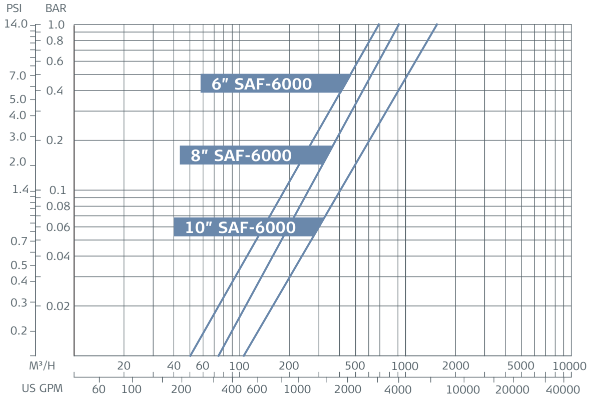












Dim. in mm (inch)
*Approx. length required for maintenance

Technical Specifications

Filter Type	SAF 1500	SAF 3000	SAF 4500	SAF 6000
General Data				
Maximum flow rate*	80 m³/h (352 US gpm)	150 m³/h (660 US gpm)	250 m³/h (1100 US gpm)	400 m³/h (1760 US gpm)
Inlet/Outlet diameter (mm)	2″ 3″ 4″ (50 80 100)	3″ 4″ 6″ (80 100 150)	4″ 6″ 8″ (100 150 200)	6″ 8″ 10″ (150 200 250)
Standard filtration degrees	Weave Wire Screen 800, 500, 300, 200, 130, 100, 80, 50, 25, 10 micron			
Min. working pressure	2 bar (30 psi) For lower pressure please consult manufacturer			
Max. working pressure	10 bar (145 psi)		10 bar (145 psi) 16 bar (232 psi) upon request	
Max. working temperature	50°C (122°F)	50°C (122°F)	60°C (140°F) 95°C (203°F) upon request	60°C (140°F) 95°C (203°F) upon request
Electrical Supply	3 phase, 220 / 380 / 440 VAC 50 / 60 Hz			
Weight (empty)	86 kg (190 lb)	110 kg (242.5 lb)	160 kg (353 lb)	250 kg (551 lb)

* Consult Amiad for optimum flow depanding on filtration degree & water quality.

Flushing Data				
Minimum flow for flushing (at 2 bar -30 psi)	6 m³/h (26 US gpm)	11 m³/h (48 US gpm)	15 m³/h (66 US gpm)	25 m³/h (110 US gpm)
Reject water volume per flush cycle (at 2 bar -30 psi)	25 liter (7 US gallon)	64 liter (17 US gallon)	83 liter (22 US gallon)	280 liter (74 US gallon)
Flushing cycle time	15 seconds	20 seconds	20 seconds	40 seconds
Exhaust valve	2″ 50 mm	2″ 50 mm	2″ 50 mm	2″ 50 mm
Flushing criteria	Differential pressure of 0.5 bar (7psi), time intervals and manual operation			

Screen Data				
Filter area	1500 cm² (323 in²)	3000 cm² (465 in²)	4500 cm² (697 in²)	6000 cm² (930 in²)
Screen types	Four-layer Weave Wire stainless steel 316L			
	Molded Weave Wire stainless steel 316L			

Control and Electricity				
Rated operation voltage	3 phase, 220/380/440 VAC 50/60 Hz			
Electric motor	¼ HP	¼ HP	¼ HP	⅓ HP
Current consumption	0.6 Amp	0.6 Amp	0.6 Amp	0.8 Amp
Control voltage	24 VAC 12V or 24 VDC upon request			

Construction Materials*	
Filter housing	Epoxy-coated carbon steel 37-2
Filter lid	SMC Polyester / Epoxy-coated carbon steel 37-2
Cleaning mechanism	Stainless steel 316L, Acetal
Exhaust valve	Epoxy-coated cast iron, Natural rubber
Seals	Synthetic rubber, Teflon
Control	Aluminum, Brass, Stainless steel, PVC, Nylon

* Amiad offers a variety of construction materials. Consult us for specifications.

GE
Sensing

Applications

The AquaTrans AT868 liquid flow transmitter is a complete ultrasonic flow metering system for measurement of:

- Potable water
- Wastewater
- Sewage
- Discharge water
- Treated water
- Cooling and heating water
- Other liquids

Features

- Economical non-intrusive flow measurement
- Simple setup and installation
- Suitable for wide range of pipe sizes and materials
- Suitable for lined pipes
- Two-channel/two-path version available
- Velocity, volumetric and totalized flow
- Internal keypad for field programming

AquaTrans™ AT868

Panametrics Liquid Flow Ultrasonic Transmitter

AquaTrans AT868 is a Panametrics product. Panametrics has joined other GE high-technology sensing businesses under a new name–GE Industrial, Sensing.

GE
Sensing

Liquid Flow Ultrasonic Transmitter

The AquaTrans AT868 liquid flow ultrasonic transmitter combines state-of-the-art flow measurement capability with a low-cost transmitter package that can be installed right at the process measurement point. It's designed specifically for water and wastewater applications in full pipes.

The all-digital AquaTrans AT868 has no moving parts and requires minimal maintenance. An onboard microprocessor uses patented Correlation Transit-Time™ technology for long-term, drift-free operation. Automatic adjustment to changing fluid properties and dynamically configured operating software simplify programming.

Transit-Time Flow Measurement Technique

The transit-time technique uses a pair of transducers with each transducer sending and receiving coded ultrasonic signals through the fluid. When the fluid is flowing, signal transit-time in the downstream direction is shorter than in the upstream direction; the difference between these transit times is proportional to the flow velocity. The AquaTrans AT868 measures this time difference and uses programmed pipe parameters to determine flow rate and direction.

Wetted or Clamp-On Transducers

Ultrasonic flow transducers are classified as either wetted or non-wetted (clamp-on). Clamp-on transducers are clamped onto the outside of the pipe and never come into contact with the process fluid. Wetted transducers are mounted into the pipe or flowcell in direct contact with the process fluid.

Clamp-on transducers offer maximum convenience, flexibility and a low installation cost compared to traditional flow metering technologies. With proper installation, wetted transducers provide maximum accuracy (better than 1% of reading) in most applications.

Two-Channel Model

An optional second channel provides the capability to measure flow in two pipes or average two paths on the same pipe for increased accuracy.

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AT868 Specifications

Operation and Performance

Fluid Types
Acoustically conductive fluids, including most clean liquids, and many liquids with entrained solids or gas bubbles. Maximum void fraction depends on transducer, interrogation carrier frequency, path length and pipe configuration.

Pipe Sizes
- Clamp-on transducers: 0.5 to 300 in. (12.7 mm to 7.6m) and larger
- Wetted transducers: 1 in to 200 in (25.4 mm to 5 m) and larger

Pipe-Wall Thickness
Up to 3 in (76.2 mm)

Pipe Materials
All metals and most plastics. Consult GE for concrete, composite materials, and highly corroded or lined pipes.

Flow Accuracy (Velocity)
0.5% of reading (achievable with process calibration)

Typical Clamp-On Flow Accuracy (Velocity)
- Pipe ID>6 in (150 mm): ±1% to 2% of reading
- Pipe ID<6 in (150 mm): ±2% to 5% of reading

Typical Wetted Flow Accuracy (Velocity)
±1% of reading

Accuracy depends on pipe size and installation and whether measurement is one-path or two path.

Repeatability
±0.1% to 0.3% of reading

Range (Bidirectional)
–40 to 40 ft/s (–12.2 to 12.2 m/s)

Rangeability (Overall)
400:1

Specifications assume a fully developed flow profile (typically 10 diameters upstream and 5 diameters downstream of straight pipe run) and flow velocity greater than 1 ft/s (0.3 m/s).

Measurement Parameters
Volumetric flow, totalized flow and flow velocity

Electronics

Flow Measurement
Patented Correlation Transit-Time mode

Enclosure
Epoxy-coated aluminum weatherproof Type 4X/IP66

Dimensions
Standard: Weight 2 lb (0.9 kg), size (h x w x d) 7.25 in x 5.9 in x 3.5 in (184 mm x 150 mm x 89 mm)

Channels
- Standard: One channel
- Optional: Two channels (for two pipes or two-path averaging)

Display
2-line x 16 character backlit LCD display, configurable to display up to four measurement parameters in sequence

Keypad
Six-button internal keypad

Power Supplies
- Standard: 85 to 265 VAC, 50/60 Hz
- Optional: 12 to 28 VDC, ± 5%

Power Consumption
20W maximum

Operating Temperature
14°F to 131°F (–10°C to 55°C)

Storage Temperature
–40°F to 158°F (–40°C to 70°C)

Standard Inputs/Outputs
- One 0/4 to 20 mA isolated output per channel, 600 Ω maximum load
- One frequency/pulse rate/totalizer output per channel, optically isolated, 3A maximum, 100 VDC maximum, 1W maximum, from 0.1 to 10 kHz

GE
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AT868 Specifications

Digital Interfaces

- Standard: RS232
- Optional: RS485 (multiuser)

European Compliance

System complies with EMC Directive 89/336/EEC, 73/23/EEC LVD (Installation Category II, Pollution Degree 2) and transducers comply with PED 97/23/EC for DN<25

Clamp-On Ultrasonic Flow Transducers

Temperature Ranges

- Standard: –40°F to 300°F (–40°C to 150°C)
- Optional: –40°F to 210°F (–40°C to 230°C)

Mountings

Stainless steel chain or strap, welded or magnetic clamping fixtures

Area Classifications

- Standard: General purpose
- Optional: Weatherproof Type 4/IP65
- Optional: Submersible IP67/68

Wetted Ultrasonic Flow Transducers

Temperature Range

–40°F to 212°F (–40°C to 100°C)

Pressure Range

0 to 3000 psig (1 to 207 bar)

Materials

- Standard: Stainless steel
- Optional (for Pan-Adapta® Plugs): Titanium, Hastelloy® alloy, Monel® alloy, duplex, CPVC, PVDF and others

Pan-Adapta plugs allow installation and removal of wetted transducers without interrupting the process or emptying the pipe.

Process Connections

- Standard: 1 in or 3/8 in NPTM
- Optional: RF flanged, socket weld, fuse bond and others

Mountings

Flanged flowcell, hot tap or cold tap

Area Classifications

- Standard: General purpose
- Optional: Weatherproof Type 4/IP65 submersible

Transducer Cables

- Standard: One pair of coaxial cables, type RG62 AU, or as specified for transducer type
- Optional: Lengths up to 1000 ft (330 m) maximum

Additional Options

PanaView™ PC-Interface Software

The AquaTrans AT868 communicates with a PC through a serial interface and Windows® operating systems. Consult the manual for details on sites, logs, and other operations with a PC.

920-038C

N4271

www.gesensing.com

6.0 Architectural Design Criteria

6.1 General

The new blower building will be a single room approximately 700 square feet located directly on top of the proposed Southside Clearwell roof. The structure will have a functional appearance with materials chosen for low maintenance and similarity to the existing facilities. To remain cost-effective, the building design will not duplicate the exact construction of the existing facilities but will be consistent with the overall exterior aesthetic.

6.2 Building Material

The facility will be a single story building constructed with steel columns supporting a roof system of steel beams, steel joists, and steel decking. The exterior wall construction will include reinforced CMU block walls supporting a natural stone veneer separated by an air cavity and insulation. The building will have adequate soundproofing. The stone veneer will be a single shade of stone to match a single color chosen from the existing variegated stone walls. The stone veneer will be laid plumb in a bond pattern to match the existing veneer walls.

6.3 System

The roof system will include a fully adhered membrane roofing material on top of ¼ inch per foot sloped insulation on the metal deck. Roof Drainage will consist of roof gutters with downspouts and splash blocks at grade.

6.4 Doors

The building will use a fiberglass door system (Chem-Pruf, or approved equivalent) to match the existing facilities with door hardware keyed to match existing system. A pair of doors will be provided and sized to accommodate the removal of the largest piece of equipment.

6.5 Finishes

All floor surfaces will be exposed concrete with clear floor sealer. Interior wall and overhead structure surfaces will be provided with protective painted finishes as required for ease of clean up and corrosion protection.

6.6 Code Issues

The building will have no hazardous materials and will be classified as Factory Industrial F-2 Low-hazard Occupancy with no automatic sprinkler system and no exit signage required. A single manual fire extinguisher will be provided.

6.7 Exclusions

No exterior building signage is anticipated. Skylights and windows are not anticipated to be required. The precast concrete fascia/exterior soffit that occurs on the existing buildings will not be incorporated into blower building design.

6.8 Sustainability Review (LEED Charette)

Black & Veatch conducted a LEED Charette workshop with the City of Austin to review the sustainability of the alternative filtration technologies under consideration for the Walnut Creek WWTP Tertiary Filter Rehabilitation Project. The objective of the workshop was to (1) review the Project and City sustainability goals and objectives, and (2) evaluate the sustainability of the technology alternatives

6.8.1 Project and City Sustainability Objectives

The LEED requirements stipulated in the City Resolution were reviewed and it was determined that:

- This project does not meet the requirement to provide LEED Silver certification because of occupancy and scope of construction.
- This project team should use best practice procedures to follow LEED principles, when applicable.
- No specific building measures were provided by the City of Austin to prioritize.

6.8.2 Process Measures/Evaluation

The evaluation of the technology alternatives used the following basis/assumptions for ***process*** measures:

- Energy costs are relatively low when compared to other plant processes and, therefore, savings would not be impactful compared to other resources.
- Water measures are partially based on manufacturer claims that have not been independently substantiated.
- Disposal costs for spare parts are not included in the totals.
- Cost analysis based on 20 year life cycle evaluating capital costs and operating costs.

The technology alternatives resulted in the following rankings for ***process*** measures.

Table 6-1: Sustainability Scorecard – Process Measures

Process Measures (Initial Cost / Life Cycle)	Granular Media Filters	Cloth Media Filters	NOVA Ultrascreen Filters
Energy	38kW 2	27 kW 3	150 kW 1
Water	98.5% , 1 MGD 2	98% , 1.5 MGD 1	99% , 0.75 MGD 3
Chemicals	$2,800 / Year 2	$3,200 / Year 1	$2,200 / Year 3
Spare Parts (Annual Replacement)	$17,800 / Year 3	$73,000 / Year 2	$86,000 / Year 1

Note: 3 = Best, 2 = Average, 1 = Worst

- The Granular Media Filter is proven technology with low annual cost, average chemical cost and acceptable water efficiency.
- The Cloth Media Filter Alternative is newer technology with high annual cost, highest chemical cost and lowest water efficiency.

- The NOVA Ultrascreen Filter Alternative is cutting edge technology with no existing projects to compare currently at this proposed scale. Highest annual cost, low chemical cost and highest claimed water efficiency (not demonstrated).

6.8.3 Building Measures/Evaluation

The evaluation of the technology alternatives used the following basis/assumptions for ***building*** measures:

- The current technology (Granular Media Filter) requires less building scope than the other alternatives because roof enclosures over the filter boxes are required to house the other filter alternatives.
- Commissioning will need to be implemented to provide checks and balance of the measures to ensure proper installation that provides actual designed benefit.
- HVAC will be primarily designed to support ventilation for mechanical equipment versus the larger range of comfort required for human occupants.
- Lighting will be equivalent for all three alternatives except for the Granular Media Filter Alternative, which has less enclosed area. Natural lighting in lieu of electric lighting will be utilized when applicable in all alternatives.
- The quantity of the process equipment motors varies for each alternative. In all cases, premium efficiency motors will be used.
- Because the structure does not need to be modified to accommodate the current technology (Granular Media Filter) the other alternatives create much more construction waste.
- Process waste is highest for the Granular Media Filter Alternative and the least for the NOVA Ultrascreen Filter Alternative.
- All three alternatives equally utilize the existing construction.
- Indoor Air Quality including Tobacco Smoke control and Low-Emitting materials will be equivalent for all three alternatives.
- Due to the limited scope, controllability of the lighting and thermal comfort will be minimal and equivalent for all three alternatives.

The technology alternatives resulted in the following rankings for ***building*** measures.

Table 6-2: Sustainability Scorecard – Building Measures

Building Measures (Construction Costs)	Granular Media Filters	Cloth Media Filters	NOVA Ultrascreen Filters
Building Commissioning Options	3	3	3
Minimize Energy Use			
- HVAC (Ventilation throughout; A/C Upstairs)	3	3	3
- Lighting	2	2	3
- Process Equipment Motors (Premium Efficiency)	2	3	1
Natural Light			
- Skylights	3	1	2
- Windows	3	2	3
Construction Waste Management			
- Construction Waste	3	2	1
- Process Waste	1	3	3
Minimize Electrical Lighting			
- Filter Building (Control Area)	3	3	2
- Filter Gallery	3	3	3
Innovative Roof Options			
- Photo-Voltaic Roof Panels	1	3	3
- Vegetative “Green” Roof	1	1	1
- White Single-Ply Adhered Roof	1	3	3
Light Pollution Reduction	2	3	3
Regional Materials			
- Construction Materials	3	3	3
- Process Materials	2	2	1
Building Re-Use	3	3	3
Indoor Air Quality High Performance			
- Filter Building (Control Area)	3	3	3
- Filter Gallery	3	3	3
Tobacco Smoke Control	3	3	3
Low-Emitting Materials	2	3	3
Controllability of Systems			
- Lighting	3	3	3
- Thermal Comfort	3	3	3
Note: 3 = Best, 2 = Average, 1 = Worst			

- Because the current technology (Granular Media Filter) requires less building scope than the other alternatives, there is less opportunity to implement sustainable measures. However, less building scope does indicate fewer resources are being utilized and fewer discarded materials are created.
- The Cloth Media Filter Alternative and the NOVA Ultrascreen Filter Alternative are mostly equivalent in the sustainable building measures that can be utilized. The differences are only attributed to the difference in process materials and process waste requirements.

7.0 Structural Design Criteria

7.1 Introduction

The structural design criteria presented herein will be used for the design of filter improvements to Walnut Creek WWTP for the COA. The design criteria represent minimum requirements and will be used as a guide in the structural design and evaluation of the Walnut Creek WWTP facilities. Criteria may be modified where appropriate for specific circumstances. All items noted herein which require approval shall be reviewed and approved by the design firm’s structural project manager and all significant changes will be presented to the COA for review and comment prior to implementation.

7.2 Design Codes and References

Although there are many codes, standards, specifications, and design aids used by structural engineers, this section outlines the primary documents that will be used for the structural design portion of the project. Where conflicts occur between two or more of the documents presented, the more stringent one will apply. The most recent version of the listed codes and standards shall be used for design.

7.2.1 Codes and Standards

The strength, serviceability, and quality for materials and design procedures will meet the expectations of the following codes and standards. The latest editions that have been adopted by the COA at the time of design are presented below.

- International Building Code (IBC 2009)
- American Concrete Institute (ACI) 318: Building Code Requirements for Structural Concrete
- American Concrete Institute (ACI) 350: Code Requirements for Environmental Engineering Concrete Structures
- American Institute of Steel Construction (AISC): Steel Construction Manual

7.2.2 Supplemental Codes

- American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI): ASCE/SEI 7-05 Minimum Design Loads for Buildings and Other Structures
- Occupational Safety and Health Administration (OSHA): Code of Federal Regulations (CFR), 29 CFR Part 1910
- American Concrete Institute (ACI) 350.3: Seismic Design of Liquid-Containing Concrete Structures
- American Concrete Institute (ACI) 350.4R: Design Considerations for Environmental Engineering Concrete
- International Code Council–Evaluation Services (ICC-ES): Evaluation reports for specific products
- American Association of State Highway and Transportation Officials (AASHTO): Standard Specifications for Highway Bridges

7.3 Materials

7.3.1 Concrete

All concrete materials will conform to the requirements of Chapter 19 of the IBC and CoA Specification Item No. 403S, Concrete for Structures. Specific requirements for the project are as follows:

- Class A Concrete: f'c = 3,000psi (28 day); maximum water-to-cement (w/c) ratio = 0.60; minimum cement = 470 pounds per cubic yard; Use for slab-on-grade, housekeeping pads, toppings on metal deck, and seal slabs.
- Class S concrete: f'c = 4,000 psi (28 day); maximum w/c ratio = 0.45; minimum cement = 564 pounds per cubic yard; Use for formed/suspended concrete floor or roof systems.
- Class Ssp Concrete: f'c = 4,000 psi (28 day); maximum w/c ratio = 0.45; minimum cement = 564 pounds per cubic yard; contains an approved high-range water reducing (HRWR) admixture, ASTM C 494 Type F or G; Use for formed concrete walls, columns, or suspended concrete floor/roof systems.
- Class Sw Concrete: f'c = 4,000 psi (28 day); maximum w/c ratio = 0.40; minimum cement = 564 pounds per cubic yard; contains an approved HRWR admixture, ASTM C 494 Type F or G; Contains Class F Fly Ash, ASTM C 618, minimum 20 percent of cementitious content by weight, maximum 30 percent cementitious content by weight; Used for liquid containing structures.
- Coarse aggregate size shall be Grade 4 (Size #57) per Table 2 of CoA Specification Item No. 403S. Grade 4 coarse aggregate has a nominal maximum size of 1-inch. Coarse aggregate is to be crushed limestone.
- Reinforcing steel: ASTM A 615 or ASTM A 706, Grade 60, deformed
- Portland Cement: ASTM C 150, Type I or Type I/II
- Controlled Low-Strength Material (CLSM) shall be supplied for specific fill areas in accordance with ACI 229 and CoA Specification Item No. 402S, Controlled Low-Strength Material.
- Use air-entrainment in all mixes.

7.3.2 Structural Steel

Materials for structural steel will conform to the requirements of Chapter 22 of the IBC. Specific additional requirements for the project are:

- W-Shapes: ASTM A 992, Grade 50
- M-Shapes, S-Shapes, Channels, Angles, Plates, Bars, and Threaded Rods: ASTM A 36
- Round, Square , and Rectangular Hollow Structural Shapes (HSS): ASTM A 500, Grade B
- Structural Steel Pipe: ASTM A53, Grade B
- High-Strength Steel Bolts will conform to the requirements of ASTM A 325, Type 1. Furnish with heavy-hex carbon-steel nuts per ASTM A 563, Grade C and hardened carbon-steel washers per ASTM F 436, Type 1.
- Embedded anchor rods shall conform to the requirements of ASTM F 1554, Grade 55.
- Structural Steel Welding Electrodes: E-70XX
- Stainless Steel W-Shapes: ASTM A 276 and/or ASTM A 479
- Stainless Steel Plate, Sheet, and Strip: ASTM A 666 and/or ASTM A 240
- Stainless Steel Bolts, Threaded Rod and Expansion Anchors: ASTM F 593 and/or ASTM A 193
- Stainless Steel Nuts: ASTM F 594 and/or ASTM A 194

- Where stainless steel is required for both wet and dry conditions, Type 304 or 304L will be used unless specific justification is provided for the use of Type 316 or 316L (for example: chlorine exposure area).

7.3.3 Aluminum

Aluminum materials will conform to the requirements of Chapter 20 of the IBC, The Aluminum Association ASM 35, and Parts 1-A and 1-B of The Aluminum Association's Aluminum Design Manual. Aluminum material will not be used in a submerged condition. Specific requirements for the structural components on this project are as follows:

- Structural Shapes and Plates: Alloy 6061-T6
- Extruded Aluminum Pipe: Alloy 6063-T6

Fasteners for aluminum connections will be Type 304 stainless steel with proper dielectric isolation, unless specific justification is provided for the use of Type 316 stainless steel.

7.3.4 Concrete Masonry

The minimum specifications for the design of structural masonry will be in accordance with the requirements of Chapter 21 of the IBC for reinforced masonry and as presented below:

- Concrete Masonry Units: ASTM C 90, Grade N, medium-weight with f'm = 1,500 psi; all reinforced cells will be solid grouted.
- Mortar: ASTM C 270, Type S; mix design by proportion; all mortar below grade shall be Type M.
- Grout: ASTM C 476; mix design by proportion
- Reinforcing Steel: ASTM A 615, Grade 60

7.4 Design Loads

Design loads for each structure will be in accordance with the applicable codes previously presented. The criteria presented below are a partial summary of the requirements.

7.4.1 Dead Loads

Dead loads will consist of the self-weight of the structure and all equipment of a permanent or semi-permanent nature, including but not limited to: Heating, Ventilation, and Air Conditioning (HVAC) ductwork, electrical equipment, electrical wiring and lighting, interior partitions, exterior back-up walls, and masonry veneers.

The numerical values to be used for the dead loads of well-defined components of a structure are documented in the following recognized publications:

- SEI/ASCE 7-05: Minimum Design Loads for Buildings and Other Structures (Table C1)
- AISC Steel Construction Manual (Latest Edition)
- In addition, dead load information will be drawn from:
- Manufacturers' catalogs
- Equipment data sheets

The following uniform loads will be used as a minimum:

- Interior partitions: 20 pounds per square foot (psf), unless otherwise specified
- Lighting, wiring, HVAC Ductwork and Sprinklers (Total): 10 psf, unless otherwise specified

Actual or estimated equipment weights will be confirmed with the appropriate design engineers or equipment suppliers.

7.4.2 Live Loads

Live loads will consist of uniform live loads and equipment live loads. Uniform live loads are assumed to be sufficient to provide for movable and transitory loads, such as the weight of people, small equipment, and stored materials. These uniform loads need not be applied in addition to equipment loads to floor areas that will be permanently covered with equipment. Equipment room floors will be designed for the uniform live load or actual equipment loads, whichever is greater.

Uniform and concentrated loads will conform to IBC Table 1607.1 and will be applied in accordance with Section 1607 of the IBC.

7.4.3 Wind Loads

Wind loads will conform to the requirements of the IBC, Section 1609.

- Basic Wind Speed (3-second gust): 90 mph
- Wind Exposure Category: Exposure C
- Wind Importance Factor: 1.15

For the purposes of design, the wind pressure will be taken upon the gross area of the vertical projection of the building or structure, measured above the average level of the adjoining ground.

7.4.4 Seismic Loads

The facility will be designed in accordance with IBC Chapter 16 and ASCE 7, Chapters 11 through 15 and Chapter 20 through 22. Concrete liquid-containing structures will be designed according to the provisions of ACI 350, Chapter 21.

7.4.5 Impact Loads

- Lifting Eyes: Design for 150-percent of the lifted weight
- Light Machinery, Shaft- or Motor-Driven: Design for 120-percent of the total machine weight or manufacturer's recommendation.
- Reciprocating Machinery or Power-Driven Units: Design for 150 percent of the total machine weight or manufacturer's recommendation.

7.4.6 Liquid Loads

The maximum operating fluid level will be used for the static load case. In addition, the maximum fluid level to the top of an open containment or to the maximum level possible due to passive overflow (no operator action required) will be used for the overflow case. Closed containment structures will be provided with air vents adequately sized to prevent pressurization due to inflow and outflow and will be designed for the maximum internal fluid pressure due to overflow conditions. Venting between adjacent compartments will be considered. Where overflow is part of an open structure, care should be taken to assure that the overflow conditions cannot be blocked.

Basic design conditions will be as follows for structures that contain liquids, extending below grade, or both:

- Maximum operating fluid level and no backfill. No relief will be given for any passive soil pressure on a structure on the face remote from the contained liquid.
- Backfill with groundwater and water containment structure empty
- Any tank cell empty or with a maximum liquid level in any combination

Buoyancy will be checked for all structures below design groundwater level. This analysis will assume the structure to be empty. Pressure relief valves will be provided in floors and walls of structures where the structures self-weight does not exceed the buoyancy force by a factor of 1.25.

7.4.7 Soil Loads

Below grade structures, such as the proposed Southside Clearwell, will be designed in accordance with the design values and recommendations provided by the geotechnical engineering consultant for this project.

7.4.8 Thrust Loads

Where pumps and pipes penetrate walls or slabs, pipe thrust will be considered. The method of transfer of thrust load into the structure will be considered, including local shear stresses, as well as overall stresses in the element. The greater of the maximum surge pressure and internal piping test pressure will be the basis for calculated thrusts.

7.4.9 Gate Operating Loads

Sluice gate and slide gate support brackets and corbels used to support gate operators will be designed to resist the following forces:

- For all gates with cranks, a minimum of 2.5 times the output thrust force of the gate operator based on a 40-pound effort applied at the operator crank handle.
- The output thrust of the operator based on the stalled motor torque for electric motor operators or the cylinder capacity at maximum working pressure for hydraulic and pneumatic operators.

These forces may act in either direction. Both the supporting wall and corbel will be designed to resist these forces.

7.5 Design

7.5.1 *Loading Combinations*

All structures and components thereof will be designed to sustain all dead loads and other loads previously discuss within the stress limitations of Chapters 16, 19, 20, 21 and 22 of the IBC. Applicable loads will be combined using strength design or allowable stress design. Live loads will be arranged to cause maximum shear and bending moments along the member.

7.5.2 *Stability Requirements*

A continuous load path will be provided for all vertical and lateral loads to deliver reactions to the foundation material. The safety factor against overturning due to wind loads shall be in accordance with the IBC. A safety factor of 1.5 will be provided against sliding and against overturning for isolated retaining walls or basins with unbalanced loads under normal loading conditions.

Where hydrostatic uplift occurs, resistance to buoyant forces may be provided by the permanent dead weight of the concrete structure plus the weight of the soil above the footings, with a factor-of-safety of 1.25. Where this resistance is not feasible, pressure relief valves will be used in the floor and/or walls of the structure.

7.5.3 *Foundation Design*

Foundations will be designed in accordance with the conclusions and recommendations provided by the geotechnical report prepared for this project. Construction sequencing and backfilling will be considered during design. Preferably, substructures will be designed to permit backfilling prior to placement of the top slab. As a minimum, below-grade structures will be designed to permit backfilling after construction of the finished grade-level slab.

7.5.4 *Concrete Design*

Concrete design for process structures will be in accordance with ACI 318 and ACI 350. Structures used to convey, store, or treat liquids or wastewater are classified as environmental engineering structures. Environmental durability factors presented in the latest edition of ACI 350 will be included in the design of all environmental engineering concrete structures, except when designing for short-term loads, such as wind or seismic loads. Rebar sizes and spacing will be adjusted to conform to the maximum reinforcement tensile stress limits per ACI 350, which correspond with limiting crack widths to 0.01-inch or less. For the Southside Clearwell construction, steel stress will be limited to meet the requirements for Normal Environmental Exposure. Normal Environmental Exposure is defined as exposure to liquids with a pH greater than 5 or exposure to sulfate solutions of 1000 parts per million (ppm) or less.

7.5.5 *Steel and Aluminum Design*

Structural steel design will be in accordance with the American Institute of Steel Construction's (AISC) Steel Construction Manual, latest edition.

Aluminum is generally used for gratings, cover plates, hatches, handrails, guardrails, and ladders. Aluminum members will be designed in accordance with engineering data and specifications published by The Aluminum Association.

7.5.6 Concrete Masonry Design

Concrete masonry design will be done in accordance with the Masonry Standards Joint Committee (MSJC) Building Code Requirements for Masonry Structures (TMS 402/ACI 530/ASCE 5) and Specifications for Masonry Structures (TMS 602/ACI 530.1/ASCE 6) and IBC Chapter 21.

7.5.7 Deflection Limitations

Structures will be designed according to the deflection limitations stated in Section 1604 of the IBC. Additional deflection limitations which must be considered are listed below.

- Maximum total load deflection of roof or floor framing members: L/240
- Maximum live load deflection of roof or floor framing members: L/360
- Maximum total load deflection of steel roof decking: L/240
- Maximum live load deflection of floor plates and gratings: L/360 (1/4-inch maximum)
- Maximum deflection of members supporting masonry: L/600 (3/8-inch maximum)

7.5.8 Vibration

Vibration of equipment will be accounted for in the design of all support structures. Basic guidelines that will be considered are as follows:

- Mount all rotating equipment on concrete foundations or concrete support systems.
- Recommend use of vibration isolators or dampeners where appropriate.
- Consult with manufacturers to obtain recommendations, frequencies, and unbalanced loads.
- Where possible, provide a concrete base on-grade with a mass equal to 10 times the rotating mass of the equipment or four times the gross mass of the machine, whichever is greater. Where this is not possible or practical, vibration will be considered when designing the support structure.
- Use embedded anchor rods for anchorage to concrete foundations, where possible. Do not use drilled-in anchors unless approved by the structural project manager.

7.6 Structural Detailing Concepts

7.6.1 Concrete Member Thicknesses

The following recommended minimum thicknesses will be used as a guide in order to facilitate concrete placement:

- Slabs-on-grade and minor trenches with one mat of reinforcement shall be at least 6-inches thick.
- Trench walls and weir walls shall be at least 8-inches thick.
- Slabs with two mats of reinforcement shall be at least 12-inches thick.
- Walls taller than 6-feet and walls requiring waterstops shall be at least 14-inches thick.

7.6.2 Spacing of Reinforcement

The minimum reinforcement spacing for environmental structures shall be 6-inches. The maximum reinforcement spacing shall be 12-inches. Reinforcement spacing shall be adjusted to meet the maximum reinforcement tensile stress limits per ACI 350.

7.6.3 Concrete Cover

Minimum concrete protective cover over reinforcement shall be as follows:

- Unformed surfaces in contact with earth or fill material: 3-inches clear cover
- Formed surfaces exposed to earth, water, or weather: 2-inches clear cover
- Soffit of slab over water: 2-inches clear cover
- Slabs and joists in a dry (interior) condition: 1-inch clear cover
- Beams and columns in a dry (interior) condition: 1-1/2-inch clear cover
- Walls in a dry (interior) condition: 1-inch clear cover

7.6.4 Joints in Concrete Walls and Slabs

The performance of joints in liquid-containing environmental engineering concrete structures can be problematic. The joints are highly susceptible to undesirable and unsightly leaks. Expansion joints are particularly troublesome and should be avoided or minimized if possible. Consequently, the use and location of joints of any type will be carefully considered. The types of joints and their descriptions are as follows:

- Expansion Joint: An expansion joint is a type of joint that separates adjacent concrete sections and allows free movement of the adjacent parts. This joint is a type of movement joint. Expansion joints are generally used only in very long structures – typically ones that exceed 150-feet in length or where abrupt changes in configuration or support occur. Expansion joint widths range from 1 to 2 inches. The space between concrete sections is formed by compressible filler, such as premolded mastic or cork.
- Full Contraction Joint: This is another type of movement joint. It is designed to dissipate the effects of restrained shrinkage. All reinforcing at a Full Contraction Joint is discontinuous across the joint. Separate smooth dowels may be placed across the joint to provide for the transfer of shear forces and to maintain wall alignment. It is detailed like an expansion joint, but without the large gap between sections of concrete.
- Partial Contraction Joint: This is a modified type of movement joint where no more than 50 percent of the reinforcing steel perpendicular to the joint passes through the joint. This type of joint is less effective at dissipating the effects of shrinkage than the Full Contraction Joint, therefore requiring closer spacing of the joints or increased reinforcing steel. A footnote at the bottom of Table 7.12.2.1 of ACI 350 suggests reducing the spacing to 2/3 of the spacing for other movement joints.
- Construction Joints: A construction joint is a joint separating work done at different times and is normally used to accommodate the construction sequence. All reinforcing is continuous across this joint. The elapsed time between casting adjacent elements shall be at least 48 hours.

All joints in water-containing structures shall be detailed with a suitable waterstop made of rubber or plastic. Waterstops should be selected to allow for anticipated movements. Joints at the juncture of a wall and a base slab or footing should be designed to include a "starter" wall, which can accommodate the placement of a waterstop without interfering with the top reinforcement of the base slab or footing. Expansion and contraction joints should be grooved and caulked on both sides of the wall with a suitable joint sealant. For slabs on grade, only the exposed side of the joint requires caulking.

7.6.5 Guidelines for Joints – Type and Location

The following criteria are general guidelines on the type and locations for joints in liquid-containing environmental concrete structures. These guidelines provide for reasonable performance of the joints in most cases.

- All joints shall be located on the plans by dimension, with the type of joint indicated.
- Expansion joints in liquid-containing structures will be avoided if structural dimensions will allow. They are generally prone to leaking.
- Construction joints shall be spaced at approximately 30-feet on-center. In rectangular tanks 30 feet or less in dimension, a construction joint shall be located at mid-length. Unless more steel is required for flexure, the minimum percentage of horizontal steel passing through the joint shall be provided per ACI 350, Table 7.12.2.1.
- Joints in base slabs shall be spaced to align as nearly as possible with walls in adjoining walls. Joints detailed as construction joints shall have all reinforcing passing through the joint. Splices in lengths of reinforcing shall be staggered and shall conform to ACI Class B splices.

7.6.6 Minimum Reinforcement of Concrete Elements

Minimum reinforcement ratios for environmental engineering structures will be provided per ACI 350, Table 7.12.2.1, with consideration for spacing and types of movement joints.

Concrete walls cast against previously-placed base slabs require additional attention. Since the base slab restrains the bottom of the wall from freely shrinking, additional reinforcing should be provided to minimize the effects of this restraint and control possible cracking. Accordingly, the amount of horizontal reinforcing in a zone at the bottom of the wall shall be double the amount of horizontal reinforcing provided elsewhere in the wall. This can easily be accomplished by reducing the normal spacing by one-half. This zone shall be considered to be three to four feet high. For very tall walls, the zone should be increased with the maximum height limited to approximately one-fourth of the wall height.

A situation similar to that discussed in the previous paragraph occurs in base slabs where sections of base slab are placed tightly against previously cast concrete. Therefore, additional reinforcing shall be placed in a zone parallel to the joint between the sections. Depending upon the placing sequence, it is possible that additional reinforcing could be required along two or more edges of the newly placed section.

7.6.7 Waterstops

Waterstops will be provided in all joints in walls and slabs of liquid containment structures to prevent exfiltration of liquid into soil or dry areas of the structure. Waterstops will also be provided in all below-grade joints in walls and slabs to prevent infiltration of groundwater into the structure.

At liquid containment and below-grade structures, eight-inch, wire-reinforced, ribbed Polyvinyl Chloride (PVC) waterstops will be used at construction joints and nine-inch, wire-reinforced, ribbed PVC waterstops with centerbulbs will be used at expansion and contraction joints.

7.7 Descriptions of Proposed Structural Work

7.7.1 Southside Clearwell Expansion and New Blower Building

A southward expansion of the existing Primary Clearwell is being proposed, this is the proposed Southside Clearwell. The existing clearwell is located below Filter Basins 1 and 3. This proposed expansion is to be constructed directly adjacent to the existing Primary Clearwell. It will be constructed with a cast-in-place concrete mat foundation, concrete walls, concrete columns at a spacing of approximately 10-feet on-center, and a concrete roof structure. The floor of the proposed expansion will match the elevation of the Primary Clearwell. The majority of the clearwell roof structure, adjacent to the existing filter basins, will extend to (or near) the adjacent finished grade elevation. This grade-level portion of the roof will support slide gate and sluice gate operators for the Southside Clearwell construction and will also act as the foundation for the new blower building. The southern portion of the clearwell roof will be about 11-feet below finished grade in order to provide a path for future underground utilities and to allow the new clearwell to extend beneath the existing roadway.

In order to allow the existing filter structure to remain in operation, a concrete channel will be constructed around the existing 72-inch effluent pipe, which runs south of the Primary Clearwell. This existing pipe will need to be supported (suspended) by temporary structures during the period of the enveloping channel's construction. After the channel footing and walls are constructed around the pipe, the new channel will be filled with a lean concrete up to the centerline of the existing pipe, to support the pipe. The temporary support structures can be removed after the lean concrete fill has attained its design strength. For hydraulic process reasons, the top half of the existing effluent pipe will eventually be removed. After the remainder of the Southside Clearwell structure is constructed, an opening will be saw-cut in the existing channel wall to link the Southside Clearwell conduit to the existing Primary Clearwell.

A new blower building will be required to house two new blowers. It will be constructed on top of the higher (grade level) concrete roof structure of the proposed Southside Clearwell. This building will be framed with steel columns supporting a roof system consisting of steel girders, steel joists, and steel roof decking. The steel building columns will be located on a grid to align with the concrete columns in the clearwell below. The roof structure will also support a 3-ton monorail hoist runway beam. The hoist will be required to lift and transport blowers or their motors for future maintenance or replacement operations. The backup wall system at the perimeter of the building will consist of reinforced concrete masonry (CMU) walls. The CMU backup walls will be connected to the foundation and roof structure to also act as shear walls, resisting wind loads on the building structure.

7.7.2 Northwest Clearwell Expansion

A separate clearwell expansion is being proposed at the northwest area of the Filter Complex, this is the Northwest Clearwell. This separate expansion is being proposed as an add alternate to provide additional capacity and more flexibility for plant operations. The proposed expansion is located directly adjacent to the west side of the existing junction box, which is located west of Filter Building 2. This clearwell expansion will be constructed with a cast-in-place concrete mat foundation, concrete walls, one north-south row of columns at the center of the clearwell, and a concrete roof structure. The roof of this proposed clearwell will extend to (or near) the adjacent finished grade elevation. This portion of the roof will support slide and/or sluice gate operators for the clearwell. The interior of the clearwell will have two different floor elevations. The lower floor will be the top of the mat footing elevation. The upper floor slab and wall supporting the slab's north edge will be constructed inside of the perimeter walls of the clearwell. The perimeter walls at the east and west sides of the proposed clearwell will be constructed around an existing 66-inch effluent pipe. The existing pipe will perpendicularly penetrate the new walls. When construction of this proposed clearwell is complete, the portion of the existing pipe inside the walls of the clearwell will be removed.

7.7.3 Coating of Filter Basins 1 through 4

The existing basins for filters 1 through 4 have experienced more than 30 years of service. It appears that the cement mortar matrix of these concrete basin structures has been partially eroded due to chemical and biological exposure. Although there are no apparent signs of distress to the concrete or its reinforcing at this time (such as cracking, spalling, or rusting), we recommend applying a corrosion-resistant protective coating to the walls, floor and washwater troughs at these basins to increase the lifespan of this structure. Having these basins emptied-out as a part of this project will provide a convenient opportunity to apply a protective coating. Our recommendation is to apply a ½-inch thick coating of "QM-1s Restore" by Quadex, Inc. This product is a high-strength, cement-based, polypropylene fiber reinforced, shrinkage-compensating mortar enhanced with a mono-crystalline quartz aggregate. It is designed for placement by low-pressure spraying. A probable cost for this application is provided with the cost estimate section of this report

8.0 Mechanical Design Criteria

This section outlines the design criteria for the proposed addition of the air scour blowers used in the combination air/water backwash cycle. Required criteria for the proposed HVAC improvements are also addressed in this section.

8.1 Filter Air Scour Blowers

Two new multistage centrifugal blowers will provide low pressure air for backwashing of the filters 1 through 10. The blowers will be located in a new air blower building above the proposed Southside Clearwell. Each blower will provide 100 percent of air required to backwash one filter. The design criterion for the blower equipment is provided in Table 8-1.

Table 8-1: Filter Air Scour Blowers Design Criteria

Type	Multistage centrifugal, constant speed
Location	Filter Building 1
Number of units	2 (1 duty, 1 standby)
Elevation above sea level, ft	458
Outdoor ambient /blower inlet temperature range, ^{o}F	25 to 110
Rated discharge pressure, psig	6.7
Design capacity of each blower at rated discharge pressure, scfm	3,270
Motor size, hp	200
Motor speed, rpm	3,600

Each blower will be provided with a cartridge type intake filter silencer, installed outdoors in the individual suction piping. The filter element will be synthetic, and will remove 98 percent of particles 10 micron and larger. A modulating electric inlet butterfly valve will be provided for each blower to control air flow. Additionally, an automatic open-close, electric blow-off valve and blow-off silencer will be provided in the blow-off piping.

Protection controls will be provided to monitor the conditions listed below:

- Blower bearing temperature.
- Vibration in each blower bearing.
- Surge and overload conditions.
- Differential pressure across each inlet filter.
- Blower inlet valve sequence failure.

Alarms will be provided for the following conditions:

- High bearing temperature
- High bearing vibration
- Approach surge
- Approach overload
- Startup/shutdown sequence failure
- High filter differential pressure conditions

Safety shutdowns will be provided for the following conditions:

- High-high bearing temperature
- High-high bearing vibration
- Surge and overload conditions

The surge trip point will be automatically compensated for changes in ambient/inlet air temperature.

Before blower startup, the system will verify for each operating blower that the modulating inlet valve is closed and the blow-off valve is open. After verification, the blower will start. After a time delay to allow the motor to reach full speed, the blow-off valve will close and inlet valve will open simultaneously, to achieve the desired operating point.

A calibrated ammeter provided with each blower, will be used in conjunction with the modulating inlet valve to control air flow to the filter being scoured based on motor amps. A flow set point will be provided for backwashing the filters, which will vary based on the filter being backwashed. The blower inlet valve will modulate to maintain a constant air flow during backwash cycle.

8.2 HVAC Systems

The existing HVAC systems for Filter Building 1 and Filter Building 2 both do not have sufficient cooling capacity to condition each control room under peak conditions with the new control heat loads. The fans used to provide ventilation air for the pipe gallery below are providing approximately three air changes per hour to the space but are not effectively ventilating or dehumidifying the space. This portion of the report will provide recommendations for replacing the existing air conditioning equipment to accommodate the additional load at the filter building control rooms and for increasing the ventilation rate for the pipe gallery.

8.2.1 Existing Building Air Conditioning Systems

The existing Filter Buildings 1 and 2 are each served by a split direct expansion (DX) air conditioning system, consisting of an interior air handler and an exterior condensing unit. The air handler serving Filter Building 1 is an eight ton cooling capacity unit located in the piping gallery below the building. This unit was designed with hot water heating coils fed from a boiler in an adjacent building but the supply of hot water to this building has been removed and the unit currently operates with no heating capacity. Air is routed from this unit up into the control room above via a duct chase and distributed through ceiling mounted grilles. The unit draws 450 CFM of outside air from a louver located in the roof eave on the south side of the building. The condensing unit associated with this air handler is a 7.5 ton unit which uses R-410a refrigerant. It is located at the northeast corner of the building on a concrete pad.

The ductwork for this unit is not sized per SMACNA standards for the unit airflow. It appears that the ductwork was sized for a four ton capacity unit, but a larger unit was installed. The existing duct is original to the building and is very dirty. The grilles for the system are also dirty and corroded.

The air handler unit for Filter Building 2 is a four ton cooling capacity unit located in the control room above the ceiling. Air is ducted from this unit and distributed through ceiling mounted grilles. This air handler provides heating and cooling via a heat pump condensing unit located at the southwest corner of the building on a concrete pad. The unit draws 100 CFM of outside air through a louver located at the building exterior in the roof eave. The ductwork for this system appears to be correctly sized per SMACNA standards for this unit. It is not, however, the correct size for the new larger system being proposed and therefore the duct and grilles will need to be replaced. Some of the existing grilles may be able to be reused.

8.2.2 New HVAC Systems

The preliminary HVAC load calculations indicate that 7.5 tons of air conditioning will be required at each of Filter Building 1 and 2 control rooms. The new units shall be provided with electric resistance heaters or be heat pump type as the boiler hot water supply is no longer available.

The existing air handler unit serving the Filter Building 1 control room is several years old, near the end of its service life and does not meet the current minimum efficiency standards for HVAC equipment. The unit should be replaced to ensure that the building is properly conditioned and that a minimal amount of maintenance is required. The air handler will be located in a new mechanical room created in the northwest corner of the existing storage room on the east end of the building. This room will have double doors for unit clearance and access that open into the control room. See attachment 8-1. The existing opening through the concrete floor slab for supply air and return air ductwork will be filled in and the existing chase can be reclaimed for control room use. The existing condensing unit shall be replaced with the new condensing unit in its current location, which is right outside of the new mechanical room location. Outside air for the new air handler can be routed directly from a louver in the exterior wall.

The existing air handler unit serving Filter Building 2 does not have sufficient cooling capacity to overcome the calculated HVAC load and should also be replaced. The new building has only 24”clear above the ceiling of the control area. This is not sufficient space to accommodate a new 7.5 ton air handler above the ceiling, so a new small mechanical room for the air handler will need to be provided inside the building space, see attachment 8-2. The proposed room should be at least 6’-6” wide by 3’-0” deep, with a double door in the front to access the unit. During the design process this room location will be coordinated with the control room equipment and the Owner’s needs.

The new HVAC units shall be by Trane, Carrier, Lennox or approved equivalent. The new units shall have a minimum EER rating of 11.2 per the 2009 International Energy Conservation Code. All of the new HVAC units shall have corrosion resistant coatings provided by the manufacturer. Coatings shall be provided for the coils at the air handler unit and the condensing unit, as well as any exposed copper surface. All refrigerant piping shall be insulated and protected from damage and exposure to the elements.

8.2.3 Modifications to Existing Ductwork

The supply air ductwork at Filter Building 1 is undersized based on airflow required for a 7-1/2 ton unit. New sheet metal ductwork shall be installed and shall be externally wrapped with duct insulation. The ductwork shall be sized, manufactured and installed in accordance with SMACNA's standards. The grilles in Filter Building 1 are old and very dirty. These grilles shall be replaced.

At Filter Building 2 the entire duct system will need to be replaced to accommodate the larger airflow from the new air handler. The new ductwork shall be sheet metal and shall be sized, manufactured and installed in accordance with SMACNA's standards and shall be externally wrapped with duct insulation. The duct would be routed above ceiling and distributed to supply and return air grilles throughout the building. The outside air ductwork would need to be routed to the new unit location and connected to the return air system, using an exterior wall louver from the new mechanical room location.

Each of the units will require a charcoal filter and a heavy duty Merv-8 airflow filter be installed to handle the airflow present at the plant environment.

8.3 Ventilation Systems

This section describes the proposed improvements to the ventilation systems for the pipe gallery and the proposed air scour blower building. Additionally, this section describes requirements for protection against freezing weather.

8.3.1 Pipe Gallery Ventilation

The pipe gallery, continuous below Filter Building 1 and 2, is each ventilated by exhaust fans and intake louvers and ducts. The pipe gallery under Filter Building 1 is ventilated by an in-line exhaust fan near the pumps at the Southeast corner of the vault. A roof mounted exhaust fan ventilates the pipe gallery under Filter Building 2. The fan for Filter Building 1 is located above the filter pumps. The fan for Filter Building 2 is located on the roof above the stairwell exiting the gallery. These fans each exhaust air from the pipe gallery at a rate of approximately three air changes per hour. The exhausted air is made up through outside air louvers to air handlers to the pipe gallery. The air handlers are designed to utilize hot water heating but the hot water supply is no longer available. The outside air ducts for the gallery under Filter Building 1 also contains motorized dampers to control the intake of air. The outside air ducts serving the pipe gallery under Filter Building 2 do not have motorized dampers.

During preliminary site visits water was observed in the pipe gallery near the backwash pumps. Additionally the staff has noted that this space is often humid. A larger fan should be installed to increase the number of air changes to six per hour. This will remove moisture from this portion of the pipe gallery at a greater rate and help prevent corrosion from forming on the piping and equipment. Six air changes per hour is the standard ventilation rate recommended by code for this installation.

To meet the design criteria of six air changes per hour, 6,110 CFM of exhaust air must be removed from the pipe gallery under Filter Building 1 and 7,160 CFM of exhaust air must be removed from gallery under Filter Building 2. The new systems should each consist of a new supply air fan and a new exhaust air fan. The new supply air fans should be installed with new ductwork. A charcoal filter and heavy duty air filter should also be installed in the ductwork immediately prior to these fans. The new exhaust fans can be installed in the same location as the existing fans and connected to new ductwork. The existing gooseneck outlet up through the exterior slab from Filter Building 1 will need to be replaced with a larger outlet.

8.3.2 Filter Air Scour Blower Building Ventilation

The project will also include a new building to house air scour blowers for the air scour portion of the backwash cycle. This room will be 26'x27'x14' and will require six air changes per hour of ventilation. An exhaust fan will be provided at this room designed for 1,000 CFM. The room will also require an intake fan sized for 1,000 CFM, with a charcoal filter and a heavy duty airflow filter in the intake ductwork immediately prior to the fan. The fan will connect to louvers in the exterior walls of the building.

The controls system for the air scour blowers will require air conditioning to protect the controls equipment. This is typically accomplished through the use of a unit included with the controls cabinet. The staff of the wastewater treatment plant has noted that the units included with similar control systems have had maintenance issues in the past. As an alternate, a small room could be constructed around the controls system. This room would be air conditioned through the use of a ductless split system with indoor wall mounted unit and exterior condensing unit. Having a dedicated room would allow a separate, more reliable system to be used to condition the area around the control system without need to condition the entire filter blower building. The coils and exposed metal of this system would also have factory coating for corrosion protection.

8.3.3 Freeze Protection

When the ventilation draws in outside air during the winter it can draw in air that is below freezing. The ASHRAE design condition for winter in Austin is 25 degrees Fahrenheit, though, in the previous winter, temperatures were observed as low as 15 degrees F. The originally designed system utilized hot water heating coils to bring the air to above freezing temperatures. Because the hot water supply is no longer available, the air drawn into the space is not heated.

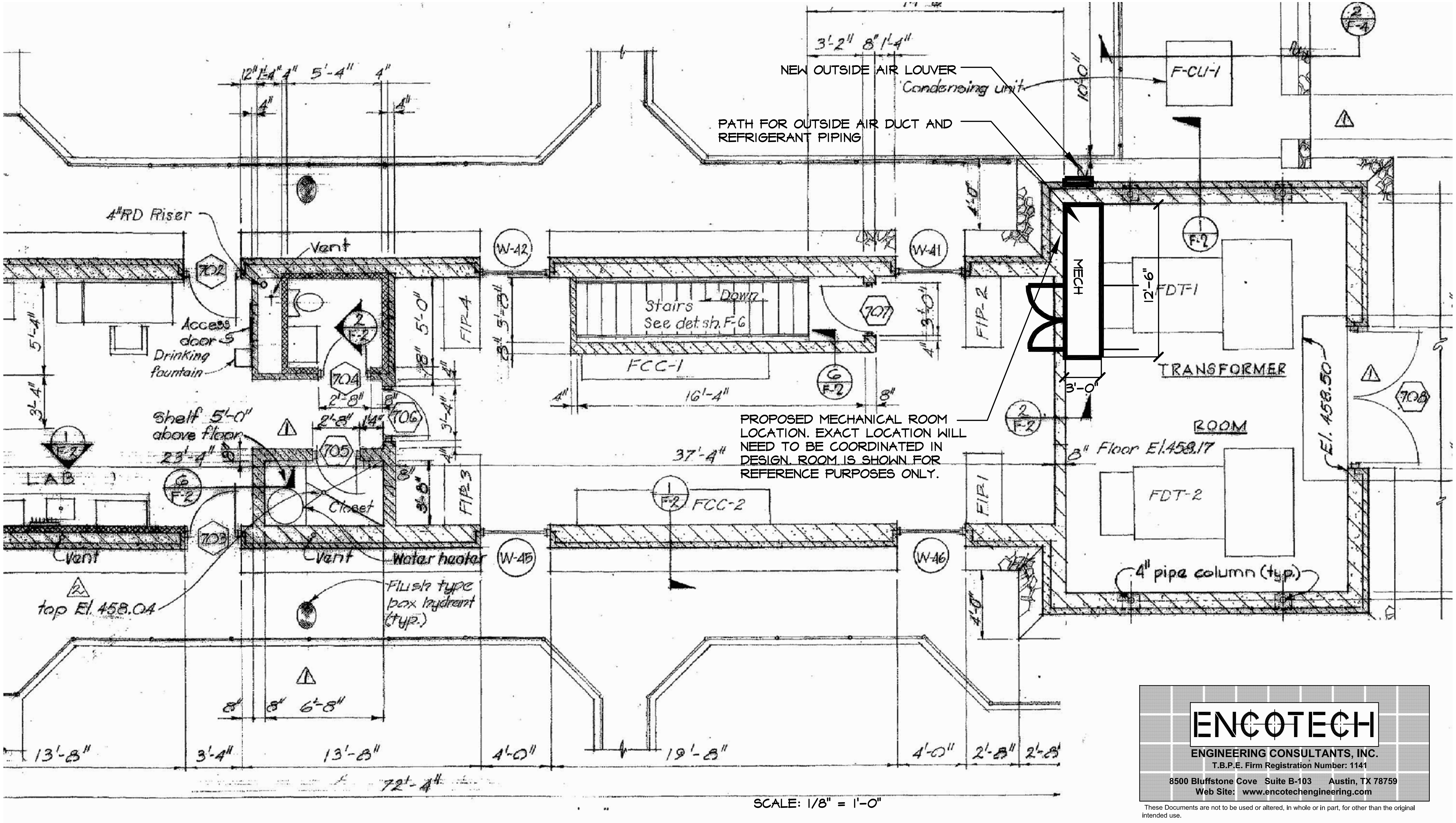
To correct this issue it is recommended that two electric resistance duct heaters be installed in the ventilation air ductwork. These heaters would be accessible from inside the piping gallery. The heaters shall each be controlled by a thermostat which will energize the heaters when the temperature of the ventilation air drops below 40 degrees F. To provide a 25 degree F temperature rise through the heaters a 50 KW heater will be required at the duct for the Filter Building 1 pipe gallery, and a 57 KW heater will be required at the duct for the Filter Building 2 pipe gallery.

8.3.4 Modifications to Existing Ductwork

The existing ventilation ductwork is not large enough and should be replaced with larger ductwork to provide six air changes per hour to the pipe vault. If the ductwork is replaced with new material the penetrations through the floor slab and the building exterior will need to be increased in size. The louvers for both intakes are also not large enough for the increased ventilation rate. They will need to be replaced or expanded to prevent moisture from being drawn into the building through the ventilation system.

The ventilation air ductwork for the gallery under Filter Building 1 is sized at 20"x16". This duct should increase in size to 32"x24". The existing intake louver is installed under the soffit facing downward at the northeast corner of the building. It is not adequately sized for the new ventilation airflow and should be replaced with a 48"x36" louver. The new ductwork would be connected to this louver.

The ventilation air ductwork for the gallery under Filter Building 2 is sized at 30”x16”.The louver for this ductwork is 42”x24” and located in the soffit of the building facing downward. Due to the difficulties in installing a larger louver in this soffit and the fact the duct is routed in chase a second louver at 42”x24” with 30”x16” duct in a chase be installed near the first louver. This will provide an adequate airflow to maintain six air changes per hour. An additional chase will be required to conceal this duct as it passes through the control room to the pipe gallery below.



SCALE: 1/8" = 1'-0"

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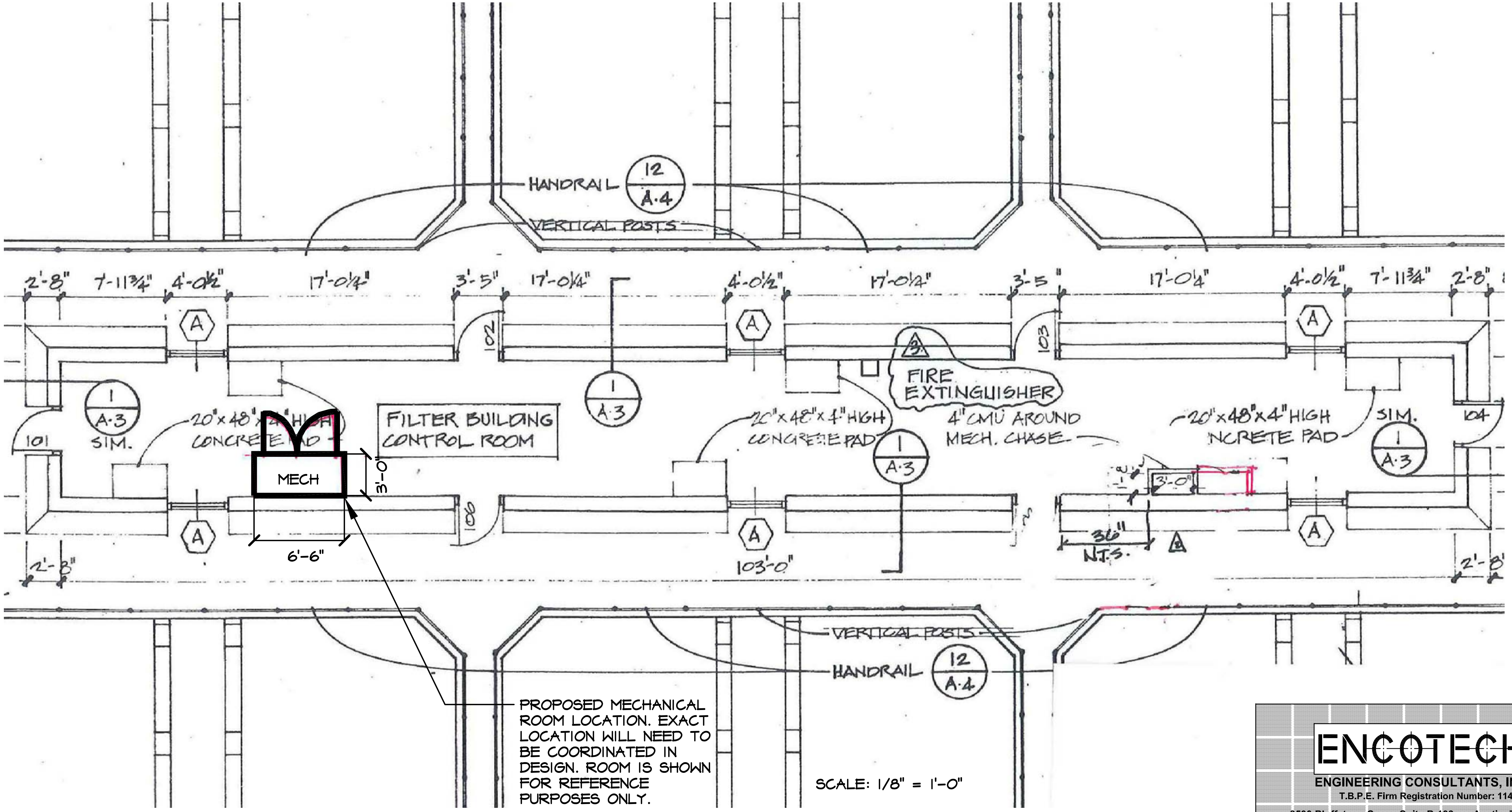
FILTER BUILDING 1 PROPOSED MECHANICAL ROOM



PROPOSED MECHANICAL ROOM LOCATION. EXACT LOCATION WILL NEED TO BE COORDINATED IN DESIGN. ROOM IS SHOWN FOR REFERENCE PURPOSES ONLY.

SCALE: 1/8" = 1'-0"

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FILTER BUILDING 2 PROPOSED MECHANICAL ROOM

9.0 Electrical Design Criteria

9.1 Introduction and Objectives

Analysis was performed for the facility using the specific proposed process/mechanical loads provided which are summarized in Table 9-1.

Table 9-1
Proposed Process/Mechanical and HVAC Loads for Filter Complex

Process / HVAC Equipment	Rated Horsepower per unit	Total Quantity	Rated Service Factor
Process/Mechanical Alternative 2 (1)			
Backwash Pump (BWP)	350	2	1.0
Air Scour Blower (ASB)	125	2	1.0
Non-Potable Water Pumps	125	3	1.0
HVAC Equipment (2)	**Rated Power per unit**	**Total Quantity**	**Rated Service Factor**
Filter Building 1			
Exhaust Fans	1.5 HP	1	1.0
Ventilation Fans	3 HP	1	1.0
Duct Heater	50 KW	1	1.0
Air Handler	16 kVA	1	1.0
Condensing Unit	15 kVA	1	1.0
Filter Building 2			
Exhaust Fans	1.5 HP	1	1.0
Ventilation Fans	3 HP	1	1.0
Duct Heater	57 KW	1	1.0
Air Handler	16 kVA	1	1.0
Condensing Unit	15 kVA	1	1.0

Table 9-1
Proposed Process/Mechanical and HVAC Loads for Filter Complex

Process / HVAC Equipment	Rated Horsepower per unit	Total Quantity	Rated Service Factor

Notes:

1. Selected process/mechanical design alternative.
2. All other existing Filter Building HVAC loads will be demolished.

An objective of this section is to propose multiple electrical design alternatives in order to support the proposed process/mechanical system design, to propose options or variations to the proposed design alternatives, and finally to present preliminary electrical construction cost opinions for each of the proposed design alternatives and options.

9.2 Summary of the Existing Electrical System

9.2.1 Existing Electrical System Description

This subsection describes general characteristics associated with the existing Filter Complex (Filter Building 1 and 2) power distribution system. . The major equipment of the power distribution system is located indoors on the control room level of the Filter Complex. The Filter Complex power distribution system is served by three 480V motor control centers MCC-FCC1, MCC-FCC2, and MCC-FCC3.

MCC-FCC1 and MCC-FCC2 receive the Filter Complex electrical service via the 12470V:480V oil filled outdoor located transformers FDT-1 and FDT-2 respectively. FDT-1 and FDT-2 are served from spliced 12470V feeders SUB1-SWGR-1L04 and SUB1-SWGR-1R04 that also serve the activated sludge and DAF complexes.

MCC-FCC1 and MCC-FCC2 each have a 1,200 ampere ampacity and are arranged in a Main-Tie-Main configuration with key interlocked main and tie circuit breakers. The majority of these motor control centers and distribution transformers date to the original construction of Filter Building 1 and serve loads dedicated to filter 1 through 4, loads shared by all filters such as the backwash pumps, and other loads such as the non-potable water pumps.

An automatic transfer switch (ATS) is mounted inside of MCC-FCC1. The normal source of the ATS is connected to the bus of MCC-FCC1 while the emergency source of the ATS is served by an emergency power generator located adjacent to the DAF pump building. The ATS serves the starter of one non-potable water pump. The ATS, emergency generator, and main service feeders to MCC-FCC1 and MCC-FCC2, as well as additions to both MCC-FCC1 and MCC-FCC2 were installed circa 1993. It appears that the emergency generator was marginally sized to serve only NPW Pump No. 2 and panelboard TLP-2. The emergency generator is sized 175 kW.

MCC-FCC3, installed circa 1987, is a radially fed motor control center with 600 ampere ampacity that is served from MCC-FCC1. MCC-FCC3 serves loads associated with filter 5 through 10.

The existing backwash and non-potable water pumping units are started with full voltage starters. Power factor correction was not observed for any load of this facility. There is no metering for the incoming services to the motor control centers. The protection system of each pumping unit is implemented through the use of electromagnetic type protection relays.

The low voltage system of the Filter Complex is served by multiple 480V:208/120V dry type transformers. Certain transformers have been mounted along with their associated panelboards inside of each motor control center while others have been mounted separately from the motor control centers. There are no provisions to provide electrical service to the low voltage power distribution system of the Filter Complex in the event of outages associated with the motor control center bus that serves the respective dry type transformers

9.2.2 Existing Electrical System Assessment

The existing design load of the entire Filter Complex incorporating significant diversity is 757.4 kVA. The application of diversity in the determination of the existing design load includes the following considerations:

- A maximum of one filter backwash at a time. Backwashes of multiple filters are not overlapped.
- While a backwash is in progress for a given filter, the motorized valves of other filters do not change position
- Redundant process/mechanical equipment is de-energized
- No load operates in its service factor
- Significant load diversity applied to auxiliary power distribution system panelboards

Additionally, it appears that certain motors may be operating at less than their full load nameplate value.

The bus ampacity of MCC-FCC1, MCC-FCC2, and MCC-FCC3 as well as their respective service feeders and service transformers FDT-1 and FDT-2 are adequately sized to handle the design load of the facility provided the significant Filter Complex load diversity is applied as previously discussed. The application of the described load diversity precludes the ability for load increases or load additions to the existing motor control centers.

MCC-FCC3 is radially served, which is inconsistent with the power distribution system concept used elsewhere in the Filter Complex and results in limited operational flexibility for the filter 5 – 10 compared to filter 1 – 4.

The motor control centers have been well maintained and are in good condition in consideration of their age. As of this writing, spare parts for plug-in type starters sized NEMA size 1 through 5 are listed in the motor control center manufacturer's catalog for the existing installed motor control center model series. This could potentially complicate the direct replacement of the backwash pump motor starters which are NEMA size 6. Custom field modifications may be needed to the motor control center to replace the backwash pump motor starters. Considering age alone, certain portions the existing power distribution equipment located inside of the Filter Complex have passed its useful life and should be replaced. The MCC modifications performed circa 1993 are comparatively new and in good condition and could be considered candidates for reuse. It has been understood that several of the process/mechanical equipment served by the modifications performed circa 1993 has been abandoned. The sizing of the existing emergency generator is marginal in consideration of the loads it serves. The emergency generator has no capacity for additional load. Installed in 1993, the emergency generator is a relatively recent addition to the Filter Complex power distribution system and appears to have additional life remaining.

9.3 Summary of Proposed Electrical System

This subsection will detail the proposed electrical system. It begins with a brief summary description of the proposed design alternatives. Finally, all proposed design alternatives are described in detail. Multiple design alternatives have been developed as shown in Table 9-2 in order to support the proposed process/mechanical system design. The design alternatives provide an overall design concept for the proposed electrical improvements.

Table 9-2
Brief Summary of Proposed Power Distribution Design Alternatives

Design Alternative No.	Description
Filter Complex	
1	Design Alternative 1 proposes distribution and motor starter equipment to support the loads associated with Filter Complex Process/Mechanical Alternative 2. This alternative combines the power distribution system for all Filter Complex loads into a single electrical service for the Filter Complex.
2	Design Alternative 2 proposes distribution and motor starter equipment to support the loads associated with Filter Complex Process/Mechanical Alternative 2. This alternative has been developed to address a minimal power distribution system to support the proposed process/mechanical load while maximizing the salvage value associated with the existing Filter Complex power distribution system. Under this alternative, the backwash pumps are served from the WRI Electrical Building.

9.3.1 Proposed Power Distribution System – Overview

This subsection describes general characteristics that are common to all of the proposed power distribution system design alternatives. Following subsections provide a detailed description for each specific design alternative. Descriptions of the emergency power distribution system design alternative and the auxiliary power distribution system design alternative are described which are common to all proposed power distribution system design alternatives.

Table 9-3 illustrates the load requirements of the Filter Complex and WRI Electrical Building (excluding system inrush) based upon the preliminary load data shown in Table 9-1 as well as existing load information.

Table 9-3

Listing of Design Loads for the Filter Complex and WRI Electrical Building to support Process/Mechanical Alternative No. 2, Excluding System Inrush

Process Area	**Preliminary Proposed Load (kVA)**	
	Power Distribution System Design Alternative No. 1	**Power Distribution System Design Alternative No. 2**
Filter Complex		
Filter Complex (1)	650.0	650.0
Backwash Pumps	345.0	[redacted]
Subtotal	995.0	650.0
WRI Electrical Building		
WRI Electrical Building (2)	1749.73	1749.73
Backwash Pumps	[redacted]	345.0
Subtotal	1749.73	2094.73

Table Notes:

1. Proposed motor efficiency and power factor were assumed by HEI. All loads were computed using the pump motor service factor shown in Table 9-1. Provisions for spare loads were not included. Spare loads should be added to accommodate for future unforeseen facility loads. The spare load value should be considered with a degree of reasonability as a percentage adder of the pump station total known load. The existing load value presented takes into account the process/mechanical equipment that is associated with the proposed process/mechanical design alternative as well as the significant diversity of the existing Filter Complex load previously described under section 9.2.2. Additionally, the analysis considers only one of the three proposed NPW pumps to be energized. The load value assumes no changes are made to existing loads or the diversity other than those previously described herein. Load value presented excludes backwash pumps.
2. Value shown includes operation of three existing low service pumps, three existing high service pumps, and one future 500 HP high service pump.

Based on the power requirements of the pump loads and available manufactured distribution equipment, the proposed loads are proposed to operate at 480 Volts Alternating Current (VAC) with the exception of the backwash pumps, which are proposed to operate at 4,160 Volts AC. This is described further in this narrative. The total proposed load for the Filter Complex exceeds that which can be supported by the existing Filter Complex power distribution system infrastructure. Multiple power distribution system alternatives have been developed accordingly to address the electrical service to this facility.

Needs for future Filter Complex facility expansion have not been identified. Subsequently, provisions for future facility expansion have not been included in the power distribution system design. Should changes to the load diversity be desired, the power distribution system will need to be expanded accordingly.

The power distribution motor control centers (MCCs) and switchboards, where applicable, are proposed to be indoor located inside of the filter buildings in environmentally controlled room(s) on the control room level. This is discussed in further detail in the subsequent narrative.

The proposed distribution system will include the use of distribution and lighting panels and their applicable dry-type transformers that will distribute power to all other low voltage auxiliary equipment (transformers, loads, etc.) throughout the Filter Complex. All auxiliary 208/120-Volt transformers associated with the distribution equipment and their associated distribution panels are proposed to have a standard power capacity.

The standardization of the equipment is proposed to facilitate maintenance by minimizing the amount of equipment stocked and decreasing unit costs due to bulk purchases of similar equipment.

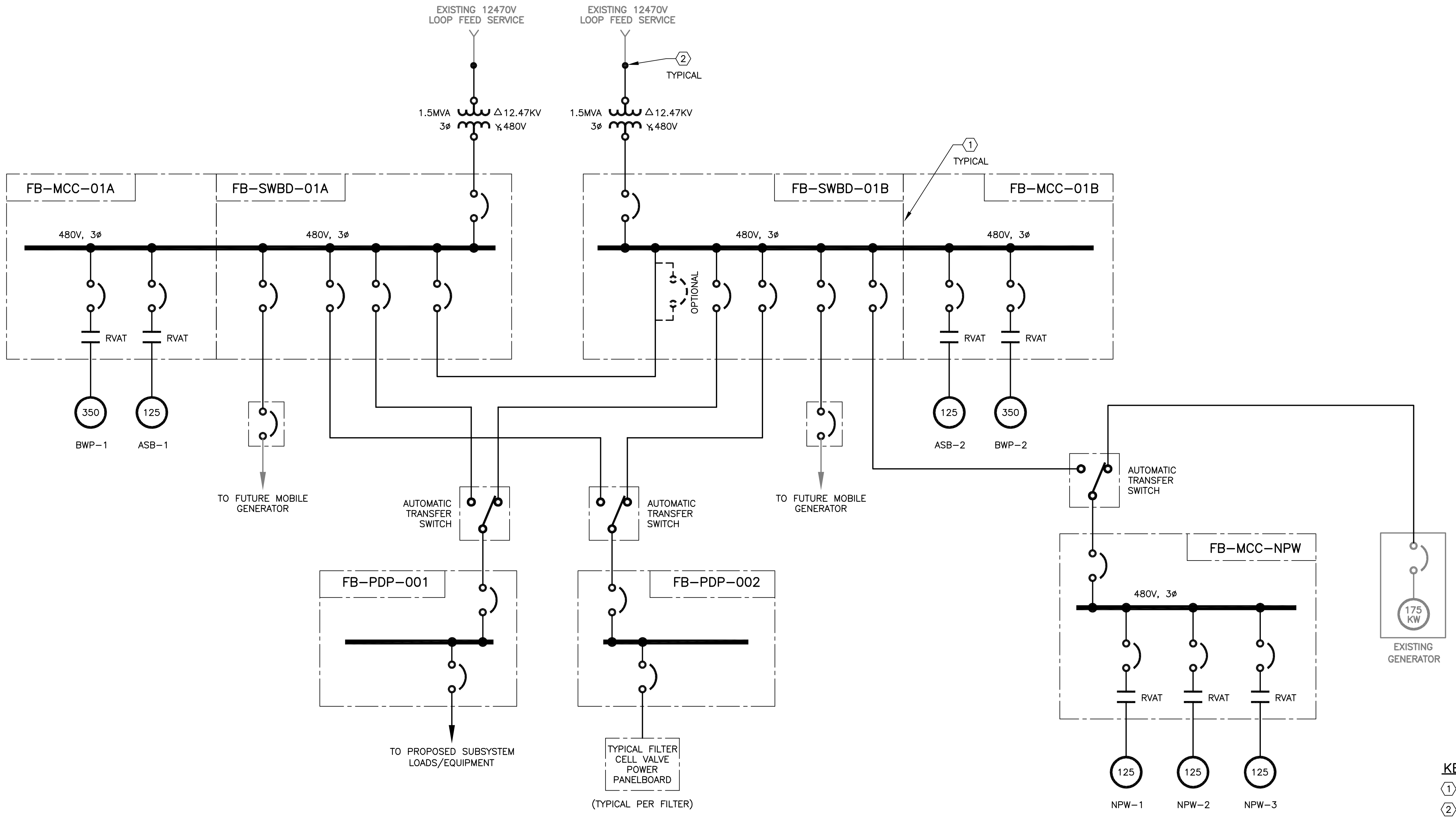
The following sub-sections describe the design alternatives associated with the improvements to the power distribution system of the Filter Complex.

9.3.1.1 Power Distribution System Design Alternative No. 1

Design Alternative No. 1 establishes a dual-feed 480 Volts system distribution concept for the Filter Complex. This alternative has been developed to address a proposed power distribution system to support the proposed process/mechanical load for Process/Mechanical Alternative No. 2 that combines the power distribution system for all filter building loads into a single electrical service for the Filter Complex.

Under this alternative, existing 12,470-Volt service from the Walnut Creek WWTP substation is terminated to proposed 12,470-Volt-to-480-Volt outdoor located oil-filled pad mounted service transformers sized 1,500 kVA. The service transformer then serves a main-tie-main secondary selective 480-Volt indoor located switchboard lineup with main bus ampacity of 2,000 Ampere. It is proposed to install main-tie-main secondary selective 480-Volt motor control centers with main bus ampacity of 1200 ampere on the control room level inside the existing filter buildings to serve other filter building loads.

See Figure 9.3.1.1 for a one-line diagram. Splicing of the existing 12,470V circuit is anticipated to facilitate the power distribution system improvements. Under this alternative, the backwash pumps would have 480V motors and be served from the proposed Filter Complex power distribution system. This alternative does not address the migration of the Filter Complex from the existing 15 kV loop feed distribution concept used in this region of the plant. Under this alternative, the Filter Complex would continue to be subjected to the operational interruptions associated with the existing 15 kV loop feed distribution system.



KEY NOTES:

① EQUIPMENT SHOWN ARE CLOSE–COUPLED.

② PROPOSED CABLES ARE SPLICED TO EXISTING 12470V LOOP FEED SERVICE CONDUCTORS

GENERAL NOTES:

1. THIS FIGURE IS INTENDED TO REPRESENT AN OVERVIEW OF THE PROPOSED POWER DISTRIBUTION SYSTEM. ONLY MAJOR ELECTRICAL EQUIPMENT HAS BEEN SHOWN FOR CLARITY.
2. THIS PRELIMINARY DESIGN FIGURE IS BEING SUBMITTED AS PART OF A PRELIMINARY DESIGN TECHNICAL MEMORANDUM AND IS FOR INFORMATIONAL PURPOSES ONLY. REFER TO THE TECHNICAL MEMORANDUM FOR ADDITIONAL INFORMATION PERTAINING TO THIS EXHIBIT. THIS FIGURE IS PRELIMINARY AND IS NOT TO BE USED FOR BIDDING, PERMITTING, OR CONSTRUCTION PURPOSES.
3. DARK LINEWORK DENOTES PROPOSED ITEMS. LIGHT LINEWORK DENOTES EXISTING ITEMS.

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FILTER BUILDING PROPOSED OVERALL ONE-LINE DIAGRAM DESIGN ALTERNATIVE NO.1

Figure
9.3.1.1

The selection of this power distribution alternative is contingent upon the construction of a new electrical room located above the proposed Southside Clearwell structure to contain the proposed switchboards and certain other equipment in an environmentally controlled room. This concept requires a larger physical area for the electrical equipment than appears to be available at the existing control room level of the Filter Complex.

The NPW pumps will be served as described in Section 9.3.1.5. Consideration can be given to reusing the existing motor control centers for cost reduction purposes as discussed in Subsection 9.3.1.3 “Additional Discussion Concerning the Reuse of Existing Filter Complex Power Distribution System”.

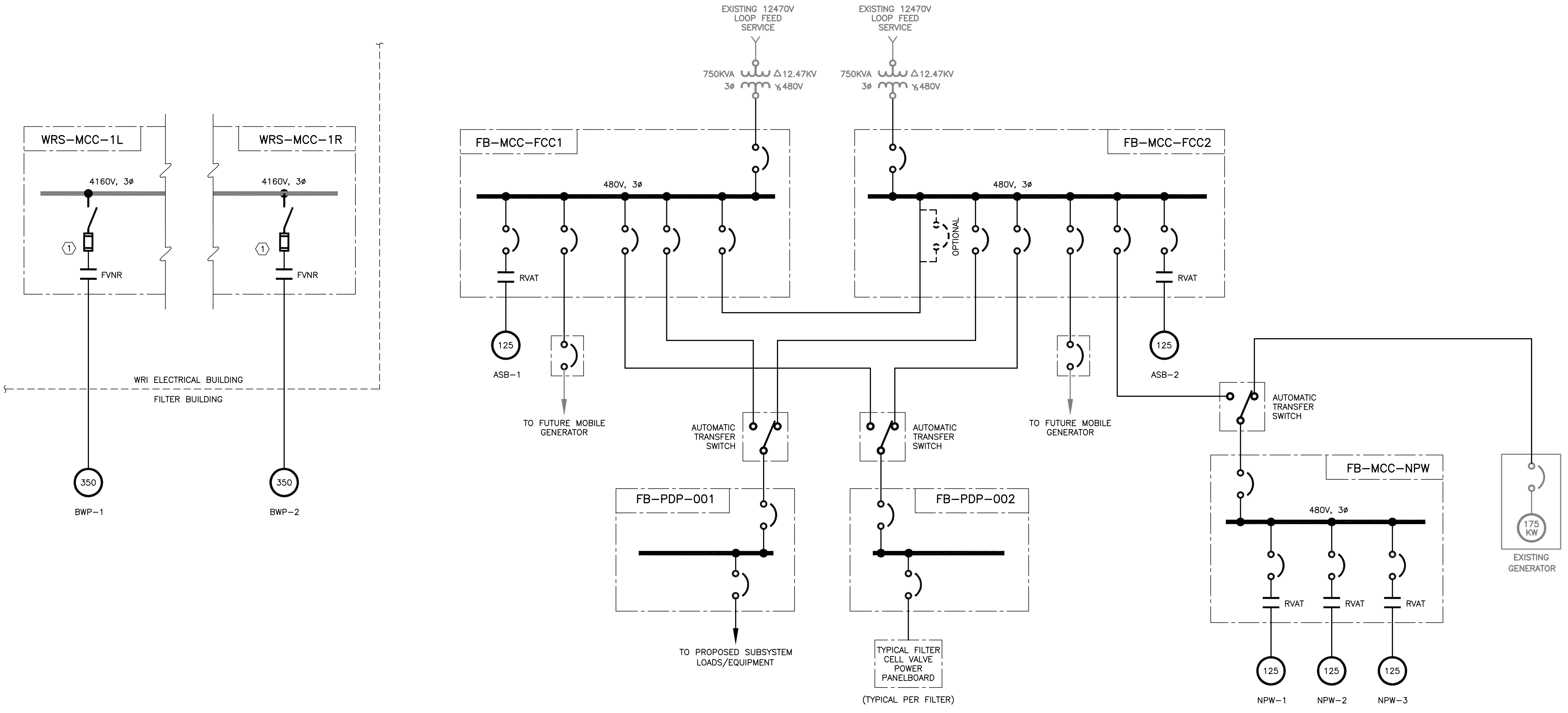
Refer to the Common Features For All Design Alternatives sub-section for additional information regarding the remaining low voltage power distribution system of the improvements to the Filter Complex. From an electrical, instrumentation, and control system perspective only, the selection of this alternative will lead to an increase of a minimum of $600,000 (excluding contingency) to the preliminary Electrical and I&C construction cost opinion over and above that shown for Power Distribution System Design Alternative No. 2. Additional costs associated with a building, structure, etc. will need to be added to the construction cost opinion to further define the ramifications associated with selecting this power distribution system design alternative.

9.3.1.2 Power Distribution System Design Alternative No. 2

Design Alternative No. 2 establishes a dual-feed 480 Volts system distribution concept for the Filter Complex. This alternative has been developed to address a minimal power distribution system to support the proposed process/mechanical load for Process/Mechanical Alternative No. 2 and maximize the salvage value associated with the existing power distribution system.

Under this alternative, the existing 12,470-Volt service from the Walnut Creek WWTP substation to the existing 12,470-Volt-to-480-Volt outdoor located oil-filled pad mounted service transformers remains unmodified. The existing Filter Complex service transformers will continue to serve the main-tie-main secondary selective 480-Volt indoor motor control center indoor lineup of MCC-FCC1 and MCC-FCC2 with main bus ampacity of 1,200 Ampere. Under this alternative, the existing motor control centers MCC-FCC1 and MCC-FCC2 will be replaced with entirely new lineups. Proposed reduced voltage starters will be added to the existing MCC-FCC1 and MCC-FCC2 for the Air Scour Blowers. The starters for the NPW pumps and backwash pumps will be removed from MCC-FCC1 and MCC-FCC2. See Figure 9.3.1.2 for a one-line diagram. The NPW pumps will be served as described in Section 9.3.1.5.

Under this alternative, the backwash pumps will each receive 4,160V service from the WRI electrical building. It is proposed to install dedicated 4,160V full voltage starters at the 4,160V motor control centers in the WRI Electrical building to serve each backwash pump. This alternative will provide electrical service for the backwash pumps that is segregated from the existing 15 kV loop feed distribution system serving the Filter Complex. This concept, used in conjunction with the mobile generators described in Section 9.3.1.5, will provide a cost effective power distribution alternative to support Filter Complex operation in the event of 15 kV loop feed electrical service interruption at the Filter Complex that maximizes the salvage value of equipment already in residence at the plant.



KEY NOTES:

① PROPOSED STARTER ADDED TO EXISTING MOTOR CONTROL CENTER LINEUP

GENERAL NOTES:

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FILTER BUILDING PROPOSED OVERALL ONE-LINE DIAGRAM DESIGN ALTERNATIVE NO.2

Figure
9.3.1.2

The distribution system of the existing WRI electrical building presently has available capacity to facilitate the electrical service to the backwash pumps. From review of the record drawings, there also appears to be adequate physical space to add the additional distribution equipment. Preliminary calculations indicate the WRI electrical service power quality will not be negatively impacted by the use of full voltage starters for the backwash pumps.

Circuit breakers will be added to MCC-FCC1 and MCC-FCC2 to facilitate service to the low voltage power distribution system. Refer to the Common Features For All Design Alternatives sub-section for additional information regarding the remaining low voltage power distribution system of the improvements to the Filter Complex.

This concept maximizes the salvage value associated with the existing 12,470V circuits to the Filter Complex, Filter Complex pad mounted transformers, and WRI electrical system, and provides new motor control center lineups for the Filter Complex to facilitate the process/mechanical system improvements.

Refer to Figure 9.3.1.3 for a preliminary major electrical equipment arrangement of the Filter Complex Control Room Level. As can be seen in the Figure, equipment clearances are minimal.

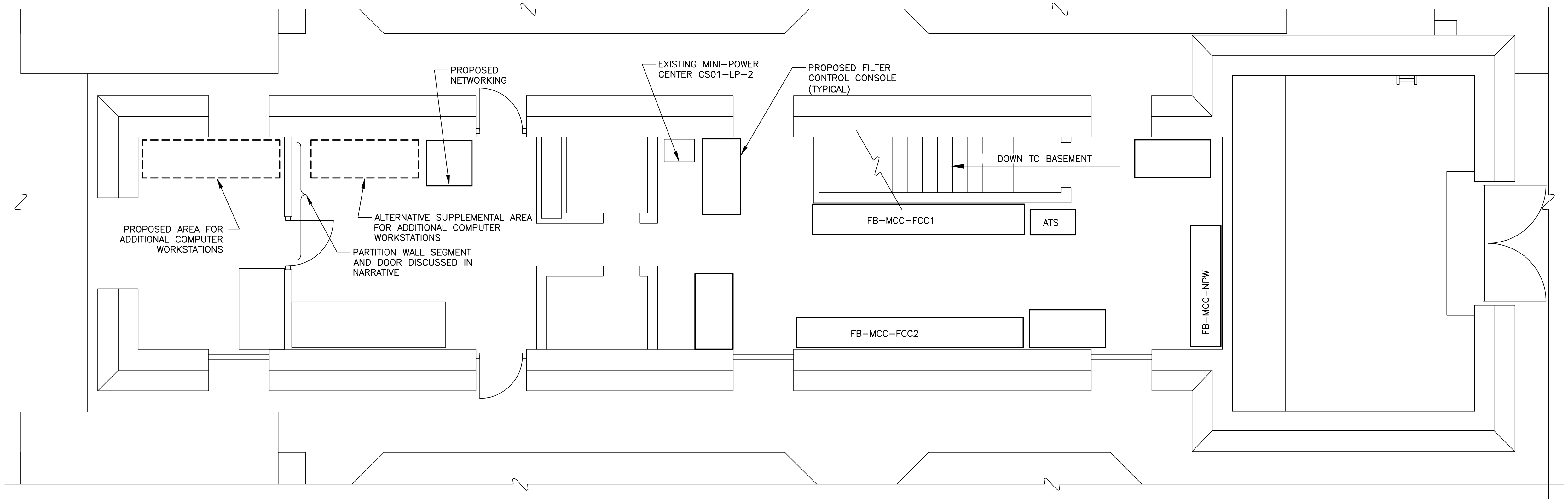
9.3.1.3 Additional Discussion Concerning the Reuse of Existing Filter Complex Power Distribution System

As a cost savings measure and although it would not be following the theme of this project, a portion of the existing Filter Complex power distribution equipment could continue to be used and replaced upon failure or upon announcement by the motor control center manufacturer of further reductions in available spare parts.

It is noted that the major pump loads being improved under this project include the pump loads which are presently served by the power distribution equipment that is both the oldest power distribution equipment as well as that most prone to obsolescence by the manufacturer.

The proposed motor starters for the air scour blowers could be purchased to match the same manufacturer as the existing MCC in an attempt to minimize use of available floor space inside Filter Building 1 and 2. While this concept would lessen competition among bidders for power distribution equipment and lead to higher initial construction cost, it would also lessen the overall quantity of power distribution equipment to be purchased compared to purchasing an entirely new MCC lineup. Based upon the extent of the proposed system modifications, it appears that some amount of custom type modifications will be needed to the existing motor control center in order to realize other project objectives described herein. This type of customization performed on dated equipment will exacerbate future maintenance activities.

It is noted that the incorporation of power factor correction equipment into the existing motor control centers would lead to the need for extensive motor control center modification effort and additional floor space for electrical equipment beyond that presently available. The reuse of the existing motor control centers is discouraged.



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FILTER BUILDING NO. 1 CONTROL ROOM LEVEL PRELIMINARY EQUIPMENT LAYOUT PLAN

SCALE: 1/8"=1'-0"

GENERAL NOTES:

1. THIS FIGURE IS INTENDED TO REPRESENT THE PROPOSED EQUIPMENT ARRANGEMENT IN THE CONTROL ROOM LEVEL OF THE FILTER BUILDING. ONLY MAJOR ELECTRICAL EQUIPMENT HAS BEEN SHOWN FOR CLARITY.

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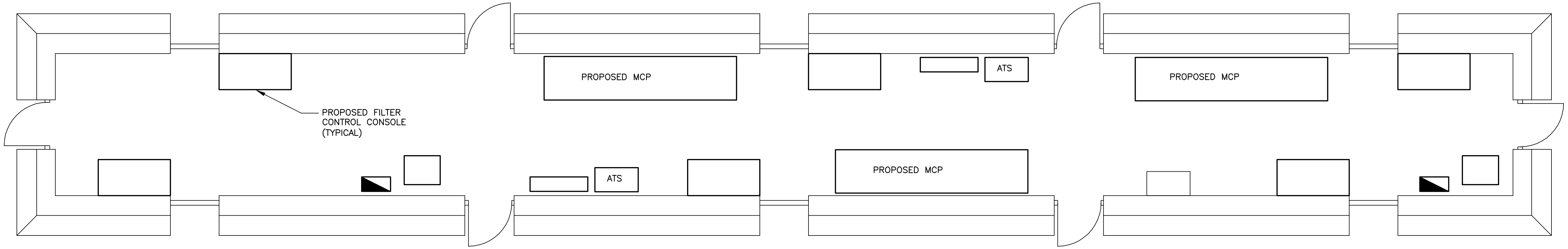

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FILTER BUILDING NO. 2 CONTROL ROOM LEVEL PRELIMINARY EQUIPMENT LAYOUT PLAN

SCALE: 1/8"=1'-0"

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PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

FILTER BUILDING CONTROL ROOM LEVEL PRELIMINARY EQUIPMENT LAYOUT

Figure
9.3.1.3

9.3.1.4 Low Voltage Power Distribution System Common to All Proposed Filter Complex Power Distribution System Design Alternatives

This subsection describes the low voltage power distribution system for the Filter Complex. The low voltage power distribution system described herein is common to all of the proposed power distribution design alternatives previously mentioned.

Based upon the proposed loads, it is proposed to employ the 480-Volt distribution system voltage for the low voltage distribution system. It is proposed that the switchboards/motor control centers will serve an automatic transfer switch that is dedicated to serve a 480-Volt power distribution panel. The proposed power distribution panel will feed 480-Volt-to-120/208-Volt distribution power transformers, panelboards, and other miscellaneous loads. Panelboards and/or distribution transformers located in the pipe gallery level will be elevated as much as practicable to address potential concerns associated with water accumulation in the pipe gallery level.

For enhanced operational flexibility, it is proposed to install a second automatic transfer switch dedicated solely to serve a 480-Volt power distribution panel to facilitate power distribution to dedicated filter cell panelboards that serve the filter cell motorized valves. It is anticipated that all motorized valve actuators will be provided with integral starters. To enhance maintenance, additional automatic transfer switches with associated distribution panels can be added in order to assign specific groups of filters to separate buses.

It is anticipated that all motorized valve actuators will be provided with integral starters.

9.3.1.4.1 Demolition of MCC-FCC3

The existing MCC-FCC3 is radially fed, which is inconsistent with the power distribution system concept used elsewhere in the Filter Complex and results in limited operational flexibility for the filter 5 through 10 compared to filter 1 through 4. Several loads connected to MCC-FCC3 are scheduled for demolition. It is proposed to move the starters located in MCC-FCC3 to available locations in MCC-FCC1 and MCC-FCC2, serve the filter valve actuators served from the power distribution panel as described in subsection 9.3.1.4, install a stand-alone 480:208/120V dry type transformer and lighting panel for the associated low voltage auxiliary power distribution, and demolish the existing MCC-FCC3.

Alternatively as a cost reduction measure, MCC-FCC3 can be left unmodified, with the exception that the electrical service to the filter valve actuators be disconnected and served from the power distribution panel as described in subsection 9.3.1.4. This would improve the operational flexibility associated with the filter process/mechanical system operation and leave the remaining HVAC and auxiliary system loads with reduced operational flexibility.

9.3.1.5 Emergency Power Distribution System Common to All Proposed Filter Complex Power Distribution System Design Alternatives

This subsection describes the proposed low voltage emergency power distribution system for the Filter Complex. The low voltage emergency power distribution system described herein is common to all of the proposed power distribution design alternatives previously mentioned. The proposed system provides for the capability for any one of the three NPW pumps to be served from the existing on-site standby power generator. Preliminary calculations indicate that the existing on-site standby power generator is marginally sized to serve one NPW pump. It has been understood that although three pumps are proposed to be installed, no more than one pump will operate at a time. Replacement of the existing generator is not anticipated. See Figure 9.3.1.1 and Figure 9.3.1.2 for a one-line diagram

It is proposed to install a dedicated 480V stand alone motor control center that contains the starters for all three NPW pumps. The proposed motor control center will also feed the existing 480-Volt-to-120/208-Volt distribution transformer and associated panelboard (mini-power center). It is proposed that the motor control center will be served by a dedicated proposed automatic transfer switch that is served from the existing on-site emergency power generator as well as the proposed non-emergency power distribution system of the Filter Complex via MCC-FCC2. Generator starting will be initiated by the proposed automatic transfer switch dedicated to the proposed NPW motor control center.

For additional operational flexibility, it is also proposed that dedicated circuit breakers will be added to MCC-FCC1 and MCC-FCC2 with additional means for feeder connection to a mobile generator. The potential use of a mobile generator for this application appears cost effective and appears to offer additional operational advantages as mobile generators could be used for other similar type needs elsewhere in the plant as needed in addition to serving the Filter Complex. Although the cost of additional mobile generators for use at Walnut Creek WWTP is not included in the preliminary Electrical and I&C construction cost opinion, the Owner may wish to consider the purchase of a mobile generator that is dedicated for use at the Walnut Creek WWTP facility.

It is proposed to demolish the existing NPW pump No. 1 starter and its associated existing ATS presently served by the existing generator and contained in MCC-FCC1.

9.3.2 Power Quality Issues

This subsection describes power factor considerations for the proposed power distribution system, followed by the results of preliminary motor starting studies performed for the project.

9.3.2.1 Power Factor Considerations

It is proposed that dedicated power factor correction capacitors be provided for each proposed pump sized three horsepower and greater that is provided with an induction motor. It is anticipated that induction motors will be provided for this project. The size of the existing control room level precludes the installation of the power factor correction capacitors in the MCCs, although this is preferred. It is anticipated that the capacitors will be located at the motor terminal boxes.

9.3.2.2 Starting of Large Process Motors

It is generally proposed that large process motors will be started with reduced voltage starters. Full voltage starters are anticipated for the 4,160V backwash pumps. Reduced voltage motor starters will be applied on low voltage motors when the motor horsepower is greater than 50 horsepower.

The “solid state” reduced voltage starter type could potentially be used for an adjustment to the preliminary electrical and I&C construction cost opinion. Of all the available reduced voltage starter types, the use of the solid-state type of starter would help facilitate the most gradual application of motor torque to the pump during starting. In the consideration of solid state reduced voltage starters, attention will also need to be given to address the application of power factor correction capacitors at this existing space-limited facility. Reduced voltage auto-transformer type starters have been included in the preliminary Electrical and I&C construction cost opinion.

Preliminary calculations performed indicate that the power quality of the electrical service at the WRI electrical building will not be negatively impacted by the use of full voltage starter for the 4,160V backwash pump served from the WRI electrical system.

9.3.2.3 Proposed Motor and Power Distribution Equipment Efficiency

To minimize overall energy costs, all process equipment, ventilation equipment, and air handling unit motors and distribution transformers will be specified as high efficiency where possible. When it is not possible or economically practical for such equipment to be high efficiency, the highest efficiency equipment possible or economically practical will be employed.

9.3.3 Power Metering and Protection Issues

Microprocessor-based power monitoring equipment is proposed to be installed at the incoming power source (line side) in the low voltage motor control center, as applicable. The equipment is proposed to be a programmable device that measures and displays the following characteristics of incoming power:

- Voltage per phase
- Current per phase
- Power factor
- Frequency
- Active power
- Apparent power
- Reactive power

For the air scour, backwash, and NPW pump motors, a microprocessor-based motor protection relay unit will be installed on the MCC at the load side of the branch feeder/starters serving the load. At a minimum, the motor protection relay shall monitor or meter the following parameters:

- Voltage per phase
- Current per phase
- Power factor
- Frequency
- Active power
- Apparent power
- Reactive power
- Watt-hour
- Var-hour
- Demand amperage
- Demand watts
- Demand var
- Demand volt-amps
- Demand peak

Each power-monitoring/protection unit is proposed to have standard control interface ports, including RS-232C and RS-485 serial communication ports for peripheral programming and data transfer via the Ethernet communication protocol over an Ethernet communication network. This network is proposed to interface with the respective PLC. The above-discussed values monitored by the power monitoring units and motor protection relays will be telemetered to the Top-End system by the PLC. Each unit will also have a digital display of measured/telemetered parameters for local display. Also refer to the distributed control system architecture Figure 10.3.1.1 for additional information regarding the data communication network interconnection.

9.3.4 *Miscellaneous Electrical Subsystems*

9.3.4.1 Lighting and Convenience Receptacles

At the proposed air scour blower building, fluorescent light fixtures will be installed inside the room to achieve 40 to 50 foot-candles. Exterior air scour blower building perimeter metal-halide light fixtures will be installed on the exterior wall of the air scour blower room. The exterior air scour blower building fixtures are anticipated to be photocell controlled.

Pole mounted metal-halide task lighting will be added in the east side of Filter Building 1 to increase the night-time task lighting level to 15 to 30 foot-candles in the immediate vicinity of Filter No. 1 to improve lighting associated with the sodium bicarbonate application task effort. The light fixtures will be manually switched and photocell controlled locally at the fixture. Alternatively to metal-halide fixtures, LED task light fixtures can be provided for an increment to the Preliminary E&IC Construction Cost Opinion of $2,000. As of this writing, City of Austin security personnel are researching the compatibility between LED light fixtures and the City of Austin standard security cameras. If there is a desire to incorporate security cameras within the plant site as well as LED light fixtures, the final application of LED light fixtures would be pending the receipt of the final assessment from the City of Austin security system design group. This is anticipated to occur during the design phase.

As a cost savings measure, it is proposed to re-serve the existing lighting and convenience receptacle circuiting at the Filter Complex where possible.

Additional convenience receptacles are anticipated for the Filter Complex in the area reserved for the backup lift station telemetery system.

Additional outdoor perimeter, security, walkway, parking lot, landscape, etc., types of lighting is not anticipated. The Preliminary Conceptual Electrical and I&C Construction Cost Opinion will need to be increased for additional new lighting and convenience receptacles beyond those described herein.

9.3.4.2 Raceway System

The electrical wiring raceways will consist of a conduit system. Conduit routing methodology will be aboveground and exposed. To the extent possible, the conduit system will be routed in the pipe gallery level of the building structure.

Where duct banks are required, conduit bodies and systems concealed below slab or buried underground shall be corrosion resistant and shall be made of Schedule No. 40 PVC per NEC requirements. In recognition of the Filter Complex life cycle, it is proposed to encase such conduit systems in a reinforced concrete-encased duct bank.

Conduits shall not be filled greater than the 40-percent maximum fill percentage as allowed by the NEC. Modification to the existing 15kV and I&C duct bank systems will be needed in the vicinity of the existing Filter Complex to support the installation of the proposed clearwells. It is anticipated that the duct banks will be re-routed to avoid the proposed clearwells. Minimalist, temporary type conduit systems are anticipated to be installed to facilitate continued plant operations during the demolition and associated reconstruction of these existing duct banks.

9.3.4.3 Electrical, Instrumentation, and Control Wiring

All 600-Volt power wiring will be copper with 600-Volt insulation when serving equipment rated 600 Volts and below. All 600-Volt I&C system wiring will be copper. It is proposed to maintain separation between the power/control and instrumentation wiring such to facilitate safety and maintenance of the process equipment during operation.

It is proposed to utilize 600-Volt rated single conductor control/power cable for process related equipment.

For the non-fiber optic-based I&C wiring systems, it is proposed that the physical routing of the conduit/duct bank systems associated with the I&C systems be segregated from those of the power distribution system.

9.4 Recommendations

Design Alternative No. 2 is recommended for the facility. This alternative provides a minimal power distribution system to support the proposed process/mechanical load while maximizing the salvage value associated with the existing Filter Complex power distribution system as well as the WRI facility power distribution system.

10.0 Instrumentation & Control Design Criteria

10.1 Introduction and Objectives

An objective of this section is to propose multiple I&C system design alternatives in order to support the proposed process/mechanical system modifications and to propose options or variations to the design alternatives.

10.2 Existing Filter Complex I&C System

This subsection describes general characteristics associated with the existing I&C system of the Filter Complex.

There is an existing I&C system for the existing Filter Complex. The control system architecture for the Filter Complex consists of a Square D SY/MAX programmable logic controller (PLC) installed as part of the Contract No. 6 Expansion Project, circa 1987, used for monitoring and control of selected points for each filter. The PLCs are located indoors in the air conditioned control room level of the existing Filter Complex. The PLCs are linked to the Top-End computer system via a single channel twin-coaxial cable based communication link that is daisy-chained between PLCs inside the Filter Complex as well as various other process areas of the plant.

Remote I/O rack “CS01-LCP” was added circa 1993 for control of the chlorine contact basin sampling pumps and other related equipment. This remote I/O rack is networked with the existing Chlorination Building. Numerous pieces of equipment associated with this rack appear to have been demolished and/or abandoned. Remote I/O rack “FB1-CP-WRS” was added circa 2000 and facilitates signal transfer between “CS01-LCP” and the WRI electrical building PLC system over a dual channel fiber optic communication link. Equipment associated with “CS01-LCP” and “FB1-CP-WRS” does not appear to directly support the operation of the filter process.

The control logic for each filter is implemented using a combination of discrete hardwired controllers, control relays, and PLCs located in each respective filter’s local control panel.

The Filter Complex appears to have experienced corrosion of PLCs and other control equipment due to the process environment. An admirable effort has been made by City I&C personnel in their attempt to maintain system operation under these environmental conditions. Numerous existing Filter Complex PLC components, control devices, etc., that support the filter system operation are non-functional.

It is noted that the PLC implementation used in the Filter Complex is a minimalist type implementation and does not follow the present City of Austin standards for PLC based control system implementation. The Square D SY/MAX PLCs series are obsolete. The existing filter hardwired I&C system components date circa 1986 and have past their useful service life. “CS01-LCP” and “FB1-CP-WRS” related components appear to be outside the theme of this project and as such no modifications are anticipated.

Numerous valve actuators in the filter gallery level are located such that they are inaccessible. The filter effluent valve actuators appear to have been recently replaced.

No machine monitoring has been observed for the existing NPW or backwash pumps.

10.3 Proposed I&C System Overview

The Filter Complex is designed for operation using a Programmable Logic Controller (PLC) based control system with remote monitoring and control. The control system design criteria is to have as much reasonable automation as possible to achieve maximum efficiency and be sensitive to energy usage and cost without causing complexity to operations or maintenance personnel. This will be accomplished by utilizing a Distributed Control System (DCS) with a general overall PLC for the Filter Complex. The quantity and allocation of PLCs within the Filter Complex is described in further detail below.

The majority of control functions shall be performed by PLCs in conjunction with a minimal quantity of hardwired (based upon electromagnetic relays) control functions. Hardwired control functions will be incorporated only for critical hydraulic functions, personnel safety/protection, machine protection, or where it provides the greatest cost effectiveness in the design. The control philosophy is thereby one that is highly reliant upon a functioning PLC network for automatic control. In the event of a PLC failure, provisions are to be available to operate any or all segments of the process, if necessary, with close observation of field instrument monitors and in a fully attended hand mode of operation.

It is proposed that, depending on the application, most individual process equipment would have means to provide the operator the ability to engage or disengage the equipment from operation. Such means, here called a Field Control Station (FCS), would be located near the equipment and generally would only be used should a particular PLC become nonfunctional or during maintenance activities for that process equipment. Operation at the FCS level of control will not include automatic coordination with the rest of the process and will require the operator’s complete attention in order to operate the facility.

It is proposed to locate the General PLC and most I&C equipment (except FCSs and field instruments) applicable to the overall filter process inside a centralized Main Control Panel (MCP), which is dedicated to the Filter Complex and located indoors in the control room level in an air conditioned environment. The arrangement of the MCP will be tailored to the application and is described in further detail below.

Proposed major primary sensing elements to monitor process variables necessary for monitoring and controlling the facility will be made available at the field (at instrument level on the field instrument), at an Operator Interface Unit (OIU), and at the Top-end computer in the Administration Building. The OIU provides a graphical presentation of the process with a touch-screen interface.

The following subsections describe specific features of the I&C system design concepts followed by general characteristics of the I&C systems.

The following brief summary table of operator interface location points associated with the Filter Complex I&C System design alternatives is presented below to assist in comparisons between the proposed I&C system design alternatives. The design alternatives and acronyms used in the table are described in detail hereinafter.

Table 10-1: Brief Summary Table of Location and Type of Filter Complex Operator Interfaces Associated With Each Filter I&C Design Alternative

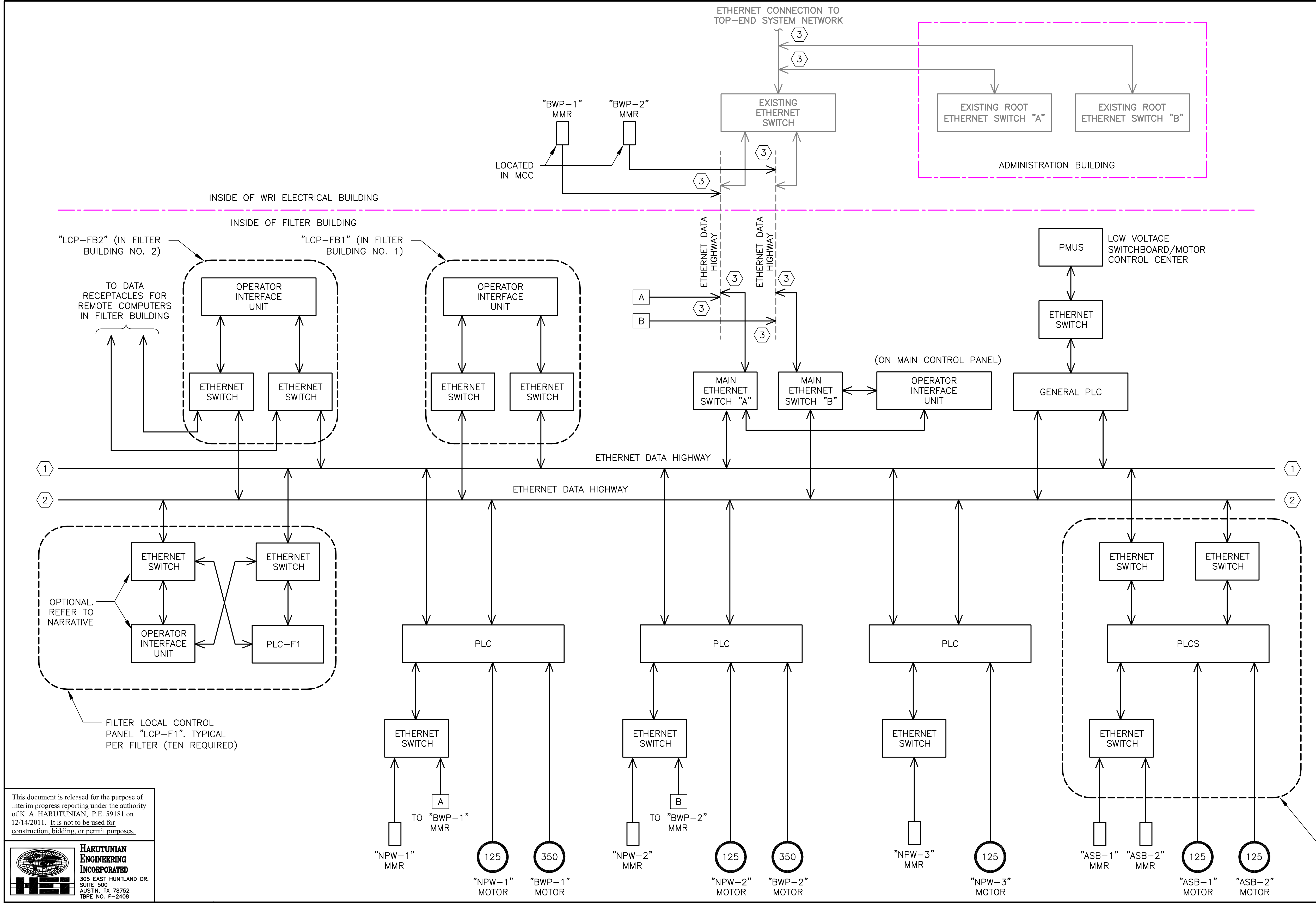
Location and Type of Operator Interface	**Filter Complex I&C Design Alternative Number**		
	1	**2**	**3**
Accessible field control station (FCS) with discrete operators (pushbuttons, selector switch, etc.) adjacent to process/mechanical equipment located in Filter Complex Pipe Gallery Level	INCLUDED	INCLUDED	INCLUDED
Discrete Operators (pushbuttons, selector switch, etc.) for each filter's motorized valves located on the respective filter LCP in the control room level of the Filter Complex	N/A	N/A	INCLUDED
OIU located at each Filter LCP	N/A	INCLUDED	N/A
Stand-alone LCPs containing OIUs, one in the control room level of each Filter Complex	INCLUDED	N/A	INCLUDED
OIU at the Main Control Panel in Filter Building 2	INCLUDED	INCLUDED	INCLUDED
Data receptacles at each Filter LCP and at Main Control Panel for connection of mobile computer workstation node to the SCADA network	INCLUDED	INCLUDED	INCLUDED
Walnut Creek WWTP Top-End Computer System in the Administration Building	INCLUDED	INCLUDED	INCLUDED

Table Legend:

INCLUDED = Point of Operator Interface is included in this design alternative.
N/A = Point of Operator Interface does not apply to this design alternative.

10.3.1 Filter Complex I&C System Design Alternative No. 1

Figure 10.3.1.1 shows a conceptual control system architecture design alternative for the Filter Complex.



KEY NOTES:

① DEVICES WITH A LINK TO THIS LINE REPRESENT A DIRECT LINK TO MAIN ETHERNET SWITCH "A".

② DEVICES WITH A LINK TO THIS LINE REPRESENT A DIRECT LINK TO MAIN ETHERNET SWITCH "B".

③ TRANSITION BETWEEN FIBER AND COPPER IMPLIES A TRANSCEIVER DEVICE.

GENERAL NOTES:

1. THIS FIGURE IS INTENDED TO REPRESENT AN OVERVIEW OF THE PROPOSED COMMUNICATIONS NETWORK. ONLY MAJOR ELECTRICAL AND COMMUNICATION EQUIPMENT HAS BEEN SHOWN FOR CLARITY.
2. THIS PRELIMINARY DESIGN FIGURE IS BEING SUBMITTED AS PART OF A PRELIMINARY DESIGN TECHNICAL MEMORANDUM AND IS FOR INFORMATIONAL PURPOSES ONLY. REFER TO THE TECHNICAL MEMORANDUM FOR ADDITIONAL INFORMATION PERTAINING TO THIS EXHIBIT. THIS FIGURE IS PRELIMINARY AND IS NOT TO BE USED FOR BIDDING, PERMITTING, OR CONSTRUCTION PURPOSES.
3. DARK LINEWORK DENOTES PROPOSED ITEMS. LIGHT LINEWORK DENOTES EXISTING ITEMS.

LEGEND:

- - - - - - -	FIBER OPTIC ETHERNET
———	COPPER ETHERNET
A	SIGNAL CONTINUATION IDENTIFIER (SIGNAL A SHOWN)

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ENGINEERING
INCORPORATED
305 EAST HUNTLAND DR.
SUITE 500
AUSTIN, TX 78752
TBPE NO. F-2408

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PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

FILTER BUILDING PROPOSED CONTROL SYSTEM ARCHITECTURE

Figure
10.3.1.1

As shown in the figure, it is proposed to install a dual-channel single-mode Ethernet fiber optic network with star topology at the Filter Complex to facilitate communication between the Filter Complex and the existing Walnut Creek WWTP Top-end computer system. The manner in which the proposed communication network is interconnected with the existing fiber optic network is discussed later in following paragraphs. It is proposed to install a dual-channel Ethernet copper network with star topology to facilitate communication between the individual PLCs, respective OIUs, and power monitoring/protection units within the Filter Complex. A dual channel single mode fiber optic based network between PLC within the Filter Complex can be provided for an increase in the preliminary electrical and I&C construction cost opinion.

Dual-channel Ethernet media is recommended for reliability and ease of maintenance; however, a single-channel network may be implemented as a cost savings measure. It is observed that in the event a single-channel network interconnection between the Filter Complex and the Top-end computer system is selected for implementation, the failure of the single-channel network communications system would affect plant operations. This failure could render the Filter Complex isolated from the other process areas with no data transfer between them.

As shown for the Filter Complex on Figure 10.3.1.1, it is anticipated that one local control panel (LCP) will be provided per filter to contain the PLC and other I&C equipment dedicated to a respective filter. One PLC will be allocated per filter and the PLC will be used to monitor and control the entire filter, i.e. filter motorized valves, filter level monitoring, etc. On Figure 10.3.1.1, the typical filter LCP is labeled “LCP-F1” while the typical filter PLC is labeled “PLC-F1”. Discrete operators and indicators or OIUs mounted to the dedicated filter LCP are not anticipated under this design alternative. This design is modular, easily standardized, cost effective, and also assists in spatial planning considerations. Although a low profile console type cabinet is anticipated for the filter LCP, a taller free standing modular type enclosure could be employed for the filter LCP if desired.

Based upon the existing Filter Complex configuration which includes separation between the control rooms of filter 1 through 4 (Filter Building 1) from those of filter 5 through 10 (Filter Building 2), it is proposed that one OIU be installed in a centrally located LCP in each filter building to assist in providing overall control and indication of selected points within the system from the control room level of the building. These LCPs are labeled as “LCP-FB1” and “LCP-FB2” on the Figure 10.3.1.1. Additional discrete operators and indicators mounted to the LCPS are not anticipated. It is anticipated that the LCPs will be separate from the respective filter LCPs. “LCP-FB2” may be deleted as a cost savings measure provided the main control panel in Filter Building 2 as described hereinafter is provided with an OIU. Further refinement of the final quantity of OIUs in Filter Building 2 is anticipated to occur during the final design phase.

Additionally, a general purpose Main Control Panel (MCP) is anticipated to contain the remainder of the Filter Complex I&C equipment that is commonly used by all filters such as the backwash pumping units and NPW pumps. The MCP will be physically configured to make optimal use of the existing arrangement of available space within the existing Filter Building 2. The MCP will contain the equipment shown on Figure 10.3.1.1 that is not assigned to other control panels and is intentionally not identified on Figure 10.3.1.1 for clarity. A visible OIU will be provided on the face of the MCP for control and indication of selected points within the system in lieu of using discrete operators and indicators. Further refinement of the allocation of PLC racks to the equipment commonly used by all filters is anticipated during the design phase to balance operational needs, optimize expenditures, and address single point of failure related concerns. The design shown will support filter backwash upon failure of the Filter Complex General PLC.

Data receptacles will be provided at each filter LCP and the main control panel to facilitate the communication network for the Filter Complex mobile computer workstation. The receptacles are labeled as “Data Receptacles to Remote Computers” on Figure 10.3.1.1. The mobile computer workstation will be a node on the SCADA network and can facilitate backwashing individual filters locally at each filter LCP in the event of OIU failure as well as other SCADA software features as enabled for this node.

It has been understood that a packaged control system is desired for the air scour blowers. It is anticipated that the air scour blower packaged control system will reside at the air scour blower building. It is anticipated that the air scour blower packaged control panel be provided with an air conditioner for environmental control. Alternatively, an environmentally controlled closet could be constructed as part of the new air scour blower building to contain the air scour blower control panels. Environmental control associated with the air scour blower control panels will be further refined during the design phase. Coordination will occur with packaged equipment manufacturers during the design phase regarding the incorporation of City of Austin standard control equipment into the packaged air scour blower control system. A fiber optic communication link will also be considered for the air scour blower communication network.

For cost reduction purposes, it is proposed to use existing spare elements of the fiber optic communication link infrastructure located at existing control panel “FB1-CP-WRS” to establish the proposed communication link between the proposed Filter Complex PLC system and the Top-end computer system. Similarly, spare fibers will also be used to establish a communication link between the Filter Complex and the proposed backwash pump protective relays located in the WRI electrical building that are associated with the power distribution system design alternative. The backwash pump protective relays are identified as “BWP-1 MMR” and “BWP-2 MMR” on Figure 10.3.1.1. The communication link for the backwash pump protective relays may be connected with the General PLC in the event that the General PLC and backwash pump PLCs are consolidated. This will be further refined during the design phase. A duct bank is anticipated to facilitate the control wiring interconnections between the Filter Complex and the Backwash pump motor starters located in the WRI electrical building.

The COA has standardized on Modicon PLCs and the application of the various Modicon PLC families for use on this project will be made based upon cost effectiveness with the general organization as follows:

- Quantum series for Filter Complex General PLC
- M340 series for individual Filter Cell and pumping unit PLCs as needed

The existing Filter Complex SY/MAX PLCs are linked to the Top-end computer system via a single channel twin-coaxial cable based communication link that is daisy-chained between PLCs inside the Filter Complex as well as various other process areas of the plant. A portion of this link will not be needed for the proposed Filter Complex improvements, however, the existing link routes through the Filter

Complex and it needs to remain functional to facilitate Top-end system communications with other plant process areas. Proposed conduit/wire will be installed inside the Filter Complex to maintain the integrity of the existing communication link that routes through the Filter Complex.

It has been observed that the technology of the existing Top-end system Root Ethernet switches at the Administration Building is becoming dated. The switches appear to be in good condition and do not need to be replaced in order to facilitate the objectives of this project. The Owner may wish to consider replacing the switches to employ a more modern switch technology and also increase the plant's communication backbone speed. The preliminary electrical and I&C construction cost opinion will need to be increased to facilitate the replacement of the switches.

10.3.2 Filter Complex I&C Design Alternative No. 2

This design alternative includes Filter Complex I&C Design Alternative No. 1 as a base system and alters only the application of OIUs. Under Filter Complex I&C Design Alternative No. 2, each filter is provided with a dedicated OIU mounted on the filter LCPs (labeled "LCP-F1" on Figure 10.3.1.1). Under this alternative, an OIU is provided for the main control panel. Consideration will be given to a lesser cost OIU for the filter LCPs in this application.

10.3.3 Filter Complex I&C Design Alternative No. 3

This design alternative includes Filter Complex I&C Design Alternative No. 1 as base system. Under Filter Complex I&C Design Alternative No. 3, each filter LCP (labeled "LCP-F1" on Figure 10.3.1.1) is additionally provided with dedicated discrete operators (selector switch, push buttons, etc.) for control and monitoring of filter specific valve actuators from the respective filter LCP. The main control panel is also supplemented with dedicated discrete operators for control and monitoring of NPW pumps, backwash pumps, etc. Compared to the other I&C design alternatives, this alternative requires additional physical space.

10.3.4 Machine Monitoring

Machine monitoring is anticipated for the air scour blowers, NPW pumps, and backwash pumps. The design anticipates that the machine monitoring will be performed by the respective unit PLC in coordination with the associated motor protective relay. It is further anticipated that each vibration monitoring point is monitored with an individual vibration transmitter which is then connected to the respective unit PLC. It follows that should the unit PLC fail under this alternative, then the corresponding machine monitoring protection functionality performed by the PLC would not be available.

10.3.5 Field Control Station

The FCS provides local ON/OFF control of all process equipment with associated ON/OFF indication, if required. Local control allows the equipment to be operated locally at the equipment's location. It is anticipated that the terminology of the operators will be coordinated with that presently used at the plant to promote operator familiarity and ease of use. Limited field control stations are anticipated for this project as follows:

- Pumping Units: Local/Off/DCS selector switches with Start/Stop push buttons.
- Motorized Valves: Open/Stop/Close pushbuttons and Local/Off/Remote selector switches incorporated into each valve actuator where the actuators are accessible. Flow modulating

valves will also have valve position displays provided. Separately mounted and accessible field control stations will be provided in cases where the valve actuator is not accessible.

Additional field control stations are anticipated for the NPW and backwash pumps that are located on the MCC. The final FCS design, including components for specific equipment will be reviewed and finalized during an I&C coordination meeting held during the design phase.

10.3.6 Use of Filter Complex Lab Area as Backup Plant Operation Station

It has been understood that additional computer workstations will be installed near the Filter Building 1 entrance and Lab area for improved computer system redundancy. This area is identified on Figure 9.3.1.3.

A control panel containing networking equipment such as data communication switches, patch panels, etc. will be added to the Lab area and interconnected with the existing plant communication network. For cost reduction purposes, it is proposed to use existing spare elements of the fiber optic communication link infrastructure located at existing control panel “FB1-CP-WRS” to establish the proposed communication link between the Filter Complex Lab area and the Lift Station Telemetry System/Top-end computer system.

Communication receptacles will be provided in the Lab area for use by the Lift Station Telemetry System and Top-end workstations. With the installation of control system workstations into the Filter Building 1, it has been understood that the existing Filter Building 1 will need additional means to control personnel access into the building. Consideration can also be given to partial removal of the non-load bearing partition CMU wall and door between the Lab and the Entrance rooms to increase overall available space for the backup control system. These means (both personnel access control and wall demolition) will need to be defined during the final design phase and increases to the preliminary electrical and I&C construction cost opinion will be needed accordingly.

Certain existing I&C conduit/wire associated with the chlorine contact basin sampling sub-system terminates in the lab area and appears to have been abandoned in place. This conduit/wire will be demolished. Additional field investigations will be needed during the design phase to confirm the continued need for “CS01-LCP” and define the extent of any potential demolition. The preliminary electrical and I&C construction cost opinion will need to be increased to include demolition effort associated with “CS01-LCP”, if any.

10.3.7 Security System

The preliminary electrical and I&C construction cost opinion will need to be increased to include support for a security system.

10.4 Recommendations

The recommended I&C Design Alternative for this project to incorporate:

- PLC based distributed control system architecture with one dedicated PLC per filter
- Graphical digital technology user interface to monitor and control the filter process combined with communication network interface port adjacent to each filter

In general, each proposed I&C Design Alternative for this project incorporates features that readily support the objectives of this project. The variation between the I&C Design Alternatives, however, reflects various degrees of operator flexibility and comfort. The selection of an I&C Design Alternative is thus dependent in large part on user preference and its relationship to life cycle cost.

I&C Design Alternative No. 1 meets the project objectives with the least life cycle cost. In contrasting I&C Design Alternative No. 2 with the other I&C Design Alternatives, the OIUs under I&C Design Alternative No. 2 would individually be used less frequently due to their increased quantity than in either I&C Design Alternative Nos. 1 or 3. However for this application, considering the anticipated frequency of use for the OIUs, the reduction would not significantly affect OIU life for the planning period of this project. On this basis, the City of Austin may wish to consider the selection of I&C Design Alternative No. 3 over that of I&C Design Alternative No. 2. I&C Design Alternative No. 3 provides the greatest degree of flexibility and operator comfort to support process system operation and does not subtract from the I&C system engineering concept.

One of many considerations in the selection of an I&C design alternative is the ability of operations staff to operate the filter process under extreme conditions of widespread multiple PLC failures and the number of operators required to operate the facility under these conditions. From a technical perspective, it is noted that a widespread multiple PLC failure based upon the proposed I&C Design Alternatives, although possible, would be an unlikely event over the planning period of this project. If there is a preference to maintain the present day operational staffing level operating the filter process in a manual only mode under the pretext of a widespread multiple PLC failure, the various indicators and control operators necessary to operate each filter should be located in the same relative physical space, i.e., at the Filter Complex control room level. Only I&C Design Alternative No. 3 meets this objective. The City of Austin is advised that the implementation of either I&C Design Alternative No. 1 or No. 2 will lead to the need for temporarily increasing operator staffing compared to present day staffing level in the event of a widespread multiple PLC failures.

The City reviewed the three alternatives and has selected to move forward with Alternative 2 as the basis of design for the project with the following additional considerations:

- The City would like the individual filter PLCs to be able to call the backwash pumps without routing through the master PLC (in case of master PLC failure). It is likely this functionality will be password protected.
- The City will keep the three PLCs for the backwash and NPW pumps.
- The City would like all 10 individual filter PLCs to have roll cart connection
- The City does not want to include master OIUs in each filter building. Only include individual OIUs on each filter cell, the workstation in Building 1, and the roll cart.
- In addition, unrelated to controls, the City would like the doors refurbished to keep bugs out.

11.0 Engineer's Opinion of Probable Construction Cost

An Engineer's Opinion of Probable Construction Cost (EOPCC) has been developed individually for all improvements described within this PER. They are presented in Attachment 11-1

11.1 EOPC Methodology

The project improvements discussed in this PER are at the preliminary level of development and, as a result, do not provide the level of design detail required for estimating on the basis of detailed quantities and unit pricing. However, where certain items of materials and equipment were identified for replacement or rehabilitation, vendors were contacted and provided budget pricing. As a result, the estimates have been developed from a combination of the following estimating resources and references and adjusted, as appropriate, to provide results that represent a conservative level of cost relative to current late 2011, early 2012 pricing in the construction industry.

- Current budget price quotations from vendors for individual items of equipment. In addition to the cost of equipment, the cost of equipment installation is accounted for based on a percentage of the equipment cost. In general, for all equipment except electrical equipment, the installation percentage used is 40 percent. This amount is adjusted up or down as appropriate for the amount of labor, materials and equipment anticipated for the installation.
- Cost references for materials and commodities available from cost estimates for other water and wastewater related projects that have been prepared within the last several months.
- Cost references for labor and materials, equipment rental, construction aids, etc. available from building and heavy construction cost data published annually by RS Means.
- Where other references were not available, certain costs have been estimated based on previous experience and engineering judgment.
- 10% was added to each portion of the work to account for general conditions, overhead and profit.
- A 30% contingency was added to each portion of the work.

The National ENR CCI for this period ranged from 9172 (12/2011) to 9176 (1/2012). This estimate is meant to be a Level C cost estimate as defined by the City of Austin. A Level C cost estimate as defined in the contract is one with a margin of error of +/- 25% of the probable project construction cost.

11.2 Estimate Components

An estimate was prepared for each of the primary components of the recommended projects, as well as alternatives for the non-potable water system, the Northwest Clearwell and the instrumentation and control system. The nozzle underdrain system with mono-media, the new Southside Clearwell, the new backwash pumps, the associated power improvements, replacing assets at the end of their useful life and the HVAC improvements are recommended for construction. Costs for these projects have been included in Table 11-1. Costs for the alternatives for the new non-potable water, the Northwest Clearwell and the associated power and I&C systems are included, as well, Table 11-2. Costs in both tables are total estimated costs and include the 10% general conditions, overhead and profit multiplier and the 30% contingency.

Table 11-1: Engineer's Opinion of Probable Construction Cost Summary for Required Improvements

Item	Estimated Cost
Nozzle Underdrain w/ Mono-Media Filter	$2,000,300
Air Supply Within New Structure	$713,800
Backwash Storage in Expanded Clearwell	$3,274,400
Replace/Renovate Assets	$1,739,800
Power and System Upgrades	$3,351,400
HVAC Improvements	$176,000
Sub-Total	$11,255,700

Table 11-2: Engineer's Opinion of Probable Construction Cost Summary for Alternatives

NPW Alternative No. 1	$179,100
NPW Alternative No. 2	$207,700
NPW Alternative No. 3	$159,900
NPW Alternative No. 3	$14,000
Northwest Clearwell	$727,700
Filter System I&C Alternative No. 1	$3,028,000
Filter System I&C Alternative No. 2	$3,098,800
Filter System I&C Alternative No. 3	$3,432,000

The total estimate for construction is dependent on the alternatives the City of Austin selects to accompany the recommended projects. At least one non-potable water alternative and one instrumentation and control alternative is needed. The Northwest Clearwell alternative is not required.

Table 11-3 lists all of the required items, as well as the non-potable water alternative 1 and instrumentation and control alternative 2 to provide a total estimate.

Table 11-3: Engineer's Opinion of Probable Construction Cost

Item	**Estimated Cost**
Nozzle Underdrain w/ Mono-Media Filter	$2,000,300
Air Supply Within New Structure	$713,800
NPW Alternative No. 1	$179,100
Backwash Storage in Expanded Clearwell	$3,274,400
Replace/Renovate Assets	$1,739,800
Power Distribution System Upgrades	$3,351,400
Filter System I&C Alternative No. 2	$3,098,800
HVAC Improvements	$176,000
Total	$14,533,600

CITY OF AUSTIN
WALNUT CREEK WWTP
TERTIARY FILTER REHABILITATION PROJECT

TM1 CONDITION ASSESSMENT

CITY OF AUSTIN CIP ID: 3023.025
B&V PROJECT NO. 168622

JUNE 9, 2011

BLACK & VEATCH
Building a world of difference.

1.0 BACKGROUND AND PURPOSE

This TM1 presents the assessment of the condition of the existing Filter Building 1 and Filter Building 2. This TM1 has been prepared in accordance with the requirements of the Scope of Services for the Preliminary Engineering Phase of the Walnut Creek WWTP Filter Improvements Project. This TM1 includes a description of the history of construction for the facilities within the scope of this project, the methodology employed during the condition assessment, and the results of the condition assessment.

The purpose of this TM1 is to document the condition of the existing facilities and the performance characteristics of the granular media filtration process. The structural and process mechanical components of the facility will be evaluated to determine the remaining useful life of these facilities. The results of the condition assessment documented in this TM1 will be used to develop the scope of work for Alternative One – Renovation of the Existing Facilities.

1.1 History of Construction

There have been 10 major construction projects implemented at the Walnut Creek WWTP since the original construction of Filter Building 1. Some of these have impacted the filter complex, others have not. The following paragraphs describe the projects that have impacted the filter complex in chronological order.

1.1.1 Contract IV – Sections I & II, Treatment Facilities

Black & Veatch drawings dated 1974 and conformed to construction records in 1979. This project includes the construction of Filter Building 1, and as such is the first construction in the filter complex. Other facilities included in this project were the Administration Building, Equipment Storage Building, the original Headworks Facilities, Primary Basins 1 and 2, Flow Equalization Basins 1 and 2, the Operations Building, Aeration Basins 1 and 2, Final Clarifiers 1 and 2, Chlorine Contact Basins 1 and 2, and support systems such as low-pressure air, chlorine feed, and non-potable water. The secondary facilities were rated for an average day design flow of 18 mgd and a maximum day design flow of 36 mgd.

The design of the filter complex at the completion of this project included filters 1 through 4, designed as dual media filters with 22-inches of anthracite over 12-inches of sand. The sand is supported on 10-inches of support gravel which is constructed on clay tile filter underdrains. The filters are provided with surface wash mechanisms that run off of the non-potable water system. Backwash water was supplied from the chlorine contact basins upstream of the filters. The valve actuators are described as either pneumatic or hydraulic for the valves within the filter complex. The hydraulic profile for this plant indicates that filtration at the design flow is possible only with the water elevation in Walnut Creek below elevation 442. During flood events, the filters were to be bypassed.

A junction box on the north side of Chlorine Contact Basins 1 and 2 provides a passive bypass from the filter influent to the Walnut Creek outfall in the event that flows exceed the rated capacity of the filters or in the event that the water level in Walnut Creek exceeded elevation 442.

1.1.2 Contract 2 – Walnut Creek Wastewater Treatment Plant Expansion Contract

CDM drawings dated May 1985 and stamped as Record Drawings in August of 1990. This project includes the construction of: Aeration Basins 3 and 4; Final Clarifiers 3 and 4; Chlorine Contact Basins 3 and 4; and modifications to the backwash supply system for the filter complex. The plant flow schematic and hydraulic profile indicate that the aeration basins were rated for an average daily flow of 38 mgd total and a maximum day design flow of 56 mgd total. The filters are rated for an average daily flow of 38 mgd and a maximum day design flow of 38 mgd. The overflow weir in the junction box at Chlorine Contact Basins 1 and 2 (constructed under project 1) is used to spill excess secondary effluent to Walnut Creek.

Modifications within the filter complex include the construction of a new wetwell adjacent to the effluent channel at the northeast corner of Filter Building 1. This wetwell includes a sump with suction piping for the backwash pumps and non-potable pumps. The backwash pump suction is buried on top of the existing filter effluent channel and provided with a vacuum prime system, the vacuum pumps and receiver located within the filter piping gallery in the northeast corner. The non-potable pump suction piping is submerged within the existing final effluent conduit, it follows a tortuous path around the east end of the gallery to get into the clearwell and connect to the original suction lines as they penetrate the east wall of the clearwell.

1.1.3 Walnut Creek Wastewater Treatment Plant Contract 6

CDM drawings dated May 1987 and stamped Record Drawings in August of 1990. This project includes construction of: Aeration Basins 5 and 6; Final Clarifiers 5 and 6; Chlorine Contact Basins 5 and 6; Filter Building 2 and modifications to the sludge thickening facility. The stated capacity of the modified filter complex is 120 mgd “Year 2010 Peak Flow” and 60 mgd “Year 2010 Average Daily Flow” based on the hydraulic profile on sheet G-1. This drawing also notes that the hydraulic profiles are calculated with 9 filters in operation, a total of 5 feet of head loss through filter media and underdrains, and lists the following elevations of Walnut Creek as “the maximum at which no plant flow bypasses filtration”:

- For “Year 2010 Average Daily Flow” the Walnut Creek Elevation listed is 449.65, noted as a “12.2 year flood”.
- For “Year 2010 Peak Flow” the Walnut Creek Elevation listed is 444.28, noted as a “2.4 year flood”.

The structural and mechanical drawings for the filter complex expansion allow two alternative types of underdrains. From observation of the placement of access manholes into the underdrain plenum, PCI nozzle type underdrains were installed with a false floor. This alternative is detailed to have 3-inches of gravel support and 4-feet of anthracite above the false floor. A note on the mechanical sheet requires all of the existing hydraulic actuated valves for filters one through four to have the actuators replaced with electronic actuators. This set has the 10-inch low pressure air line routed over from the aeration basin complex to supply air to the six new filters which feature combined air/water backwash and no surface wash. The main backwash flow control valve was replaced with a “24” SPECIAL NON-CAVITATING B.F. VA. WITH MOTOR OPERATOR” (Note 5, Sheet M-36).

Main filter influent conduits were revised as part of this project so that a new junction box west of the filter complex accepts flow from chlorine contact basins 4, 5 and 6 while the original junction box (north of aeration basins) accepts flow from chlorine contact basins 1, 2 and 3. Both junction boxes have long weirs that allow overflow to the Walnut Creek Outfall in the event that effluent flow from the chlorine contact basins exceeds the rated capacity of the filter complex.

1.1.4 Walnut Creek WWTP Chlorination/Dechlorination Improvements

Abbe/Garrett Engineering drawings dated June 1993 and sealed as Record Drawings in October of 1996. The work includes construction of the Dechlorination Building used to feed sulfur dioxide for dechlorination of plant effluent. Three feed points are located within existing structures in the vicinity of the filter complex: 1) Outlet of the clearwell; 2) Overflow of the junction box north of Chlorine Contact Basins 1 and 2; and 3) Overflow of the junction box west of Filter Building 2. This project also includes construction of the standby generator in a separate structure to the east of Filter Building 1; this 175 kw unit is designed to maintain operation of one of the NPW pumps so that the chlorine and sulfur dioxide injectors can continue uninterrupted operation in the event of a power outage.

This project also included chlorine modifications, notably the installation of 9 sample pumps that were installed in the chorine contact basins. The analyzers that were fed by these pumps were located in the lab area of Filter Building 1 on the ground floor.

1.1.5 Walnut Creek Wastewater Treatment Plant Effluent Outfall to the Colorado River

Freeze and Nichols drawings dated September of 1995 with Record Drawings in January 2000. Construction includes a new 96-inch diameter outfall that connects to the existing 90-inch diameter Walnut Creek outfall and conveys the plant effluent to the Colorado River in lieu of Walnut Creek. The hydraulic gradient in the outfall at a flow of 200 mgd is depicted on the plan and profile sheets, the hydraulic gradient at the connection to the existing 90-inch is approximately elevation 439. Therefore, it appears that this outfall has eliminated a significant hydraulic constraint which would limit the capacity of the filters when Walnut Creek would flood. However, the hydraulic profile shown at the outfall to the Colorado is lower than the 100-year floodplain depicted in the river. It is not clear how a flood in the Colorado would impact the capacity of the filter complex. A new effluent meter and dosing point for sulfur dioxide is included in the outfall conduit.

1.1.6 Water Reclamation Initiative – Phase I

GSG drawings dated 2000 with Record Drawings in 2002. This work includes construction of a low service pump station that takes suction from the same sump that the backwash pump and non-potable water pumps use at the northeast corner of Filter Building 1. The low service pump station discharges to an at-grade storage tank that feeds a high service pump station. The high service pump station feeds off-site reservoirs and back-feeds the non-potable system onsite.

2.0 METHODOLOGY

The process for completing a condition assessment of assets includes:

- Level of Service and Reliability Determination
- Visual Condition Assessment
- Failure Modes and Effect Analysis
- Remaining Useful Life Determination

2.1 Level of Service and Reliability

The desired level of service and reliability for a system or individual asset is determined in order to identify the overall criticality of an asset. The determination considers effects on upstream and downstream processes in case of asset failure. Redundancy and other means of addressing asset failure are considered in the desired level of service and reliability determination.

2.2 Visual Condition Assessment

The visual condition assessment process is used to establish the overall condition and performance of an asset. The visual condition assessment focuses on the mechanical, electrical, and structural components of an asset to determine its potential failure risk exposure. The methodology used in this assessment is as follows.

- Preliminary review of background data for the asset from available inventories
- Review of appropriate design drawings
- Review of operations and maintenance logs from the City’s “Infor” records
- Interview electrical maintenance, mechanical maintenance, and operations staff and inspect the assets with these staff members.

Existing asset inventory data is reviewed for critical gaps, such as manufacturer, model number, serial number, size or speed, and installation dates. Identified gaps are filled during the visual condition assessment. During the visual condition assessment, general condition, abnormalities such as oil leaks and significant rust, and any other asset deterioration are recorded. Based on the results of the interviews and inspections, the condition of each asset is ranked using the standardized scale presented in Table TM1-1.

Table TM1-1. Condition Ranking Scale

Ranking	Condition Level
1	Excellent
2	Slight Visible Degradation
3	Visible Degradation
4	Integrity of Component Moderately Compromised
5	Integrity of Component Severely Compromised

Performance rankings are used to assess the performance status of assets. The scale used for asset performance ranking is described in Table TM1-2.

Table TM1-2. Asset Performance Ranking Scale

Ranking	Performance Level
1	Component Functioning as Intended
2	In-service, but Higher than Expected Operations and Maintenance
3	In-service, but Function is Impaired
4	In-service, but Function is Highly Impaired
5	Component is not Functioning as Intended

The condition and performance rankings define general condition of the individual assets and are used as factors in calculating the qualitative risk exposure associated with the asset. The asset risk exposure is defined by using a quantitative risk matrix shown in Table TM1-3.

Table TM1-3 Condition Assessment Quantitative Risk Matrix

		Performance Ranking				
		1	**2**	**3**	**4**	**5**
Condition Ranking	1	Insignificant	Insignificant	Minor	Moderate	Major
	2	Insignificant	Minor	Moderate	Major	Extreme
	3	Insignificant	Minor	Moderate	Major	Extreme
	4	Minor	Moderate	Major	Extreme	Extreme
	5	Minor	Moderate	Major	Extreme	Extreme

Table TM1-4 identifies recommended responses associated with each asset risk level.

Table TM1-4. Asset Risk Response Recommendation

Ranking	Recommended Responses
1	No Immediate Action Required
2	Initiate More Detail Inspection
3	Evaluation and Corrective Work Planning
4	Near-term Corrective Action Required
5	Replace / Refurbish

2.3 Failure Modes and Effects Analysis

The FMEA process is a step-by-step approach used to identify all historical asset failures and their associated consequences. Failures are prioritized according to the frequency at which the failure occurs and the severity of the failure consequences. Information determined through the FMEA process includes:

1. Asset failure modes
2. The impacts or effects of each failure mode
3. The likely frequency and cost of each failure mode

The results of the FMEA can be used to develop recommendations for detailed condition assessment and also for changes in preventative maintenance practices for the equipment. Where the cost of asset failure is quantified in the Preliminary Engineering Report, it includes the direct cost of labor plus parts, materials, and vendor expenses. The direct labor cost does not include the cost of benefits or overhead.

The focus of a FMEA is on an asset and how the asset fails. Consideration is given to the failure mode, the effects (consequences) of the failure, and the frequency at which the failure occurs. Where failure risks are unacceptable, subsequent consideration can be given to mitigation actions such as increasing preventative maintenance, contingency planning, adding redundancy, changing the design, and purchasing critical spare parts or equipment to minimize the effects of failure. It is important to note that asset failure is not caused exclusively by asset condition in every case. Asset failure can result from systematic failures which can stem from organizational factors, human factors, or equipment factors. Equipment failure can be caused by design flaws, age, condition, and improper application. The FMEA process identifies the causes of asset failure in terms of possible failure modes.

In the qualitative FMEA analysis, levels of risk associated with various assets were determined by combining the frequency and the effects of each failure mode to produce a risk ranking. The rating system used to evaluate the frequency of asset failure is presented in Table TM1-5.

Table TM1-5. Asset Failure Frequency Ranking

Ranking	Failure Frequency	Description
1	Occurs Very Rarely	Exceptional event
2	Occurs on Rare Occasions	Every 2 to 5 years
3	Occurs Annually	About once a year
4	Occurs Quarterly	About 4 times a year
5	Occurs Regularly	Monthly or great frequency

The system used to rank the effect of an asset failure is presented in Table TM1-6.

Table TM1-6. Asset Failure Effect Ranking

Ranking	Failure Effects
1	No injury, no treatment process implication or financial loss
2	Treatment process upset, minor financial impact
3	Treatment process interruption (recoverable in one month), moderate injury, moderate financial impact
4	Treatment process failure (3 months to recover), severe injury, major financial impact
5	Catastrophic treatment process failure, death, extreme financial loss

After the frequency and effects of each failure mode were determined, the overall risk ranking for that mode was defined using the FMEA qualitative risk matrix shown in Table TM1-7.

Table TM1-7. FMEA Qualitative Risk Matrix

		Asset Failure Effect Ranking				
		1	**2**	**3**	**4**	**5**
Asset Failure Frequency Ranking	1	Insignificant	Insignificant	Minor	Moderate	Major
	2	Insignificant	Minor	Moderate	Major	Extreme
	3	Insignificant	Minor	Moderate	Major	Extreme
	4	Minor	Moderate	Major	Extreme	Extreme
	5	Minor	Moderate	Major	Extreme	Extreme

The qualitative risk matrix ranking is defined as follows:

Extreme – Must correct.
Major – Detailed condition assessment is warranted (e.g., vibration, ultrasound, physical breakdown of equipment).
Moderate – Preliminary detailed condition assessment is warranted (e.g., detailed visual assessment) if condition-related.
Minor – Preventative maintenance measure should be implemented to reduce asset risk exposure.
Insignificant – Requires no further attention.

2.4 Remaining Useful Life Determination

Remaining useful life is a prediction of the remaining useful life of an asset. Remaining useful life is determined for assets based upon the age and utilization of the assets, original expected life of assets, current condition, and performance rankings of the assets. The methodology flow diagram used to estimate RUL is shown in **Figure TM1-1**.

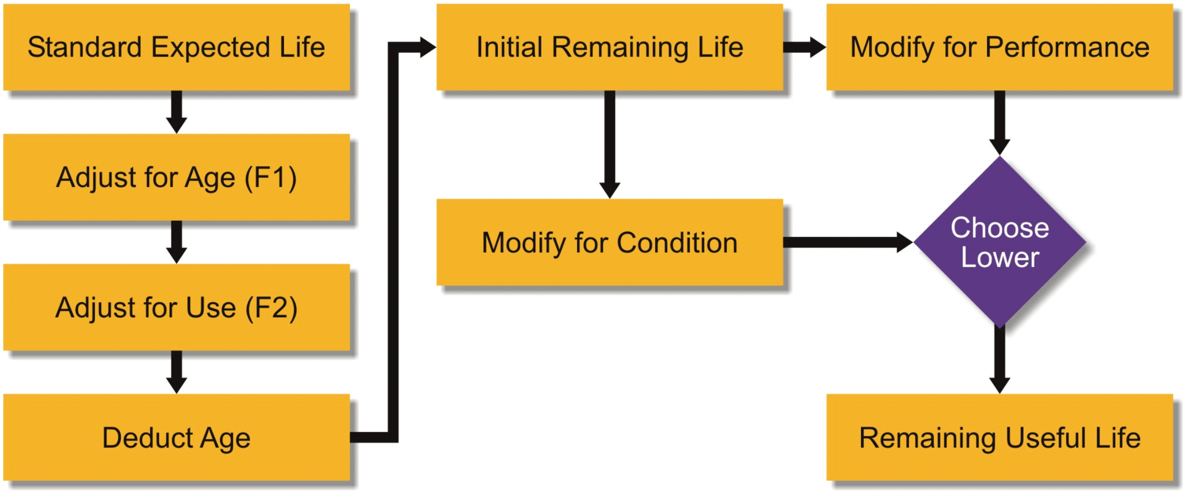

Figure TM1-1. Remaining Useful Life Flow Diagram

Service life (standard expected life) values for City of Austin assets are defined as the current typical service life for asset function. The service life for the specific asset classes are used to start the remaining useful life calculation. Table TM1-8 lists the asset class service life values.

TableTM1-8. Asset Class Service Life Values

Asset Class	Asset Class Description	Service Life
Concrete Structures	Water containing structures exposed to treated wastewater	50 years
Pump	Pumps	30 years
Motor	Motors	20 years
Mech_Misc	Mechanical Equipment not otherwise specified	30 years
Emer-GEN	Emergency Generator	25 years
Gates	Gates	30 years
HVAC	Heating and Ventilation	20 years
Piping/Valves	Process Piping	50 years

In order to establish a new remaining useful life, the condition, performance and utilization were then assessed against the current remaining useful life to establish a new remaining useful life. The remaining useful life sometimes results in a total life of the assets which is greater than the original projected service life.

3.0 RESULTS

The results of the condition assessment for the assets that comprise the filter complex are presented in the following paragraphs. The scope of work for this assignment specifically excluded a condition assessment of the HVAC, electrical and control systems within this filter complex because these systems had been previously evaluated and found to be at the end of their useful life. In addition, the filters in Filter Building 1 which do not have the capability of combined air-water backwash, are assumed to be replaced and the condition of the filter media, underdrains, and surface wash system in Filters 1 through 4 have not been evaluated as part of this work.

3.1 Required Level of Service and Reliability

The required level of service and reliability for the individual assets within Filter Building 1 and Filter Building 2 were determined based on the required level of service and reliability of the individual processes that comprise this facility. The processes evaluated were:

- Filtration
- Filter Backwash
- Reclaimed Water Supply
- Non-potable Water Supply

The required level of service and reliability for each of these processes is discussed in the following sections. Note that this analysis is based on current conditions only. Potential future flows, loads and permit requirements are discussed in TM2 – Alternative Treatment Technologies.

3.1.1 Filtration

Filtration is required at the Walnut Creek WWTP in order for the plant to comply with two important criteria related to quality of the finished water: 1) 5 mg/L TSS in the effluent discharged to the Colorado River and 2) 3 NTU in the reclaimed water system. The current configuration of the treatment plant does not separate these two flow streams until after filtration, therefore the more stringent standard for reclaimed water governs.

The majority of flow from the secondary clarifiers and chlorine contact basins is routed through the filters – they have the same 75 mgd capacity rating as the secondary process under annual average conditions. However, under high flow conditions the filters may be bypassed for a short period of time. The discharge permit requirements can still be met with a partial bypass flow, since the blended effluent is measured for TSS and all the flow to the reclaimed system is filtered regardless. The current capacity of the settled water pumps is reported to be 165 mgd. The maximum rating of the filter complex is listed as 120 mgd on the latest set of record documents, or 13.3 mgd per filter with nine out of the ten filters in service. This equates to a peak loading rate over 8.5 gpm/sf, and sets the peak hydraulic capacity of the filtration complex.

The required reliability of the filtration complex is that all 10 filters be available for service under the design condition. The sizing of the filters is based on nine of the ten filters in operation, one in backwash under these conditions. In fact, the true required reliability is somewhat less than indicated by the design condition, since the plant has the ability to bypass the filters during the peak flow. A desired level of reliability could reasonably be stated at 80% - meaning that 8 out of 10 of the filters are in service at any time.

3.1.2 Filter Backwash

Filter Backwash is required in order to maintain the filter process. Currently, the filters are backwashed about every 48 hours, so that each 12-hour shift backwashes 2 or 3 filters. Based on the Manual Backwash Sequence dated November 13, 2006, each filter backwash should include the following steps:

- Six minutes of combined air-water backwash with air scour at 1,200 scfm and backwash flow at 10 mgd.
- Six minutes of water only backwash at a peak flow between 20 and 30 mgd, until the backwash water runs clear.
- Six minutes of water only backwash at a flow of 10 mgd to resettle the bed.

In order to supply these requirements, the filter backwash water supply should be capable of delivering between 10 and 30 mgd of flow at adequate head to overcome the losses in the piping, underdrains and filter media. Low pressure air should be supplied at a flow rate of 2,100 scfm with sufficient pressure to overcome losses in the piping, underdrains and filter media. Approximately 200,000 gallons of backwash water should be available for each filter backwash. This water should be the quality of chlorinated filter effluent or better. In order to maintain filter operation in the event of a plant upset that increases solids loading to the filters, approximately two filter backwash volumes or 400,000 gallons of filter effluent should be available in storage for the backwash supply. Two filter backwashes are considered adequate storage because in the event of an upset condition, the backwashed filters would immediately be placed into service and begin to replenish the backwash supply so that the remaining filters could be backwashed. If alternative technologies as selected for filtration, the quantity of water required for backwash storage could be dramatically reduced.

The reliability of the backwash system is at least as critical as the filter system, since filtration cannot be maintained without a backwash supply. Since one backwash system will serve the entire complex, 100 percent redundancy should be provided for all rotating machinery. In general, given the current frequency of backwashing, this system may not be down for longer than 24 hours before filter performance is impacted.

3.1.3 Reclaimed Water Supply

For the purpose of this condition assessment, reclaimed water supply means the piping that supplies the low service pump station with filtered effluent. The low service pump station, onsite ground storage tank, high service pump station and distribution system are not included in this evaluation. However, this relatively new process has a significant impact on the required level of service and reliability for two reasons: First, the effluent quality required is different than the flow discharged to the Colorado River, as previously noted under Filtration; Second, this system is the primary source for the on-site non-potable supply.

The quality requirements for this supply related to filtered effluent clarity are described under the filtration section. The capacity of the Reclaimed Water Pump Station is currently 3.7 mgd, with provisions in place to expand to 9 mgd as demands increase and the reclaimed water system is expanded. An ultimate system capacity of 34.6 mgd has been established in long-range planning documents. The chlorine residual in this system is boosted from the normal residual in the filter effluent of 0.5 to 0.7 mg/L to a value that ranges from 1.5 to 4.0 mg/L in order to maintain a residual throughout the reclaimed water system. There is no alternative supply for this system, so filtered water must always be available for the low head pump station to operate. The on-site storage and additional elevated storage tanks within the reclaimed system provide some level of reliability for this system, although the evaluation of demands versus available storage is beyond the scope of this work. As far as the plant is concerned, the non-potable system feed from the discharge of the high-service pumps is critical for the reasons described in the non-potable section.

3.1.4 Non-Potable Water Supply

The non-potable water supply is obtained from one of two sources, either from the discharge of the high service pumps on the reclaimed water system or from the non-potable pumps that are located in Filter Building 1. This system is utilized for general wash-down service but also feeds the eductors in the chlorine and sulfur dioxide systems on the plant site. The required pressure in this system is 80 psi and the required flow is approximately 1,500 gpm. The quality of this water is important, as it supplies equipment that can plug if there are too many solids in the system. Generally filtered effluent has proven to be acceptable, and staff has indicated that the chlorine residual in the filtered effluent (0.5 to 0.7 mg/L) is more desirable than the chlorine residual in the reclaimed water system (1.5 to 4.0 mg/L). This system must be pressurized with adequate flow continuously in order to maintain the operation of the disinfection process and in order to dechlorinate the filtered effluent. The plant would violate their permit condition for disinfection if the non-potable system were to fail.

3.1.5 Summary of Required Level of Service and Reliability

Table TM1-9 summarizes the required level of service and reliability for the processes in Filter Building 1 and Filter Building 2.

TableTM1-9. Summary of Required Level of Service and Reliability

Process	Required Level of Service	Reliability Requirements
Filtration	75 mgd annual average flow. 150 mgd peak instantaneous flow. 3 NTU filtered water turbidity.	80 percent of filtration capacity available at all times
Filter Backwash	Flow from 10 to 30 mgd. Head required to overcome losses. A minimum of 400,000 gallons backwash water in reserve.	Allowable down time less than 24 hours to maintain filtration capacity.
Reclaimed Water Supply	9 mgd flow supplied to the low service pumps. 1.5 – 4.0 mg/L chlorine residual.	Available storage allows this supply to be interrupted for 3 to 5 days.
Non-Potable Water Supply	1,500 gpm at 80 psi. Quality equal or better to filtered water with some chlorine residual.	Must operate continuously or the plant will violate permit.

3.2 Results of Visual Condition Assessment

This section presents the results of the visual condition assessment conducted at Filter Building 1 and Filter Building 2 beginning May 15, 2011 and concluding on June 8, 2011. The visual condition assessment included the review of multiple sources of documentation and several field visits. The B&V team conducted informal interviews with several operations and maintenance staff and witnessed the operation of the filters under various conditions. The sections that follow are organized by activity with a summary section that identifies the major findings of the visual condition assessment.

3.2.1 Preliminary Review of Background Data from the City's Asset Inventory

Black & Veatch was furnished a tabular listing of assets within Filter Building 1 and Filter Building 2. This information was used as the basis of Attachment TM1-1, the detailed condition assessment summary. In general, the listing of assets furnished is complete based on site inspections and review of documentation. There are a substantial number of details related to the make and model of equipment which is missing from this listing, that information has been added to Attachment TM1-1 if it was discovered during this activity. The listing furnished by the City does not include asset tags, therefore the object names from this inventory have been used in this document when referring individual assets.

Attachment TM1-1 has had the majority of electrical, controls and HVAC equipment removed, as the evaluation of those assets is not part of our scope of work. In contrast, the filter underdrains, media and surface wash system in Filter Building 1 remain in this list to document the performance level of these filters compared to the desired level of service.

In some cases, the asset inventory has been expanded to allow a more refined breakdown of the asset to aid in the development of Alternative One. Those entries can be identified within Attachment TM1-1 quite easily as the assets that do not have an entry in the "Object ID" column.

3.2.2 Review of Appropriate Design Drawings

Black & Veatch was furnished electronic files of the design drawings that have been utilized to construct and subsequently modify Filter Building 1 and Filter Building 2 over the past 32 years. The content of these documents is described under the History of Construction portion of this TM1, the content of the record drawings were verified during the site inspections. In general, these documents describe the existing facilities with a high degree of accuracy. There have been minor changes to some small piping in this facility and some additional modifications to the chlorine feed system in Filter Building 1, but there were no major discrepancies discovered between the record drawings and the field observations.

3.2.3 Review of Operation and Maintenance Logs

The City furnished three reports listing the Operation and Maintenance Logs for Filter Building 1 and Filter Building 2 in response to the data request from Black & Veatch. The first two reports were furnished in hard copy and consisted of printouts listed for the Equipment "WC-FB1" and "WC-FB2". The period covered by these reports is listed as May 2, 1977 to May 2, 2011, but the earliest work orders date from 1992. These two listings include only a brief description of the work order, so Black & Veatch requested copies of the full detail for numerous work orders in order to further evaluate the activity in the filter complex. In general, the content of the work orders reviewed was of minimal value. The majority of the work orders does not include additional information regarding the equipment that was maintained, the required hours and staff to complete the activity, or the costs of materials utilized. The most useful information obtained was the commentary from the personnel who performed the maintenance.

The third report furnished was an electronic file listing all of the assets in Filter Building 1 and Filter Building 2 in alphabetical format by Object ID. This listing has additional detail compared to the initial lists furnished, as the comments on the Work Orders have been repeated on the listing. This listing covers the period from 2001 through 2010 and is 124 pages long.

Comparing the two different versions of the reports, the project team has not been able to resolve certain discrepancies. Obviously the second report is limited to work orders after 2001, so all work orders prior to that date in the first two reports are not repeated. After 2001, some but not all of the work orders listed in the first two reports are repeated in the third report. There is no obvious reason why a work order is repeated or not, and the question remains as to whether Black & Veatch has been furnished a complete listing. It is apparent that the first two reports include only those work orders logged to the Object IDs “WC-FB1” and “WC-FB-2”, while the third report includes work orders for these two Object IDs as well as many other Object IDs.

For the purpose of this report, all three reports have been used to determine the frequency of maintenance activities in Filter Building 1 and Filter Building 2. The instrumentation work described within the work orders has been included if it is related to an asset that is hard piped into the system (such as a flowmeter or a valve actuator). If the maintenance was related to the control system manufactured by “Turbitrol”, it was not included in the overall condition assessment. Attachment TM1-1 includes a cross-reference to a few selected work orders that represent the maintenance performed on the assets.

3.2.4 Staff Interviews and Site Inspections

The object of the staff interviews and site inspections was to develop individual ratings for each asset related to condition and performance, as described under the Methodology section of this TM1. Over the course of the visual condition assessment, Black & Veatch interviewed several members of the Operations and Maintenance staff at the Walnut Creek WWTP. Black & Veatch staff witnessed backwashing of all of the filters and took numerous readings related to the performance of assets within the filter complex during normal filtration and backwash operations. On May 25, 2011, the City assisted with a challenge test of filters 5 through 10. The details related to the observation of existing operation are listed in Attachment TM1-2.

3.2.5 Summary of Findings of the Condition Assessment

The condition ratings and performance ratings for the assets that are part of the Filter Complex are listed in Attachment TM1-1 using the 1 to 5 scale described in the Methodology section of this TM1. The comments section of the asset listing describes the reasons for condition ratings 3 and higher, this section of the text summarizes the rationale for performance ratings of three and higher. This approach is used because performance ratings are generally based on a process system or sub-system which is difficult to fully describe within the notes on a tabular listing. The listing of individual assets is cross-referenced to the following text by the comments in Attachment TM1-1 that read "See text Section 3.2.5".

Filter Media, Underdrains and Surface Wash System for Filter Building 1. The condition of the filter media and underdrains in Filter Building 1 were not evaluated as part of this condition assessment. These units were constructed with a clay tile underdrain system with support gravel and a dual media filter (anthracite over sand). Because one of the objectives of the condition assessment is to identify improvements required to keep the granular filters in service as Alternative One for the Business Case Evaluation, the decision was made that Filters 1 through 4 would, at a minimum, be retrofit to utilize combined air/water backwash and a monomedia bed. This approach will ensure that Alternative One will be constructed with a single type of filter and eliminate the two different backwashing procedures now in place.

Backwash System. The existing backwash pumps supply backwash water from the clearwell below Filters 1 and 3 via a siphon arrangement from a sump located in the northeast corner of Filter Building 1. The capacity of the clearwell and filter effluent conduit is approximately 175,000 gallons, assuming 5 feet of useable depth from the weir elevation at the outlet of the clrearwell to the low water level lock-out for the pumps. This volume is less than that required for one filter backwash, so if the filters are blinded off due to high solids from the secondary process it may not be possible to get the filters backwashed and operating. Plant staff reports that the low service pumps will kick out on low level before the filter backwash pumps, so the actual volume available could be less than this amount and the supply to reclaimed water will certainly be impacted during this situation. There is no way to access the clearwell for cleaning without taking the entire filter complex off-line.

Low Pressure Air System. The low pressure air system consists of a supply line taken from the blowers that supply air to the aeration basins. The air to the filters is regulated by a main supply valve and flow meter located at the top of the piping gallery directly above the influent conduit. The valve and flowmeter are not accessible without the removal of significant amounts of piping that would shut down the operation of at least 4 filters. The buried piping has significant leaks, plant staff reports that the air supply to the aeration basins drops off significantly when this system operates and they are forced to start a second aeration blower.

Non-Potable System. The non-potable system within Filter Building 1 could be operated as a back-up system to the feed off of the reclaimed water system, but during the period of the condition assessment that feed was not operable and the non-potable system was being supplied from pump NPW-2 exclusively. The discharge of this pump is fitted with a bypass valve that re-directs flow to the clearwell. That valve was not functional; a butterfly valve within the piping is used to manually throttle the amount of flow being returned to the clearwell so that adequate pressure is maintained in the system. Only NPW Pump 2 can be powered by the standby generator.

3.3 Results of Failure Modes and Effects Analysis

The FMEA analysis was conducted by major groupings of assets, since the failure modes and effects of the individual asset are reflected in these larger groupings. Table TM1-10 summarizes the FMEA analysis done for these groupings.

TableTM1-10. Summary of Failure Modes and Effects Analysis

Asset Group	Description	Frequency Ranking	Failure Effect	Effect Ranking	Qualitative Risk
Filter Structure	All concrete in filter boxes and gallery	**1**	Treatment process interruption (recoverable within one month), moderate injury, moderate financial impact	**3**	**Minor**
Filter Super-structure	All structure above the deck	**1**	Treatment process interruption (recoverable within one month), moderate injury, moderate financial impact	**3**	**Minor**
Filter Influent Conduits	Buried and interior piping from junction boxes to filter boxes	**1**	Treatment process upset, minor financial impact	**2**	**Insignificant**
Filter Open/Close Valves	Individual filter valves in open/close service that are electrically actuated	**4**	No injury, no treatment process implication or financial loss	**1**	**Minor**
Filter Effluent (modulating) Valves	Modulating valves and actuators on filter effluent valves in service to control flow (not the current control)	**5**	Treatment process upset, minor financial impact	**2**	**Moderate**
Filter Instrumentation	Flow, differential head and filter box level on each filter	**5**	Treatment process upset, minor financial impact	**2**	**Moderate**
Filter Backwash Supply Pumps	Includes pumps, electrical gear, vacuum prime system, clearwell	**3**	Treatment process interruption (recoverable within one month), moderate injury, moderate financial impact	**3**	**Moderate**
Filter Backwash Instrumentation	Includes flowmeter and flow control valve	**4**	Treatment process interruption (recoverable within one month), moderate injury, moderate financial impact	**3**	**Major**

TableTM1-10. Summary of Failure Modes and Effects Analysis

Asset Group	Description	Frequency Ranking	Failure Effect	Effect Ranking	Qualitative Risk
Low Pressure Air System	Piping, valve and flowmeter on supply side of filter air scour	**5**	No injury, no treatment process implication or financial loss	**1**	**Minor**
Surface Wash System	Non-potable pump number 3, piping, valves and in-basin equipment	**5**	No injury, no treatment process implication or financial loss	**1**	**Minor**
Filter Effluent Conduit	72-inch buried conduit that connects to Plant Outfall	**1**	Treatment Process Failure (3 months to recover), severe injury, major financial impact	**4**	**Moderate**
Chlorine Feed Equipment	Includes rotameters and valves in the gallery	**2**	Treatment process upset, minor financial impact	**2**	**Minor**
Non-potable pump system	Includes pumps and piping within the gallery	**3**	Treatment process interruption (recoverable within one month), moderate injury, moderate financial impact	**3**	**Moderate**
Major piping systems	All piping and hangers larger than 4-inches within the pipe gallery	**1**	Treatment process interruption (recoverable within one month), moderate injury, moderate financial impact	**3**	**Minor**
Minor piping systems	All piping and hangers 4-inches and smaller within the pipe gallery	**2**	No injury, no treatment process implication or financial loss	**1**	**Insignificant**

Based on the methodology portion of this memorandum, those assets within the groupings with a "Major" qualitative risk warrant a detailed condition assessment or outright replacement. Those assets with "Moderate" qualitative risk should be the subject of a more detailed condition assessment if there are no plans to replace these assets in the near future. Those assets with "Minor" qualitative risk should be reviewed by plant maintenance staff to determine if maintenance procedures should be modified to reduce asset risk exposure. The assets listed with "Insignificant" qualitative risks require no action at this time.

3.4 Determination of Remaining Useful Life

The determination of remaining useful life follows the methodology set for in this memorandum. Attachment TM1-3 lists the calculated remaining useful life of assets that were evaluated as part of this effort. In this attachment, like assets that are common for each filter building are listed only once, since they generally have the same remaining useful life. Due to the in-service date, the assets in Filter Building #1 generally have less remaining useful life than those in Filter Building #2. However, the findings of this report are that, in general, the main structure and the primary piping systems that form major portion of this facility are adequate for the 20 year remaining useful life that is benchmark used for this project.

There are specific assets that do not meet this requirement, and must be addressed if this facility is to remain in service. These are the filter backwash system, the non-potable pumping system, and Filters 1 through 4. Those assets will be evaluated in TM #2 with alternative approaches to refurbishment or replacement of the entire systems. Another group of assets that have remaining useful life less than 20 years are the valves and actuators that serve the filters. While most valves could remain in service in Filter Building #2 and still provide 20 years of service once the actuator and instrumentation are replaced, there is an advantage to replacement of similar assets with identical devices throughout the facility. Filters 5 through 10 have a remaining useful life less than 20 years, which means that they should also be considered for replacement or refurbishment during this period.

As was previously stated, the Electrical, Instrumentation and HVAC assets were not evaluated as part of this work. Previous studies have shown that these assets require replacement since they are past the end of their useful life.

3.5 Recommendations

TM #2 will describe the recommended improvements to this facility in order to maintain continuous operation of the facilities at the expected level of performance for the next 20 years. This TM#1 has been prepared such that it can be easily integrated into the Condition Assessments that are underway as part of the Asset Management Plan for all of the facilities owned and operated by the City of Austin. We recommend that the staff at the Walnut Creek WWTP consider asset management as one of the ongoing duties for personnel who operate and maintain facilities on behalf of the public. This type of program can be used to identify and mitigate risks, plan for capital expenditures, and track the O&M costs for this plant.

ATTACHMENT TM1-1

FINAL CONDITION ASSESSMENT WORKSHEET

FILTER BUILDING 1

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Buildings & Grounds	WC-FB-1	WC-FILTER BUILDING	1979					2	2	Minor	Building Superstructure only	
Filtration	Piping & Valves	WC-FB1-BFV-005-A	FILTER Influent STOP (EAST)	1979	CENTERLINE			54-INCH	2	3	Moderate	Valve - ACCESS LIMITED	
Filtration	Piping & Valves	WC-FB1-BFV-005-G	BFV-005 CHAIN ACTUATOR	1979					3	2	Minor	Actuator	
Filtration	Piping & Valves	WC-FB1-BFV-045-A	FILTER Influent CROSSOVER	1990	PRATT			54-INCH	2	2	Minor	Valve - Installed as part of Contract 6 - NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB1-BFV-045-G	BFV-045 CHAIN WHEEL ACTUATOR	1990					2	2	Minor	Installed as part of Contract 6	
Filtration	Instruments & Controls	WC-FB1-LIT-006-I	BUBBLER FILTER Influent LEVEL TRANSMITTER	1979					3	4	Major	Not currently functioning, but critical to the automation of the filter flow control system	
Filtration	Piping & Valves	WC-FB1-PIPE-001-A	FILTER INFLUENT	1979					2	1	Insignificant	Piping, fittings and pipe supports - system is adequately sized and shows no visible signs of deterioration	
Filtration	Instruments & Controls	WC-FB1-LIT-005-I	CLEARWELL LEVEL TRANSMITTER (FIT-1716)	1990	ROSEMOUNT	1151DP4E22M3 B2	1002287		3	4	Major	Did not find this device	
Filtration	Instruments & Controls	WC-FB1-LIT-1716	CLEARWELL LEVEL INDICATOR(LIT-1716)	1990					3	4	Major	Did not find this device	
Filtration	Piping & Valves	WC-FB1-PIPE-002-A	FILTER EFFUENT	1979					2	3	Moderate	Piping, fittings and pipe supports - This system currently limits the hydraulic capacity of filter complex	
Filtration	Process Equipment	WC-FB1-B1-434-01	WC-FB1-B1-434-TRAIN #1	1979				8.3 MGD (AVERAGE)	3	4	Major	Filter Media, Backwash Troughs, Underdrains and Surface Wash (in-basin) SEE TEXT SECTION 2.3.5	287123, 231279,
Filtration	Buildings & Grounds	WC-FB1-F-001-A	FILTER #1 CONCRETE STRUCTURE	1979				36 FEET BY 30 FEET IN PLAN	3	2	Minor	Filter box structure - concrete has eroded	
Filtration	Piping & Valves	WC-FB1-BFV-024-A	FILTER #1 EFFLUENT	1979	CENTERLINE			18-INCH	2	3	Moderate	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-024-G	BFV-024 GEARED ACTUATOR	1990	LIMITORQUE				3	3	Moderate	Actuator originally built for pneumatic	176724, 212908,
Filtration	Electrical	WC-FB1-BFV-024-EO	FILTER #1 EFFLUENT ELECTRIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	303410, 260118,
Filtration	Instruments & Controls	WC-FB1-BFV-024-I	FILTER #1 EFFLUENT VALVE INSTRUMENTATION	2009					3	4	Major	Replaced with new actuator by CI Actuation in 2009	303410, 184544, 197554, 208707,
Filtration	Piping & Valves	WC-FB1-BFV-027-A	FILTER #1 SURFACE WASH	1979	CENTERLINE			8-INCH	4	5	Extreme	Valve - NOT ACCESSIBLE - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-027-G	BFV-027 GEARED ACTUATOR	1990	LIMITORQUE				3	5	Extreme	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-027-I	FILTER #1 SURFACE WASH VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-027-M	FILTER #1 SURFACE WASH VALVE MOTOR	1990					2	5	Extreme	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-029-A	FILTER #1 Influent	1979	CENTERLINE			36-INCH	2	3	Moderate	Valve - NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB1-BFV-029-G	BFV-029 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-029-I	FILTER #1 Influent VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-029-M	FILTER #1 Influent VALVE MOTOR	1990					2	3	Moderate	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-030-A	FILTER #1 BACKWASH	1979	CENTERLINE			30-INCH	2	2	Minor	Valve	

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Piping & Valves	WC-FB1-BFV-030-G	BFV-030 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-030-I	FILTER #1 BACKWASH VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Moderate	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-030-M	FILTER #1 BACKWASH VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-033-A	FILTER #1 BACKWASH DRAIN	1979	CENTERLINE			36-INCH	2	2	Minor	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-033-G	BFV-033 GEARED ACTUATOR	1990	LIMITORQUE				2	2	Minor	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-033-I	FILTER #1 DRAIN VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Moderate	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-033-M	FILTER #1 DRAIN VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Instruments & Controls	WC-FB1-FIT-001-I	#1 FILTER FLOW INDICATING TRANSMITTER		ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major	Cannot keep these units calibrated	185701, 201551, 209323,
Filtration	Instruments & Controls	WC-FB1-LIT-001-I	#1 FILTER LEVEL INDICATING TRANSMITTER		DREXEL BROOK	SERIES 408-6200			3	4	Major	Cannot keep these units calibrated	
Filtration	Instruments & Controls	WC-FB1-PDIT-001-I	FILTER #1 HEAD LOSS INDICATING TRANSMITTER		ROSEMOUNT				3	4	Major	Cannot keep these units calibrated	
Filtration	Process Equipment	WC-FB1-B1-434-02	WC-FB1-B1-434-TRAIN #2	1979				8.3 MGD (AVERAGE)	3	4	Major	Filter Media, Backwash Troughs, Underdrains and Surface Wash (in-basin) SEE TEXT SECTION 2.3.5	
Filtration	Buildings & Grounds	WC-FB1-F-002-A	FILTER #2 CONCRETE STRUCTURE	1979				36 FEET BY 30 FEET IN PLAN	3	2	Minor	Filter box structure - concrete has eroded	
Filtration	Piping & Valves	WC-FB1-BFV-025-A	FILTER #2 EFFLUENT	1979	CENTERLINE			18-INCH	2	3	Moderate	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-025-G	BFV-025 GEARED ACTUATOR	1990	LIMITORQUE				3	3	Moderate	Actuator originally built for pneumatic - oil filled case now packed with grease	199794, 327580,
Filtration	Electrical	WC-FB1-BFV-025-EO	FILTER #2 EFFLUENT ELECTRIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	303410, 316571,
Filtration	Instruments & Controls	WC-FB1-BFV-025-I	FILTER #2 EFFLUENT VALVE INSTRUMENTATION	2009					3	4	Major	Replaced with new actuator by CI Actuation in 2009	303410,
Filtration	Piping & Valves	WC-FB1-BFV-028-A	FILTER #2 SURFACE WASH	1979	CENTERLINE			8-INCH	4	5	Extreme	Valve - NOT ACCESSIBLE - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-027-G	BFV-027 GEARED ACTUATOR	1990	LIMITORQUE				3	5	Extreme	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-028-I	FILTER #2 SURFACE WASH VALVE INSTRUMENTATION	1990	LIMITORQUE				2	5	Extreme	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-028-M	FILTER #2 SURFACE WASH VALVE MOTOR	1990					2	5	Extreme	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-031-A	FILTER #2 Influent	1979	CENTERLINE			36-INCH	2	3	Moderate	Valve - NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB1-BFV-031-G	BFV-031 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-031-I	FILTER #2 Influent VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-031-M	FILTER #2 INFLUENT VALVE MOTOR	1990					2	3	Moderate	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-032-A	FILTER #2 BACKWASH	1979	CENTERLINE			30-INCH	2	2	Minor	Valve	306207,
Filtration	Piping & Valves	WC-FB1-BFV-032-G	BFV-032 GEARED ACTUATOR	1990	LIMITORQUE				2	2	Minor	Actuator originally built for pneumatic - oil filled case now packed with grease	

FILTER BUILDING 1

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB1-BFV-032-I	FILTER #2 BACKWASH VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-032-M	FILTER #2 BACKWASH VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-034-A	FILTER #2 BACKWASH DRAIN	1979	CENTERLINE			36-INCH	2	2	Minor	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-034-G	BFV-034 GEARED ACTUATOR	1990	LIMITORQUE				2	2	Minor	Actuator originally built for pneumatic - oil filled case now packed with grease	
Filtration	Instruments & Controls	WC-FB1-BFV-034-I	FILTER #2 DRAIN VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-034-M	FILTER #2 DRAIN VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Instruments & Controls	WC-FB1-FIT-002-I	#2 FILTER FLOW INDICATING TRANSMITTER		ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major	Cannot keep these units calibrated	195297, 201552, 279785,
Filtration	Instruments & Controls	WC-FB1-LIT-002-I	#2 FILTER LEVEL INDICATING TRANSMITTER		DREXEL BROOK	SERIES 408-6200			3	4	Major	Cannot keep these units calibrated	
Filtration	Instruments & Controls	WC-FB1-PDIT-002-I	FILTER #2 HEAD LOSS INDICATING TRANSMITTER		ROSEMOUNT				3	4	Major	Cannot keep these units calibrated	
Filtration	Process Equipment	WC-FB1-B1-434-03	WC-FB1-B1-434-TRAIN #3	1979				8.3 MGD (AVERAGE)	3	4	Major	Filter Media, Backwash Troughs, Underdrains and Surface Wash (in-basin) SEE TEXT SECTION 2.3.5	
Filtration	Buildings & Grounds	WC-FB1-F-003-A	FILTER #3 CONCRETE STRUCTURE	1979				36 FEET BY 30 FEET IN PLAN	3	2	Minor	Filter box structure - concrete has eroded	
Filtration	Piping & Valves	WC-FB1-BFV-035-A	FILTER #3 EFFLUENT	1979	CENTERLINE			18-INCH	2	3	Moderate	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-035-G	BFV-035 GEARED ACTUATOR	1990	LIMITORQUE				3	3	Moderate		
Filtration	Electrical	WC-FB1-BFV-035-EO	FILTER #3 EFFLUENT VALVE ELECTRIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	303410,
Filtration	Instruments & Controls	WC-FB1-BFV-035-I	FILTER #3 EFFLUENT VALVE INSTRUMENTATION	2009					3	4	Major	Replaced with new actuator by CI Actuation in 2009	303410,
Filtration	Piping & Valves	WC-FB1-BFV-037-A	FILTER #3 SURFACE WASH	1979	CENTERLINE			8-INCH	4	5	Extreme	Valve - NOT ACCESSIBLE - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-037-G	BFV-037 GEARED ACTUATOR	1990	LIMITORQUE				3	5	Extreme	Actuator originally built for pneumatic - oil filled case now packed with grease	
Filtration	Instruments & Controls	WC-FB1-BFV-037-I	FILTER #3 SURFACE WASH VALVE INSTRUMENTATION	1990	LIMITORQUE				2	5	Extreme	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-037-M	FILTER #3 SURFACE WASH VALVE MOTOR	1990					2	5	Extreme	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-039-A	FILTER #3 Influent	1979	CENTERLINE			36-INCH	2	3	Moderate	Valve - NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB1-BFV-039-G	BFV-039 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-039-I	FILTER #3 Influent VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-039-M	FILTER #3 INFLUENT VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-040-A	FILTER #3 BACKWASH	1979	CENTERLINE			30-INCH	2	2	Minor	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-040-G	BFV-040 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-040-I	FILTER #3 BACKWASH VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Electrical	WC-FB1-BFV-040-M	FILTER #3 BACKWASH VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-043-A	FILTER #3 BACKWASH DRAIN	1979	CENTERLINE			36-INCH	2	2	Minor	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-043-G	BFV-043 GEARED ACTUATOR	1990	LIMITORQUE				2	2	Minor	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-043-I	FILTER #3 DRAIN VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-043-M	FILTER #3 DRAIN VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Instruments & Controls	WC-FB1-FIT-003-I	#3 FILTER FLOW INDICATING TRANSMITTER		ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major	Cannot keep these units calibrated	
Filtration	Instruments & Controls	WC-FB1-LIT-003-I	#3 FILTER LEVEL INDICATING TRANSMITTER		DREXEL BROOK	SERIES 408-6200			3	4	Major	Cannot keep these units calibrated	
Filtration	Instruments & Controls	WC-FB1-PDIT-003-I	FILTER #2 HEAD LOSS INDICATING TRANSMITTER		ROSEMOUNT				3	4	Major	Cannot keep these units calibrated	
Filtration	Process Equipment	WC-FB1-B1-434-04	WC-FB1-B1-434-TRAIN #4	1979				8.3 MGD (AVERAGE)	3	4	Major	Filter Media, Backwash Troughs, Underdrains and Surface Wash (in-basin) SEE TEXT SECTION 2.3.5	
Filtration	Buildings & Grounds	WC-FB1-F-004-A	FILTER #4 CONCRETE STRUCTURE	1979				36 FEET BY 30 FEET IN PLAN	3	2	Minor	Filter box structure - concrete has eroded	
Filtration	Piping & Valves	WC-FB1-BFV-036-A	FILTER #4 EFFLUENT		CENTERLINE			18-INCH	2	1	Insignificant	?? Entire valve replaced	
Filtration	Piping & Valves	WC-FB1-BFV-036-G	BFV-036 GEARED ACTUATOR						2	1	Insignificant	?? Entire valve replaced	
Filtration	Electrical	WC-FB1-BFV-036-EO	FILTER #4 EFFLUENT VALVE ELECTRIC OPERATOR						2	1	Insignificant	?? Entire valve replaced	
Filtration	Instruments & Controls	WC-FB1-BFV-036-I	FILTER #4 EFFLUENT VALVE INSTRUMENTATION						3	4	Major	?? Entire valve replaced	
Filtration	Piping & Valves	WC-FB1-BFV-038-A	FILTER #4 SURFACE WASH	1979	CENTERLINE			8-INCH	4	5	Extreme	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-037-G	BFV-037 GEARED ACTUATOR	1990	LIMITORQUE				3	5	Extreme	Actuator originally built for pneumatic - oil filled case now packed with grease	Is this for filter 4 - 03
Filtration	Instruments & Controls	WC-FB1-BFV-038-I	FILTER #4 SURFACE WASH VALVE INSTRUMENTATION	1990	LIMITORQUE				2	5	Extreme	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-038-M	FILTER #4 SURFACE WASH VALVE MOTOR	1990					2	5	Extreme	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-041-A	FILTER #4 Influent	1979	CENTERLINE			36-INCH	2	3	Moderate	Valve - NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB1-BFV-041-G	BFV-041 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-041-I	FILTER #4 Influent VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-041-M	FILTER #4 INFLUENT VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-042-A	FILTER #4 BACKWASH	1979	CENTERLINE			30-INCH	2	2	Minor	Valve	
Filtration	Piping & Valves	WC-FB1-BFV-042-G	BFV-042 GEARED ACTUATOR	1990	LIMITORQUE				2	3	Moderate	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-042-I	FILTER #4 BACKWASH VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-042-M	FILTER #4 BACKWASH VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Piping & Valves	WC-FB1-BFV-044-A	FILTER #4 BACKWASH DRAIN	1979	CENTERLINE			36-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB1-BFV-044-G	BFV-044 GEARED ACTUATOR	1990	LIMITORQUE				2	2	Minor	Actuator originally built for pneumatic	
Filtration	Instruments & Controls	WC-FB1-BFV-044-I	FILTER #4 DRAIN VALVE INSTRUMENTATION	1990	LIMITORQUE				3	4	Major	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BFV-044-M	FILTER #4 DRAIN VALVE MOTOR	1990					2	2	Minor	Original replaced in Contract 6	
Filtration	Instruments & Controls	WC-FB1-FIT-004-I	#4 FILTER FLOW INDICATING TRANSMITTER		ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major	Cannot keep these units calibrated	
Filtration	Instruments & Controls	WC-FB1-LIT-004-I	#4 FILTER LEVEL INDICATING TRANSMITTER		DREXEL BROOK	SERIES 408-6200			3	4	Major	Cannot keep these units calibrated	
Filtration	Instruments & Controls	WC-FB1-PDIT-004-I	FILTER #4 HEAD LOSS INDICATING TRANSMITTER		ROSEMOUNT				3	4	Major	Cannot keep these units calibrated	
Filtration	Piping & Valves	WC-FB1-BFV-008-A	BACKWASH PUMP #2 SUCTION	1979	CENTERLINE			36-INCH	3	4	Major	Valve not operable- SEE TEXT SECTION 3.2.5	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-008-G	BFV-008 CHAIN ACTUATOR	1979					3	4	Major	Actuator - VISIBLE LEAK	
Filtration	Piping & Valves	WC-FB1-BFV-011-A	BACKWASH PUMP #2 DISCHARGE	1979	CENTERLINE			30-INCH	2	4	Major	Valve not operable - ACCESS LIMITED - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-011-G	BFV-011 CHAIN ACTUATOR	1979					3	4	Major	Actuator	
Filtration	Piping & Valves	WC-FB1-BFV-017-A	BACKWASH PUMP #1 SUCTION	1979	CENTERLINE			36-INCH	3	4	Major	Valve not operable - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-017-G	BFV-017 CHAIN ACTUATOR	1979					3	4	Major	Actuator	
Filtration	Piping & Valves	WC-FB1-BFV-022-A	BACKWASH PUMP #1 DISCHARGE	1979	CENTERLINE			30-INCH	2	4	Major	Valve not operable - ACCESS LIMITED - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-022-G	BFV-022 CHAIN ACTUATOR	1979					3	4	Major	Actuator	
Filtration	Piping & Valves	WC-FB1-BFV-026-A	FILTER BACKWASH RATE CONTROL VALVE	1990	AC VALVE INC.			24-INCH	4	4	Extreme	Valve - Original replaced in Contract 6 - LEAKAGE FROM SHAFT IS CAPTURED IN BAG AND ROUTED TO	
Filtration	Piping & Valves	WC-FB1-BFV-026-G	BFV-026 GEARED ACTUATOR	1990					4	4	Extreme	Actuator - Original replaced in Contract 6	
Filtration	Instruments & Controls	WC-FB1-BFV-026-I	MAIN BACKWASH VALVE INSTRUMENTATION	2005					3	4	Major	Original replaced in Contract 6 - ACTUATOR REPLACED IN 2005	224861, 233640, 234211, 268281, 296455, 199842, 208489, 225010, OTHERS
Filtration	Electrical	WC-FB1-BFV-026-M	MAIN BACKWASH VALVE MOTOR	2005					3	4	Major	Original replaced in Contract 6 - ACTUATOR REPLACED IN 2005	222623, 241158
Filtration	Piping & Valves	WC-FB1-BFV-046-A	BACKWASH TO FILTER BUILDING #2	1990	PRATT			30-INCH	2	2	Minor	Installed as part of Contract 6	
Filtration	Piping & Valves	WC-FB1-BFV-046-G	BFV-046 CHAIN WHEEL ACTUATOR	1990					2	2	Minor	Installed as part of Contract 6	
Filtration	Pumps	WC-FB1-BWP-001-A	BACKWASH PUMP #1	1979	PATTERSON PUMP CO.	85BT 9349-F24		30 MGD	3	4	Major	CONCRETE BASE IS VERY POOR - CAPACITY IS NOT UP TO ORIGINAL RATING SEE TEXT SECTION 3.2.5	
Filtration	Instruments & Controls	WC-FB1-BWP-001-I	BACKWASH PUMP #1 INSTRUMENTATION	1990					4	4	Extreme	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BWP-001-M	BACKWASH PUMP #1 MOTOR	1990	GENERAL ELECTRIC	5KP30952A501	8428587		3	4	Major	Original replaced in Contract 6 - MOTOR MAKING NOISES	

FILTER BUILDING 1

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Pumps	WC-FB1-BWP-002-A	BACKWASH PUMP #2	1979	PATTERSON PUMP CO.	85BT 9349-F24		30 MGD	3	4	Major	NOT CERTAIN THIS UNIT IS FUNCTIONAL - DID NOT WITNESS RUN - SEE TEXT SECTION 3.2.5	326889,
Filtration	Instruments & Controls	WC-FB1-BWP-002-I	BACKWASH PUMP #2 INSTRUMENTATION	1990					4	4	Extreme	Original replaced in Contract 6	
Filtration	Electrical	WC-FB1-BWP-002-M	BACKWASH PUMP #2 MOTOR	1990	GENERAL ELECTRIC	5KP30952A501	8428586		3	4	Major	Original replaced in Contract 6 - MOTOR MAKING NOISES	
Filtration	Piping & Valves	WC-FB1-CV-004-A	VACUUM PUMP #2 CHECK VALVE	1990	POKORNEY MFG. CO.				2	4	Major	SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-CV-005-A	VACUUM PUMP #1 CHECK VALVE	1990	POKORNEY MFG. CO.				2	4	Major	SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-GV-002-A	VACUUM PUMP #2 SUCTION	1990	JENKINS				2	4	Major	SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-GV-003-A	VACUUM PUMP #1 SUCTION	1990	JENKINS				2	4	Major	SEE TEXT SECTION 3.2.5	
Filtration	Pumps	WC-FB1-VP-001-A	VACUUM PUMP #1	1998	NASH ENGINEERING CO.	SC-2/7			2	2	Minor	SEE TEXT SECTION 3.2.5	279840,
Filtration	Electrical	WC-FB1-VP-001-M	VACUUM PUMP #1 MOTOR	1998	RELIANCE		I.D.#1YAB43200 A1NN		2	2	Minor	SEE TEXT SECTION 3.2.5	
Filtration	Pumps	WC-FB1-VP-002-A	VACUUM PUMP #2	1998	NASH ENGINEERING CO.	SC-2 / 7			2	2	Minor	SEE TEXT SECTION 3.2.5	279840,
Filtration	Electrical	WC-FB1-VP-002-M	VACUUM PUMP #2 MOTOR	1998	RELIANCE		I.D.#1YAB43200 A2NN		2	2	Minor	SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-TNK-001-A	VACUUM RECEIVER TANK	1990					2	4	Major	PRONE TO PLUGGING AND DO NOT PRIME WELL - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves		VACUUM PRIMING BULB #1 FOR BACKWASH PUMP #1	1990					2	4	Major	PRONE TO PLUGGING AND DO NOT PRIME WELL - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves		VACUUM PRIMING BULB #2 FOR BACKWASH PUMP #1	1990					2	4	Major	PRONE TO PLUGGING AND DO NOT PRIME WELL - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves		VACUUM PRIMING BULB #1 FOR BACKWASH PUMP #2	1990					2	4	Major	PRONE TO PLUGGING AND DO NOT PRIME WELL - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves		VACUUM PRIMING BULB #2 FOR BACKWASH PUMP #2	1990					2	4	Major	PRONE TO PLUGGING AND DO NOT PRIME WELL - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-PIPE-003-A	FILTER BACKWASH PUMP SUCTION	1990					2	4	Major	Piping, fittings and pipe supports - BURIED ABOVE THE FILTERED EFFLUENT CONDUIT - SEE TEXT SECTION 2.5.3	
Filtration	Piping & Valves	WC-FB1-PIPE-004-A	FILTER BACKWASH PUMP DISCHARGE	1979					2	1	Insignificant	Piping, fittings and pipe supports - PIPING IS APPROPRIATELY SIZED AND ACCESSIBLE	181709,
Filtration	Piping & Valves	WC-FB1-PIPE-005-A	FILTER BACKWASH DRAIN	1979					3	1	Insignificant	Piping, fittings and pipe supports - PIPING IS APPROPRIATELY SIZED AND ACCESSIBLE - HARNESS EMBEDMENTS ARE BADLY RUSTED	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-001-A	NPW PRESSURE REGULATOR OUTLET	1979	CENTERLINE			6-INCH	2	4	Major	Valve - CURRENTLY USED TO MANUALLY THROTTLE FLOW RECYCLED TO WETWELL - SEE TEXT SECTION	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-001-G	BFV-001 HAND WHEEL ACTUATOR	1979					2	4	Major	Actuator - CURRENTLY USED TO MANUALLY THROTTLE FLOW RECYCLED TO WETWELL	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-002-A	NPW FROM FILTER Influent	1979	CENTERLINE			12-INCH	2	5	Extreme	Valve - PERFORMANCE RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-002-G	BFV-002 CHAIN WHEEL ACTUATOR	1979					2	5	Extreme	Actuator - PERFORMANCE RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-003-A	AUTO STRAINER INLET	1979	CENTERLINE			6-INCH	2	5	Extreme	Valve - PERFORMANCE RATING BASED ON STRAINER NOT FUNCTIONING	

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Effluent Pumping	Piping & Valves	WC-FB1-BFV-003-G	BFV-003 HAND WHEEL ACTUATOR	1979					2	5	Extreme	Actuator - PERFORMANCE RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-004-A	AUTO STRAINER OUTLET	1979	CENTERLINE			6-INCH	2	5	Extreme	Valve - PERFORMANCE RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-004-G	BFV-004 HAND WHEEL ACTUATOR	1979					2	5	Extreme	Actuator - PERFORMANCE RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-006-A	NPW SUPPLY TO PLANT	1979	CENTERLINE			16-INCH	2	2	Minor	Valve	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-006-G	BFV-006 CHAIN ACTUATOR	1979					2	2	Minor	Actuator	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-007-A	NPW PRESSURE REGULATOR INLET	1979	CENTERLINE			4-INCH	2	4	Major	Valve - PERFORMANCE RATING BASED ON PRESSURE REGULATOR NOT WORKING - SEE TEXT SECTION 3.2.5	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-007-G	BFV-007 HAND WHEEL ACTUATOR	1979					2	4	Major	Actuator - PERFORMANCE RATING BASED ON PRESSURE REGULATOR NOT WORKING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-009-A	NP-003 SUCTION FROM CLEARWELL	1990	KEYSTONE			12-INCH	2	5	Extreme	Valve - INSTALLED UNDER CONTRACT 2 - CONDITION RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-009-G	BFV-009 HAND WHEEL ACTUATOR	1990					2	5	Extreme	Actuator - INSTALLED UNDER CONTRACT 2 - CONDITION RATING BASED ON STRAINER NOT FUNCTIONING	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-010-A	NP-003 SUCTION FROM FILTER Influent	1990	KEYSTONE			12-INCH	2	2	Minor	Valve - INSTALLED UNDER CONTRACT 2	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-010-G	BFV-010 HAND WHEEL ACTUATOR	1990					2	2	Minor	Actuator - INSTALLED UNDER CONTRACT 2	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-012-A	NON-POTABLE PUMP #3 DISCHARGE	1979	CENTERLINE			10-INCH	2	2	Minor	Valve	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-012-G	BFV-012 CHAIN ACTUATOR	1979					2	2	Minor	Actuator	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-013-A	NPW PUMP DISCHARGE CROSSOVER (SOUTH)	1979	CENTERLINE			12-INCH	2	2	Minor	Valve	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-013-G	BFV-013 CHAIN ACTUATOR	1979					2	2	Minor	Actuator	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-014-A	NP-002 SUCTION FROM CLEARWELL	1979	CENTERLINE			12-INCH	2	2	Minor	Valve	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-014-G	BFV-014 HAND WHEEL ACTUATOR	1979					2	2	Minor	Actuator	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-015-A	NP-002 SUCTION FROM FILTER Influent	1979	CENTERLINE			12-INCH	2	2	Minor	Valve	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-015-G	BFV-015 HAND WHEEL ACTUATOR	1979					2	2	Minor	Actuator	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-016-A	NON-POTABLE PUMP #2 DISCHARGE	1979	CENTERLINE			10-INCH	2	2	Minor	Valve	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-016-G	BFV-016 HAND WHEEL ACTUATOR	1979					2	2		Actuator	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-018-A	NPW PUMP DISCHARGE CROSSOVER (NORTH)	1990	CENTERLINE			8-INCH	2	2	Minor	Valve - INSTALLED IN CONTRACT 2? (KEYSTONE?)	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-018-G	BFV-018 CHAIN ACTUATOR	1990					2	2	Minor	Actuator	
Filtration	Piping & Valves	WC-FB1-CV-001-A	NON-POTABLE PUMP #3 CHECK VALVE	1979	CENTERLINE			10-INCH	2	2	Minor		

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Piping & Valves	WC-FB1-CV-002-A	NON-POTABLE PUMP #2 CHECK VALVE	1979	CENTERLINE			10-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB1-CV-003-A	NON-POTABLE PUMP #1 CHECK VALVE	1990	ADV			8-INCH	2	2	Minor	Contract 6	
Filtration	Piping & Valves	WC-FB1-GV-001-A	NPW TO FILTER COMPLEX	1979	STOCKHAM				2	2	Minor		
Effluent Pumping	Pumps	WC-FB1-NP-001-A	NON-POTABLE WATER PUMP #1	1979	PATTERSON PUMP CO.				4	5	Extreme	WAS ORIGINALLY INSTALLED AS NPW-3, THEN MOVED TO SURFACE WASH DUTY. PUMP REALLY ROUGH - SEE TEXT SECTION 2.3.5- PROCESS SHOULD BE "FILTRATION"	
Effluent Pumping	Instruments & Controls	WC-FB1-NP-001-I	NPW PUMP #1 INSTRUMENTATION	1979					4	5	Extreme	ALL "INSTRUMENTATION" IN MCC	
Effluent Pumping	Electrical	WC-FB1-NP-001-M	NON-POTABLE WATER PUMP #1 MOTOR	1979	U.S. MOTORS		C602969-715 86-19051		3	5	Extreme		
Effluent Pumping	Pumps	WC-FB1-NP-002-A	NON-POTABLE WATER PUMP #2	1979	PATTERSON PUMP CO.	6 X 5 M	74PT-781-A5		2	4	Major	PATTERSON PUMP INDICATES THAT A NEW ROTATING ASSEMBLY FOR THIS PUMP WAS SHIPPED IN 1998 - SEE TEXT SECTION 2.3.5	
Effluent Pumping	Instruments & Controls	WC-FB1-NP-002-I	NPW PUMP #2 INSTRUMENTATION	1979					3	4	Major	ALL "INSTRUMENTATION" IN MCC - SEE TEXT SECTION 2.3.5	
Effluent Pumping	Electrical	WC-FB1-NP-002-M	NON-POTABLE WATER PUMP #2 MOTOR	1979	SIEMENS	123	1-5122-335511-1-1		2	4	Major	SEE TEXT SECTION 2.3.5	
Effluent Pumping	Pumps	WC-FB1-NP-003-A	NON-POTABLE WATER PUMP #3	1979	PATTERSON PUMP CO.	6 X 5 M	74PT-782-A5		2	4	Major	RAN FOR ONLY A SHORT PERIOD OF TIME. THIS UNIT WILL NOT DELIVER THE SAME PRESSURE AS NPW-2 AND IS NOT BACKED UP WITH STANDBY POWER.	215487,
Effluent Pumping	Instruments & Controls	WC-FB1-NP-003-I	NPW PUMP #3 INSTRUMENTATION	1979					3	4	Major	ALL "INSTRUMENTATION" IN MCC	
Effluent Pumping	Electrical	WC-FB1-NP-003-M	NON-POTABLE WATER PUMP #3 MOTOR	1979	GENERAL ELECTRIC	5KS405AL272	SA 193014		2	4	Major		
Effluent Pumping	Piping & Valves	WC-FB1-PRS-001-A	CLAY VALVE NPW PRESSURE REGULATOR	1979	CLA-VAL CO.	CAT.# 6-50-018	STOCK# 50-01-80G		3	5	Extreme	NOT FUNCTIONAL	196777, 183779,
Effluent Pumping	Piping & Valves	WC-FB1-PRS-002-A	NPW PRESS. REG. STATION TO HOSE BIBS	1979	WATTS REGULATOR CO.	5M2						DID NOT FIND THIS DEVICE	
Effluent Pumping	Process Equipment	WC-FB1-STR-001-A	AUTOMATIC STRAINER	1979	ZURN INDUSTRIES INC.	PROD.#595 REF#595-6-71068	4078 STRAIN-O-MATIC		3	5	Extreme	NOT FUNCTIONAL	
Effluent Pumping	Process Equipment	WC-FB1-STR-001-G	AUTOMATIC STRAINER GEAR REDUCER	1979					3	5	Extreme	NOT FUNCTIONAL	
Effluent Pumping	Electrical	WC-FB1-STR-001-M	AUTOMATIC STRAINER MOTOR	1979					3	5	Extreme	NOT FUNCTIONAL	
Filtration	Piping & Valves	WC-FB1-PIPE-006-A	SURFACE WASH	1979					3	5	Extreme	NOT FUNCTIONAL - PIPING HAS BEEN PATCHED MANY TIMES AND IS VERY INACCESSIBLE	
Effluent Pumping	Piping & Valves	WC-FB1-PIPE-007-A	NON-POTABLE WATER	1979					3	4	Major	Piping, fittings and pipe supports - ADEQUATELY SIZED BUT THE SMALL DIAMETER PIPING HAS HAD NUMEROUS LEAKS REPORTED - SEE TEXT SECTION 3.2.5	287145, 285230, 284046, 283594, 267310, 176851
Effluent Pumping	Piping & Valves	WC-FB1-BFV-019-A	NP-001 SUCTION FROM CLEARWELL	1979	CENTERLINE			8-INCH	2	5	Extreme	Valve - should be Filtration Process (Surface Wash Pump) PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	

FILTER BUILDING 1

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Effluent Pumping	Piping & Valves	WC-FB1-BFV-019-G	BFV-019 HAND WHEEL ACTUATOR	1979					2	5	Extreme	Actuator - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-020-A	NP-001 SUCTION FROM FILTER Influent	1979	CENTERLINE			8-INCH	2	5	Extreme	Valve - should be Filtration Process (Surface Wash Pump) - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-020-G	BFV-020 HAND WHEEL ACTUATOR	1979					2	5	Extreme	Actuator - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-021-A	SURFACE WASH VALVE	1990	KEYSTONE			8-INCH	2	5	Extreme	Valve - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Filtration	Piping & Valves	WC-FB1-BFV-021-G	BFV-021 HAND WHEEL ACTUATOR	1990					2	5	Extreme	Actuator - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-023-A	NON-POTABLE PUMP #1 DISCHARGE	1990	KEYSTONE			8-INCH	2	5	Extreme	Valve - should be Filtration Process (Surface Wash Pump) - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Effluent Pumping	Piping & Valves	WC-FB1-BFV-023-G	BFV-023 CHAIN ACTUATOR	1990					2	5	Extreme	Actuator - PROCESS RATING BASED ON SURFACE WASH SYSTEM - SEE TEXT SECTION 3.2.5	
Disinfection	Piping & Valves	WC-FB1-BV-001-A	CL2 SOLUTION TO FILTER #1	1979	CABOT			3-INCH	2	3	Moderate	All Chlorine Valves leak	
Disinfection	Piping & Valves	WC-FB1-BV-002-A	CL2 SOLUTION TO FILTER #2	1979	CABOT			3-INCH	2	3	Moderate	All Chlorine Valves leak	
Disinfection	Piping & Valves	WC-FB1-BV-003-A	CL2 SOLUTION TO FILTER #1 Influent	1979	CABOT			3-INCH	2	3	Moderate	NOT ACCESSIBLE	
Disinfection	Piping & Valves	WC-FB1-BV-004-A	CL2 SOLUTION TO FILTER #2 Influent	1979	CABOT			3-INCH	2	3	Moderate	NOT ACCESSIBLE	
Disinfection	Piping & Valves	WC-FB1-BV-006-A	CL2 SOLUTION TO FILTER #3	1979	CABOT			3-INCH	2	3	Moderate	All Chlorine Valves leak	
Disinfection	Piping & Valves	WC-FB1-BV-007-A	CL2 SOLUTION TO FILTER #4	1979	CABOT			3-INCH	2	3	Moderate	All Chlorine Valves leak	
Disinfection	Piping & Valves	WC-FB1-BV-008-A	CL2 SOLUTION TO FILTER #3 Influent	1979	CABOT			3-INCH	2	3	Moderate	NOT ACCESSIBLE	
Disinfection	Piping & Valves	WC-FB1-BV-009-A	CL2 SOLUTION TO FILTER #4 Influent	1979	CABOT			3-INCH	2	3	Moderate	NOT ACCESSIBLE	
Disinfection	Piping & Valves	WC-FB1-PIPE-008-A	CHLORINE SOLUTION	1979					2	3	Moderate	Piping, fittings and pipe supports - SOME OF THIS PIPING HAS BEEN REPLACED. THE WRI PROJECT MODIFIED THE FEED LINES AND THE CITY HAS SUBSEQUENTLY MODIFIED THIS FURTHER. FUNCTIONALITY NOT CLEAR.	
Filtration	Piping & Valves	WC-FB1-BV-005-A	SUMP PUMP #1 AND #2 DISCHARGE STOP	1979	JAMESBURY					1		NOT EVALUATED FOR CONDITION	
Filtration	Piping & Valves	WC-FB1-CV-006-A	SUMP PUMP #1 CHECK VALVE	1979	STOCKHAM					1		NOT EVALUATED FOR CONDITION	
Filtration	Piping & Valves	WC-FB1-CV-007-A	SUMP PUMP #2 CHECK VALVE	1979	STOCKHAM					1		NOT EVALUATED FOR CONDITION	
Filtration	Pumps	WC-FB1-SP-001-A	SUMP PUMP#1 (NORTH SIDE)	1979	CRANE CO.	236MG-VS1				1		NOT EVALUATED FOR CONDITION - ONE PUMP IS NEW	
Filtration	Electrical	WC-FB1-SP-001-M	SUMP PUMP#1 MOTOR	1979	U.S. MOTORS		I.D.#66-070530838			1		NOT EVALUATED FOR CONDITION - ONE PUMP IS NEW	

FILTER BUILDING 1

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Pumps	WC-FB1-SP-002-A	SUMP PUMP#2 (SOUTH SIDE)	1979	CRANE CO.	236MG-VS1				1		NOT EVALUATED FOR CONDITION - ONE PUMP IS NEW	281729,
Filtration	Electrical	WC-FB1-SP-002-M	SUMP PUMP#2 MOTOR	1979	U.S. MOTORS		I.D.#66-07053-838			1		NOT EVALUATED FOR CONDITION - ONE PUMP IS NEW	
Filtration	Process Equipment	WC-FB1-AC-001-A	AIR COMPRESSOR	??	CRAFTSMAN				3	4	Major	SITTING ON THE FILTER GALLERY FLOOR NEXT TO THE BACKWASH VALVE CONTROL PANEL	178962, 191228, 283232,
Effluent Pumping	Electrical		STANDBY GENERATOR	1990								INFORMATION NOT AVAILABLE	
Dechlorination	Process Equipment		SODIUM BISULFITE METERING PUMP									INFORMATION NOT AVAILABLE	
Dechlorination	Process Structure	WC-FB1-ST-001-A	SODIUM BISULFITE TANK (FB1-GROUND LEVEL)									INFORMATION NOT AVAILABLE	

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Buildings & Grounds	WC-FB2	FILTER BUILDING #2	1990					2	2	Minor	SUPERSTRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-084-A	FILTER Influent STOP (WEST)	1990	PRATT			54-INCH	3	2	Minor	POOR ACCESS - PAINT PEELING	
Filtration	Piping & Valves	WC-FB2-BFV-084-G	BFV 084 CHAIN ACTUATOR	1990					3	3	Moderate	Chain Derails	
Filtration	Process Equipment	WC-FB2-1-458-05	WC-FB2-1-458-TRAIN #5	1990				8.3 MGD (AVERAGE)	2	2	Minor	FILTER MEDIA, BACKWASH TROUGHS AND UNDERDRAIN. MEDIA DEPTH = 1.5 FEET	
Filtration	Buildings & Grounds	WC-FB2-F-005-A	FILTER #5 CONCRETE STRUCTURE	1990				TWO CELLS, EACH 17' BY 32'	2	1	Insignificant	FILTER BOX STRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-047-A	FILTER #5 EFFLUENT	1990	PRATT			20-INCH	3	4	Major	Valve	
Filtration	Piping & Valves	WC-FB2-BFV-047-G	BFV 047 GEARED ACTUATOR	1990					3	4	Major	Actuator oil filled case now packed with grease	
Filtration	Electrical	WC-FB2-BFV-047-EO	BFV 047 ELECTRONIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	
Filtration	Instruments & Controls	WC-FB2-BFV-047-I	FILTER #5 EFFLUENT VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-049-A	FILTER #5 BACKWASH	1990	PRATT			30-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-049-G	BFV 049 GEARED ACTUATOR	1990					3	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-049-EO	BFV 049 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-049-I	FILTER #5 BACKWASH VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-051-A	FILTER #5 Influent	1990	PRATT			36-INCH	2	3	Moderate	VALVE NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB2-BFV-051-G	BFV 051 GEARED ACTUATOR	1990					2	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-051-EO	BFV 051 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-051-I	FILTER #5 Influent VALVE INSTRUMENTATION	1990					3	4	Major		
Aeration	Piping & Valves	WC-FB2-BFV-053-A	LP AIR TO FILTER #5	1990	CENTERLINE				2	2	Minor		
Aeration	Piping & Valves	WC-FB2-BFV-055-A	LP AIR TO FILTER #5 AT MANIFOLD	1990	CENTERLINE				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-057-A	FILTER #5 BACKWASH DRAIN	1990	PRATT				2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-057-I	FILTER #5 DRAIN VALVE INSTRUMENTATION	1990					3	4	Major		
Disinfection	Piping & Valves	WC-FB2-BV-011-A	CL2 SOLUTION TO FILTER #5	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Disinfection	Piping & Valves	WC-FB2-BV-013-A	CL2 SOLUTION TO FILTER #5 Influent	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB2-FIT-005-I	#5 FILTER FLOW INDICATING TRANSMITTER	1990	ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-LIT-005-I	#5 FILTER LEVEL INDICATING TRANSMITTER	1990	DREXEL BROOK	SERIES 408-6200			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-PIT-005-I	#5 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990					3	4	Major		
Filtration	Process Equipment	WC-FB2-1-458-06	WC-FB2-1-458-TRAIN #6	1990				8.3 MGD (AVERAGE)	2	2	Minor	FILTER MEDIA, BACKWASH TROUGHS AND UNDERDRAIN. MEDIA DEPTH = 2.7 FEET	
Filtration	Buildings & Grounds	WC-FB2-F-006-A	FILTER #6 CONCRETE STRUCTURE	1990				TWO CELLS, EACH 17' BY 32'	2	1	Insignificant	FILTER BOX STRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-048-A	FILTER #6 EFFLUENT	1990	PRATT			20-INCH	3	4	Major	Valve	
Filtration	Piping & Valves	WC-FB2-BFV-048-G	BFV 048 GEARED ACTUATOR	1990					3	4	Major	Actuator oil filled case now packed with grease	
Filtration	Electrical	WC-FB2-BFV-048-EO	BFV 048 ELECTRONIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	
Filtration	Instruments & Controls	WC-FB2-BFV-048-I	FILTER #6 EFFLUENT VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-050-A	FILTER #6 BACKWASH	1990	PRATT			30-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-050-G	BFV 050 GEARED ACTUATOR	1990					3	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-050-EO	BFV 050 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-050-I	FILTER #6 BACKWASH VALVE INSTRUMENTATION	1990					2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-052-A	FILTER #6 Influent	1990	PRATT			36-INCH	2	3	Moderate	VALVE NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB2-BFV-052-G	BFV 052 GEARED ACTUATOR	1990					2	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-052-EO	BFV 052 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-052-I	FILTER #6 Influent VALVE INSTRUMENTATION	1990					3	4	Major		
Aeration	Piping & Valves	WC-FB2-BFV-054-A	LP AIR TO FILTER #6	1990	CENTERLINE				2	2	Minor		
Aeration	Piping & Valves	WC-FB2-BFV-056-A	LP AIR TO FILTER #6 AT MANIFOLD	1990	CENTERLINE				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-058-A	FILTER #6 BACKWASH DRAIN	1990	PRATT				2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-058-I	FILTER #6 DRAIN VALVE INSTRUMENTATION	1990					3	4	Major		
Disinfection	Piping & Valves	WC-FB2-BV-012-A	CL2 SOLUTION TO FILTER #6	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Disinfection	Piping & Valves	WC-FB2-BV-014-A	CL2 SOLUTION TO FILTER #6 Influent	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB2-FIT-006-I	#6 FILTER FLOW INDICATING TRANSMITTER	1990	ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-LIT-006-I	#6 FILTER LEVEL INDICATING TRANSMITTER	1990	DREXEL BROOK	SERIES 408-6200			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-PIT-006-I	#6 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990					3	4	Major		
Filtration	Process Equipment	WC-FB2-1-458-07	WC-FB2-1-458-TRAIN #7	1990				8.3 MGD (AVERAGE)	2	2	Minor	FILTER MEDIA, BACKWASH TROUGHS AND UNDERDRAIN. MEDIA DEPTH = 2.8 FEET	
Filtration	Buildings & Grounds	WC-FB2-F-007-A	FILTER #7 CONCRETE STRUCTURE	1990				TWO CELLS, EACH 17' BY 32'	2	1	Insignificant	FILTER BOX STRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-059-A	FILTER #7 EFFLUENT	1990	PRATT			20-INCH	3	4	Major	Valve	
Filtration	Piping & Valves	WC-FB2-BFV-059-G	BFV 059 GEARED ACTUATOR	1990					3	4	Major	Actuator oil filled case now packed with grease	
Filtration	Electrical	WC-FB2-BFV-059-EO	BFV 059 ELECTRONIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	
Filtration	Instruments & Controls	WC-FB2-BFV-059-I	FILTER #7 EFFLUENT VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-061-A	FILTER #7 BACKWASH	1990	PRATT			30-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-061-G	BFV 061 GEARED ACTUATOR	1990					3	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-061-EO	BFV 061 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-061-I	FILTER #7 BACKWASH VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-063-A	FILTER #7 Influent	1990	PRATT			36-INCH	2	3	Moderate	VALVE NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB2-BFV-063-G	BFV 063 GEARED ACTUATOR	1990					2	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-063-EO	BFV 063 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-063-I	FILTER #7 Influent VALVE INSTRUMENTATION	1990					3	4	Major		
Aeration	Piping & Valves	WC-FB2-BFV-065-A	LP AIR TO FILTER #7	1990	CENTERLINE				2	2	Minor		
Aeration	Piping & Valves	WC-FB2-BFV-067-A	LP AIR TO FILTER #7 AT MANIFOLD	1990	CENTERLINE				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-069-A	FILTER #7 BACKWASH DRAIN	1990	PRATT				2	2	Minor		
Disinfection	Piping & Valves	WC-FB2-BV-015-A	CL2 SOLUTION TO FILTER #7	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Disinfection	Piping & Valves	WC-FB2-BV-017-A	CL2 SOLUTION TO FILTER #7 Influent	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Filtration	Instruments & Controls	WC-FB2-FIT-007-I	#7 FILTER FLOW INDICATING TRANSMITTER	1990	ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major		

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB2-LIT-007-I	#7 FILTER LEVEL INDICATING TRANSMITTER	1990	DREXEL BROOK	SERIES 408-6200			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-PIT-007-I	#7 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990					3	4	Major		
Filtration	Instruments & Controls	WC-FB2-BFV-069-I	FILTER #7 DRAIN VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Process Equipment	WC-FB2-1-458-08	WC-FB2-1-458-TRAIN #8	1990				8.3 MGD (AVERAGE)	2	2	Minor	FILTER MEDIA, BACKWASH TROUGHS AND UNDERDRAIN. MEDIA DEPTH = 2.6 FEET	
Filtration	Buildings & Grounds	WC-FB2-F-008-A	FILTER #8 CONCRETE STRUCTURE	1990				TWO CELLS, EACH 17' BY 32'	2	1	Insignificant	FILTER BOX STRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-060-A	FILTER #8 EFFLUENT	1990	PRATT			20-INCH	3	4	Major	Valve	
Filtration	Piping & Valves	WC-FB2-BFV-060-G	BFV 060 GEARED ACTUATOR	1990					3	4	Major	Actuator oil filled case now packed with grease	
Filtration	Electrical	WC-FB2-BFV-060-EO	BFV 060 ELECTRONIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	
Filtration	Instruments & Controls	WC-FB2-BFV-060-I	FILTER #8 EFFLUENT VALVE INSTRUMENTATION	2009					3	4	Major	Replaced with new actuator by CI Actuation in 2009	
Filtration	Piping & Valves	WC-FB2-BFV-062-A	FILTER #8 BACKWASH	1990	PRATT			30-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-062-G	BFV 062 GEARED ACTUATOR	1990					3	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-062-EO	BFV 062 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-062-I	FILTER #8 BACKWASH VALVE INSTRUMENTATION	1990					2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-064-A	FILTER #8 Influent	1990	PRATT			36-INCH	2	3	Moderate	VALVE NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB2-BFV-064-G	BFV 064 GEARED ACTUATOR	1990					2	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-064-EO	BFV 064 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-064-I	FILTER #8 Influent VALVE INSTRUMENTATION	1990					3	4	Major		
Aeration	Piping & Valves	WC-FB2-BFV-066-A	LP AIR TO FILTER #8	1990	CENTERLINE				2	2	Minor		
Aeration	Piping & Valves	WC-FB2-BFV-068-A	LP AIR TO FILTER #8 AT MANIFOLD	1990	CENTERLINE				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-070-A	FILTER #8 BACKWASH DRAIN	1990	PRATT				2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-070-I	FILTER #8 DRAIN VALVE INSTRUMENTATION	1990					3	4	Major		
Disinfection	Piping & Valves	WC-FB2-BV-016-A	CL2 SOLUTION TO FILTER #8	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Disinfection	Piping & Valves	WC-FB2-BV-018-A	CL2 SOLUTION TO FILTER #8 Influent	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB2-FIT-008-I	#8 FILTER FLOW INDICATING TRANSMITTER	1990	ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-LIT-008-I	#8 FILTER LEVEL INDICATING TRANSMITTER	1990	DREXEL BROOK	SERIES 408-6200			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-PIT-008-I	#8 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990					3	4	Major		
Filtration	Process Equipment	WC-FB2-1-458-09	WC-FB2-1-458-TRAIN #9	1990				8.3 MGD (AVERAGE)	2	2	Minor	FILTER MEDIA, BACKWASH TROUGHS AND UNDERDRAIN. MEDIA DEPTH = 2.8 FEET	
Filtration	Buildings & Grounds	WC-FB2-F-009-A	FILTER #9 CONCRETE STRUCTURE	1990				TWO CELLS, EACH 17' BY 32'	2	1	Insignificant	FILTER BOX STRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-071-A	FILTER #9 EFFLUENT	1990	PRATT			20-INCH	3	4	Major	Valve	
Filtration	Piping & Valves	WC-FB2-BFV-071-G	BFV 071 GEARED ACTUATOR	1990					3	4	Major	Actuator oil filled case now packed with grease	
Filtration	Electrical	WC-FB2-BFV-071-EO	BFV 071 ELECTRONIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	
Filtration	Instruments & Controls	WC-FB2-BFV-071-I	FILTER #9 EFFLUENT VALVE INSTRUMENTATION	2009					3	4	Major	Replaced with new actuator by CI Actuation in 2009	
Filtration	Piping & Valves	WC-FB2-BFV-073-A	FILTER #9 BACKWASH	1990	PRATT			30-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-073-G	BFV 073 GEARED ACTUATOR	1990					3	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-073-EO	BFV 073 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-073-I	FILTER #9 BACKWASH VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-075-A	FILTER #9 Influent	1990	PRATT			36-INCH	2	3	Moderate	VALVE NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB2-BFV-075-G	BFV 075 GEARED ACTUATOR	1990					2	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-075-EO	BFV 075 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-075-I	FILTER #9 Influent VALVE INSTRUMENTATION	1990					3	4	Major		
Aeration	Piping & Valves	WC-FB2-BFV-077-A	LP AIR TO FILTER #9	1990	CENTERLINE				2	2	Minor		
Aeration	Piping & Valves	WC-FB2-BFV-079-A	LP AIR TO FILTER #9 AT MANIFOLD	1990	CENTERLINE				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-082-A	FILTER #9 BACKWASH DRAIN	1990	PRATT				2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-082-I	FILTER #9 DRAIN VALVE INSTRUMENTATION	1990					3	4	Major		
Disinfection	Piping & Valves	WC-FB2-BV-019-A	CL2 SOLUTION TO FILTER #9	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Disinfection	Piping & Valves	WC-FB2-BV-021-A	CL2 SOLUTION TO FILTER #9 Influent	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB2-FIT-009-I	#9 FILTER FLOW INDICATING TRANSMITTER	1990	ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-LIT-009-I	#9 FILTER LEVEL INDICATING TRANSMITTER	1990	DREXEL BROOK	SERIES 408-6200			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-PIT-009-I	#9 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990					3	4	Major		
Filtration	Process Equipment	WC-FB2-1-458-10	WC-FB2-1-458-TRAIN #10	1990				8.3 MGD (AVERAGE)	2	2	Minor	FILTER MEDIA, BACKWASH TROUGHS AND UNDERDRAIN. MEDIA DEPTH = 3.2 FEET	
Filtration	Buildings & Grounds	WC-FB2-F-010-A	FILTER #10 CONCRETE STRUCTURE	1990				TWO CELLS, EACH 17' BY 32'	2	1	Insignificant	FILTER BOX STRUCTURE	
Filtration	Piping & Valves	WC-FB2-BFV-072-A	FILTER #10 EFFLUENT	1990	PRATT			20-INCH	3	4	Major	Valve	
Filtration	Piping & Valves	WC-FB2-BFV-072-G	BFV 072 GEARED ACTUATOR	1990					3	4	Major	Actuator oil filled case now packed with grease	
Filtration	Electrical	WC-FB2-BFV-072-EO	BFV 072 ELECTRONIC OPERATOR	2009					2	2	Minor	Replaced with new actuator by CI Actuation in 2009	
Filtration	Instruments & Controls	WC-FB2-BFV-072-I	FILTER #10 EFFLUENT VALVE INSTRUMENTATION	2009					3	4	Major	Replaced with new actuator by CI Actuation in 2009	
Filtration	Piping & Valves	WC-FB2-BFV-074-A	FILTER #10 BACKWASH	1990	PRATT			30-INCH	2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-074-G	BFV 074 GEARED ACTUATOR	1990					3	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-074-EO	BFV 074 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-074-I	FILTER #10 BACKWASH VALVE INSTRUMENTATION	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-076-A	FILTER #10 Influent	1990	PRATT			36-INCH	2	3	Moderate	VALVE NOT ACCESSIBLE	
Filtration	Piping & Valves	WC-FB2-BFV-076-G	BFV 076 GEARED ACTUATOR	1990					2	3	Moderate		
Filtration	Electrical	WC-FB2-BFV-076-EO	BFV 076 ELECTRONIC OPERATOR	1990					2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-076-I	FILTER #10 Influent VALVE INSTRUMENTATION	1990					3	4	Major		
Aeration	Piping & Valves	WC-FB2-BFV-078-A	LP AIR TO FILTER #10	1990	CENTERLINE				2	2	Minor		
Aeration	Piping & Valves	WC-FB2-BFV-080-A	LP AIR TO FILTER #10 AT MANIFOLD	1990	CENTERLINE				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-BFV-083-A	FILTER #10 BACKWASH DRAIN	1990	PRATT				2	2	Minor		
Filtration	Instruments & Controls	WC-FB2-BFV-083-I	FILTER #10 DRAIN VALVE INSTRUMENTATION	1990					3	4	Major		
Disinfection	Piping & Valves	WC-FB2-BV-020-A	CL2 SOLUTION TO FILTER #10	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Disinfection	Piping & Valves	WC-FB2-BV-022-A	CL2 SOLUTION TO FILTER #10 Influent	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	

FILTER BUILDING 2

Process	Group	Object ID	Object Name	In-Service Date	Manufacturer	Model	Serial No.	Capacity/Size	Condition Ranking	Performance Ranking	Quantitative Risk	Notes	Representative Work Orders
Filtration	Instruments & Controls	WC-FB2-FIT-010-I	#10 FILTER FLOW INDICATING TRANSMITTER	1990	ROSEMOUNT	1151-DP SMART TRANSMITTER			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-LIT-010-I	#10 FILTER LEVEL INDICATING TRANSMITTER	1990	DREXEL BROOK	SERIES 408-6200			3	4	Major		
Filtration	Instruments & Controls	WC-FB2-PIT-010-I	#10 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990					3	4	Major		
Filtration	Piping & Valves	WC-FB2-BFV-081-A	MOTORIZED LP AIR STOP FOR FB2	1990	CENTERLINE				3	4	Major	Innaccessible and currently not working	
Filtration	Piping & Valves	WC-FB2-BFV-085-A	MANUAL LP AIR STOP TO FB2	1990	CENTERLINE				2	4	Major	Does not hold according to plant staff	
Disinfection	Piping & Valves	WC-FB2-BV-010-A	CL2 SOLUTION TO FILTER BUILDING #2	1990	DOUBLE UNION				3	3	Moderate	All Chlorine Valves Leak	
Filtration	Piping & Valves	WC-FB2-CV-008-A	SUMP PUMP #3 CHECK VALVE (EAST)	1990	KENNEDY VALVE CO.				2	4	Major		
Filtration	Piping & Valves	WC-FB2-CV-009-A	SUMP PUMP #3 CHECK VALVE (WEST)	1990	KENNEDY VALVE CO.				2	4	Major		
Filtration	Piping & Valves	WC-FB2-CV-010-A	SUMP PUMP #4 CHECK VALVE (EAST)	1990	KENNEDY VALVE CO.				2	4	Major		
Filtration	Piping & Valves	WC-FB2-CV-011-A	SUMP PUMP #4 CHECK VALVE (WEST)	1990	KENNEDY VALVE CO.				2	4	Major		
Filtration	Piping & Valves	WC-FB2-GV-004-A	SUMP PUMP DISCHARGE STOP	1990	STOCKHAM				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-GV-005-A	SUMP PUMP #4 DISCHARGE	1990	STOCKHAM				2	2	Minor		
Filtration	Piping & Valves	WC-FB2-GV-006-A	SUMP PUMP #3 DISCHARGE	1990	STOCKHAM				2	2	Minor		
Filtration	Pumps	WC-FB2-SP-003-A	SUMP PUMP#3	1990	GOULDS PUMP INC.	WS1534D			2	3	Moderate		
Filtration	Electrical	WC-FB2-SP-003-M	SUMP PUMP#3 MOTOR	1990	GOULDS PUMP INC.	3888			2	4	Major		
Filtration	Pumps	WC-FB2-SP-004-A	SUMP PUMP#4	1990	GOULDS PUMP INC.	WS1534D			2	3	Moderate		
Filtration	Electrical	WC-FB2-SP-004-M	SUMP PUMP#4 MOTOR	1990	GOULDS PUMP INC.	3888			2	4	Major		

ATTACHMENT TM1-2

CURRENT FILTER OPERATIONS

1.0 GENERAL

This Attachment TM1-2 documents the observations made by Black & Veatch regarding operation of the existing filter complex at the Walnut Creek WWTP as part of the visual condition assessment process. These observations were conducted on during site visits on May 17, May 18, May 25, and June 8, 2011. The observations made that pertain to operational characteristics during each of these site visits are presented in the following sections. At the same time, we conducted th visual condition assessment of the assets in the filtration complex. The results of the visual condition assessment are presented in Attachment TM1-1.

2.0 May 17, 2011

Observed the backwash of Filter 5. The procedure used involved taking the filter off line by closing the filter influent valve, which was actuated from the individual filter control panel. After the filter level dropped to about a foot above the media, the filter effluent valve was closed by walking down to the valve actuator in the gallery. The filter backwash drain valve and the individual filter backwash valves were opened from the filter console, and then the backwash supply was started. The local control station for the main backwash control valve was set in auto and Backwash Pump 1 was started from Filter 1 control panel. The main backwash valve was placed into automatic control from Filter 1 control panel with a setpoint of 20 mgd. The valve slowly opened to 100 percent. The main backwash flow meter read zero at the local display in the piping gallery. After the filter backwash water ran clear, the main filter backwash valve was closed and Backwash Pump 1 was shut down from Filter 1 control panel. The filter backwash valve and backwash drain valve for Filter 5 were closed from the Filter 5 control panel and the filter inlet valve was opened from this same panel. The operator then went to the filter gallery to manually set the filter effluent valve to 50% open. There were no apparent boils or other abnormalities observed during the backwash. The backwash troughs were evenly loaded, and backwash water drained away without any problems.

Observed the backwash of Filter 2. The procedure was the same as was used for Filter 5, but before starting Backwash Pump 1, the differential pressure transmitter for the main backwash flow meter was bled off. There was substantial air in the lines. The backwash pump was started and the main backwash valve placed into control. The meter read 20 mgd and held steady, with the filter backwash valve position showing about 75% open and positioning to maintain a steady flow. At Black & Veatch's request, the flow controller for the main filter backwash was set to 10 mgd, and the main backwash control valve closed to about 45% open to maintain the 10 mgd setpoint registered on the local transmitter. This filter appeared to have more turbulence then Filter 5 as the backwash started, and cleared up very well. There were no obvious abnormalities noted during the backwash.

3.0 May 18, 2011

Observed the backwash for Filter 1. Sequence used was the similar, but not exactly like the one observed the previous day. Backwash Pump 1 and the main filter backwash control valve was set to open from Filter 1 control panel. The valve went to 100% open and the local backwash flowmeter in the basement read 22.5 mgd. The 1-1/2 inch insert downstream of the main backwash throttling valve was flowing a steady stream of water. At this backwash flow, the existing troughs were beginning to submerge on the south and east end, farthest from the backwash drain. Backwash ran clear after a reasonable amount of time, there were no obvious boils in the media during the backwash.

Observed the backwash for Filter 3. Sequence was similar to Filter 1. Very similar to Filter 1 in operation, there were no unusual displacement of media during backwash. These two filters were placed back in service with the effluent valves at 100% open, and the water level in the filter box dropped to the level of the media such that the influent was spilling out over the backwash troughs and falling down onto the top of the exposed filter media. The assumption is that the head loss through the media, underdrain and filter effluent piping is less than the distance from the clearwell weir (440.50) to the top of the media (approx 448).

The following readings were taken in the gallery during the backwash of Filters 1 and 3:

Filter Gallery Readings taken May 18, 2011 in the Morning

Filter No	Valve Pos % open	Head ft	Flow mgd
1	65%	7	15
2	60%	0	0
3	0%	0	5
4	100%	0	3
5	100%	9	9
6	50%	6	8
7	100%	7	3
8	30%	0	3
9	100%	10	8
10	50%	6	7
Ave/Tot		5	60

Since the settled water pumps were running about 42 mgd most of the day, and there is no reason to believe the zero head loss reported for filters 2, 4 and 8, the instrumentation on the effluent of these filters is suspect.

Observed the backwash of Filter 5. This filter was backwashed using the same approach as described for Filter 1. Nothing unusual to report.

Observed the backwash of Filter 8. This filter was backwashed using the same approach as described for Filter 1. Nothing unusual to report during the backwash. Backwash Pump 1 was kept running as the backwash was changed from Filter 5 to Filter 8, and both filters were taken off line and put back into service at the same time.

The following readings were taken in the gallery at the end of the day, after completion of the backwash for filters 5 and 8:

Filter Gallery Readings Taken May 18, 2011, in the Afternoon

Filter No	**Valve Pos** % open	**Head** ft	**Flow** mgd
1	100%	6	15
2	100%	3	0
3	100%	10	15
4	100%	6	0
5	100%	5	15
6	80%	9	9
7	100%	8	2
8	100%	2	15
9	100%	10	3
10	100%	8	9
Ave/Tot	98%	7	83

Again, since the settled water flow reported on May 18 was 42.7 mgd, the instruments in the filter gallery are suspect. The review of data received from the City also confirmed a substantial deviation between the individual filter flow measurements and the total plant flow. For that reason, a special test of filter operation was developed for May 25, 2011.

4.0 May 25, 2011

Beginning at 8 am, plant staff removed filters 1 through 4 from service so that all settled water flow was filtered through filters 5 through 10. Based on the operations log, these filters had last been backwashed at the following times:

May 23 (day shift): Filters 5 and 7

May 24 (night shift): Filters 8 and 10

May 24 (day shift): Filters 1 and 9

May 25 (night shift): Filters 2, 4 and 6

For the analysis of filter run time, it was assumed that night shift backwashes occur around 2 a.m. and day shift backwashes occur around 2 p.m. Plant flow during these filter runs was approximately 50 mgd, but that flow was increased to 60 mgd around 8 am on the 25th due to high flow equalization basin levels (due to the backwashing of three filters by the night shift).

Throughout the day, the filter effluent valves were all set to 100% open and the filter influent flow was split equally between the six filters on line by virtue of the similar weir length in each filter box and the negligible losses in the filter inlet conduit. The flow to each filter was therefore 10 mgd for all measurements taken except for those that were taken while Filters 8 and 10 were in backwash. Head loss was measured by recording the level in the filter box, measuring down from the deck on each side of the gullet and averaging the two measurements. This measurement was converted to an elevation and subtracted from the calculated hydraulic gradient downstream of the filters to obtain the head loss through each filter. One effluent quality sample was taken around 1 pm, prior to the backwash of filters 8 and 10.

The table on the following page list the data collected from the instruments in the gallery and the measurements taken (or flows assumed) throughout the day. Effluent turbidity samples were taken with the following results:

- Filter 5 – 1.86 NTU
- Filter 6 – 0.77 NTU
- Filter 7 – 1.08 NTU
- Filter 8 – 0.88 NTU
- Filter 9 – 0.84 NTU
- Filter 10 – 0.77 NTU

During this test, filters were loaded at a surface loading rate of 6.4 gpm/sf, and during the period that filters 8 and 10 were being backwashed, this loading increased by 50% to nearly 10 gpm/sf. During the backwashing of filters 8 and 10 the water level in the filter boxes on filters 5, 6, 7, and 9 filled up to the level of the backwash troughs, so they no longer controlled flow to each filter. All flowmeters in the gallery were pegged at 15 mgd and the filter head gauges read between 8 and 10 feet.

The backwash of filters 8 and 10 generally followed the steps described previously. This operator put the main backwash control valve in manual using the control station downstairs and positioned it at about 45% (arrow points to the big bolt). Backwash Pump 1 was then started against a closed backwash valve at the filter and the flow meter for the main backwash flow read about 18 mgd (after the air was bled off). This flowrate was maintained for about 10 minutes in both filters, and the backwash cleared up nicely. There were some significant releases of air during the backwash of filter 8 which could have been caused by air in the underdrain or air in the backwash supply system. These two filters were backwashed as a pair – they were taken off line together, backwashed one after the other without stopping the backwash pump inbetween, and placed back into service at the same time. There was no obvious mounding of the backwash or other indication of trouble with the filter underdrains. When placed back into service with the effluent valve full open, the level in the filter box fell to below the level of the top of the media, so that influent was falling from the backwash troughs onto the surface of the filter media. The calculated productivity of filters 8 and 10, assuming all 10 filters running at 50 mgd total plant flow prior to this test and 6 filters running at 60 mgd total plant flow during this test, was 99.89%

Based on the amount of air released during the backwash of Filter 8, this filter was selected for further inspection. Filter 9 was also selected for further inspection because the level in one side of the filter was observed to be different than that in the other side during this test.

Time	Filter No. 5					Filter No. 6				
	Run Time, hrs	Reported Flow, mgd	Actual Flow, mgd	Reported Head, Ft	Actual Head, Ft[1]	Run Time, hrs	Reported Flow, mgd	Actual Flow, mgd	Reported Head, Ft	Actual Head, Ft[1]
8:30	42.5	9	10	6.5	2.8	6.5	10	10	6	4.6
9:30	43.5	9	10	6.5	3.9	7.5	10	10	6	5.2
10:30	44.5	9.5	10	6.5	4.6	8.5	10	10	6	5.4
11:30	45.5	9.5	10	6.5	4.9	9.5	10	10	6	5.7
13:00	47.0	9.5	10	6.5	5.2	11	10	10	6	5.9
14:30	48.5	9	10	6.5	4.2	12.5	10	10	6.5	4.9
15:30	49.5	9	10	6.5	4.9	13.5	10	10	6.5	5.7
Time	Filter No. 7					Filter No. 8				
	Run Time, hrs	Reported Flow, mgd	Actual Flow, mgd	Reported Head, Ft	Actual Head, Ft[1]	Run Time, hrs	Reported Flow, mgd	Actual Flow, mgd	Reported Head, Ft	Actual Head, Ft[1]
8:30	42.5	12.5	10	2.5	5.6	30.5	12	10	4.5	7.3
9:30	43.5	11	10	2.5	5.6	31.5	12	10	4.5	8.7
10:30	44.5	11	10	2.5	6.4	32.5	12	10	4.5	8.8
11:30	45.5	11	10	3	6.9	33.5	12	10	5	8.7
13:00	47.0	12	10	4.5	7.9	35.0	12.5	10	6	9.3
14:30	48.5	10.5	10	4.5	7.9	0.5[3]	12.5	10	3	3.9
15:30	49.5	10.5	10	5	8.6	1.5[3]	13	10	3	4.1
Time	Filter No. 9					Filter No. 10				
	Run Time, hrs	Reported Flow, mgd	Actual Flow, mgd	Reported Head, Ft	Actual Head, Ft	Run Time, hrs	Reported Flow, mgd	Actual Flow, mgd	Reported Head, Ft	Actual Head, Ft[1]
8:30	18.5	13.5	10	8.5	8.4	30.5	11.5	10	9.5	9.4
9:30	19.5	13	10	9	8.5	31.5	11.5	10	9.5	9.5
10:30	20.5	13	10	9	8.7	32.5	11	10[2]	9.5	9.5
11:30	21.5	13	10	9	9.1	33.5	11	10[2]	9.5	9.5
13:00	23.0	12.5	10[2]	9.5	9.5	35.0	10	10[2]	9.5	9.5
14:30	24.5	12	10[2]	9.5	9.4	0.5[3]	13.5	10	6	4.4
15:30	25.5	11.5	10[2]	10	9.4	1.5[3]	13	10	6	4.7
Note 1: Actual head is the average depth of water in the filter box measured down from the deck (El 458) less the calculated hydraulic grade line at the filter outlet (443.2)										
Note 2: Backwash weirs submerged - flow is likely less than shown										
Note 3: Backwashed Filters 8 and 10 at 13:30 hrs										

5.0 June 8, 2011

On June 8, City staff had removed filters 8 and 9 from service and drained them for inspection. The two hatches which allow access into the plenum below each half of the filters had been removed for expension. A significant amount of water was draining out of these hatches. The filter media was sampled from the deck of the filter by dropping a bucket onto the surface of the media and scraping media into the bucket using a small spade on an extendable handle. The underdrains were inspected from the gallery by observing through the access hatches, they were found to be in excellent condition. The level of the surface of the media in filters 5 through 10 were measured and the resulting media depth calculated based off of information from the Contract 6 as-built drawings.

- Filter 5 Media Depth – 1.5 feet
- Filter 6 Media Depth – 2.7 feet
- Filter 7 Media Depth – 2.8 feet
- Filter 8 Media Depth – 2.6 feet
- Filter 9 Media Depth – 2.8 feet
- Filter 10 Media Depth – 3.2 feet

ATTACHMENT TM1-3

FINAL REMAINING USEFUL LIFE WORKSHEET

FILTER BUILDING 1

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Filtration	Buildings & Grounds	WC-FILTER BUILDING	1979	50	33	1	17	2	2	**22**
Filtration	Piping & Valves	FILTER Influent STOP (EAST)	1979	50	33	1	17	2	3	**17**
Filtration	Piping & Valves	BFV-005 CHAIN ACTUATOR	1979	30	33	1	-3	3	2	**-3**
Filtration	Piping & Valves	FILTER Influent CROSSOVER	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	BFV-045 CHAIN WHEEL ACTUATOR	1990	30	22	1	8	2	2	**11**
Filtration	Instruments & Controls	BUBBLER FILTER Influent LEVEL TRANSMITTER	1979	20	33	1	-13	3	4	**-15**
Filtration	Piping & Valves	FILTER INFLUENT	1979	50	33	1	17	2	1	**22**
Filtration	Instruments & Controls	CLEARWELL LEVEL TRANSMITTER (FIT-1716)	1990	20	22	1	-2	3	4	**-4**
Filtration	Instruments & Controls	CLEARWELL LEVEL INDICATOR(LIT-1716)	1990	20	22	1	-2	3	4	**-4**
Filtration	Piping & Valves	FILTER EFFUENT	1979	50	33	1	17	2	3	**17**
Filtration	Process Equipment	FILTER TRAINS 1 - 4	1979	30	33	1	-3	3	4	**-6**
Filtration	Buildings & Grounds	FILTERS 1-4 CONCRETE STRUCTURES	1979	50	33	1	17	3	2	**17**
Filtration	Piping & Valves	FILTERS 1-4 EFFLUENT VALVES	1979	50	33	1	17	2	3	**17**
Filtration	Piping & Valves	EFFLUENT VALVE GEARED ACTUATORS	1990	30	22	1	8	3	3	**8**
Filtration	Electrical	EFFLUENT VALVE ELECTRIC OPERATOR	2009	20	3	1	17	2	2	**19**
Filtration	Instruments & Controls	EFFLUENT VALVE INSTRUMENTATION	2009	20	3	1	17	3	4	**15**
Filtration	Piping & Valves	FILTERS 1-4 SURFACE WASH VALVES	1979	50	33	1	17	4	5	**7**
Filtration	Piping & Valves	SURFACE WASH VALVES GEARED ACTUATOR	1990	30	22	1	8	3	5	**2**
Filtration	Instruments & Controls	SURFACE WASH VALVES INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Filtration	Electrical	SURFACE WASH VALVE MOTOR	1990	20	22	1	-2	2	5	**-6**
Filtration	Piping & Valves	FILTERS 1-4 INFLUENT VALVES	1979	50	33	1	17	2	3	**17**

FILTER BUILDING 1

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Filtration	Piping & Valves	INFLUENT VALVES GEARED ACTUATORS	1990	30	22	1	8	2	3	**8**
Filtration	Instruments & Controls	INFLUENT VALVES INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Filtration	Electrical	INFLUENT VALVES MOTOR	1990	20	22	1	-2	2	3	**-2**
Filtration	Piping & Valves	FILTERS 1-4 BACKWASH VALVES	1979	50	33	1	17	2	2	**22**
Filtration	Piping & Valves	BACKWASH VALVE GEARED ACTUATOR	1990	30	22	1	8	2	3	**8**
Filtration	Instruments & Controls	BACKWASH VALVES INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Filtration	Electrical	BACKWASH VALVES MOTOR	1990	20	22	1	-2	2	2	**0**
Filtration	Piping & Valves	FILTERS 1-4 BACKWASH DRAIN VALVES	1979	50	33	1	17	2	2	**22**
Filtration	Piping & Valves	BACKWASH DRAIN VALVES GEARED ACTUATOR	1990	30	22	1	8	2	2	**11**
Filtration	Instruments & Controls	BACKWASH DRAIN VALVES INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Filtration	Electrical	BACKWASH DRAIN VALVES MOTOR	1990	20	22	1	-2	2	2	**0**
Filtration	Instruments & Controls	#1 FILTER FLOW INDICATING TRANSMITTER	1990	20	22	1	-2	3	4	**-4**
Filtration	Instruments & Controls	#1 FILTER LEVEL INDICATING TRANSMITTER	1990	20	22	1	-2	3	4	**-4**
Filtration	Instruments & Controls	FILTER #1 HEAD LOSS INDICATING TRANSMITTER	1990	20	22	1	-2	3	4	**-4**
Filtration	Piping & Valves	BACKWASH PUMP SUCTION VALVES	1979	50	33	1	17	3	4	**12**
Effluent Pumping	Piping & Valves	BACKWASH PUMP SUCTION VALVES CHAIN ACTUATOR	1979	30	33	1	-3	3	4	**-6**
Filtration	Piping & Valves	BACKWASH PUMP DISCHARGE VALVES	1979	50	33	1	17	2	4	**12**
Filtration	Piping & Valves	BACHWASH PUMP DISCHARGE VALVE CHAIN ACTUATOR	1979	30	33	1	-3	3	4	**-6**
Filtration	Piping & Valves	FILTER BACKWASH RATE CONTROL VALVE	1990	50	22	1	28	4	4	**23**
Filtration	Piping & Valves	BFV-026 GEARED ACTUATOR	1990	30	22	1	8	4	4	**5**

FILTER BUILDING 1

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Filtration	Instruments & Controls	MAIN BACKWASH VALVE INSTRUMENTATION	2005	20	7	1	13	3	4	**11**
Filtration	Electrical	MAIN BACKWASH VALVE MOTOR	2005	20	7	1	13	3	4	**11**
Filtration	Piping & Valves	BACKWASH TO FILTER BUILDING #2	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	BFV-046 CHAIN WHEEL ACTUATOR	1990	30	22	1	8	2	2	**11**
Filtration	Pumps	BACKWASH PUMPS 1 & 2	1979	30	33	1	-3	3	4	**-6**
Filtration	Instruments & Controls	BACKWASH PUMPS 1 & 2 INSTRUMENTATION	1990	20	22	1	-2	4	4	**-4**
Filtration	Electrical	BACKWASH PUMPS 1 & 2 MOTORS	1990	20	22	1	-2	3	4	**-4**
Filtration	Piping & Valves	VACUUM PUMP CHECK VALVES	1990	50	22	1	28	2	4	**23**
Filtration	Piping & Valves	VACUUM PUMP SUCTION VALVES	1990	50	22	1	28	2	4	**23**
Filtration	Pumps	VACUUM PUMPS	1998	30	14	1	16	2	2	**19**
Filtration	Electrical	VACUUM PUMP MOTORS	1998	20	14	1	6	2	2	**8**
Filtration	Piping & Valves	VACUUM RECEIVER TANK	1990	30	22	1	8	2	4	**5**
Filtration	Piping & Valves	VACUUM PRIMING BULBS FOR BACKWASH PUMPS	1990	30	22	1	8	2	4	**5**
Filtration	Piping & Valves	FILTER BACKWASH PUMP SUCTION PIPING	1990	50	22	1	28	2	4	**23**
Filtration	Piping & Valves	FILTER BACKWASH PUMP DISCHARGE PIPING	1979	50	33	1	17	2	1	**22**
Filtration	Piping & Valves	FILTER BACKWASH DRAIN PIPING	1979	50	33	1	17	3	1	**17**
Effluent Pumping	Piping & Valves	TYPICAL NPW BUTTERFLY VALVE	1979	50	33	1	17	2	4	**12**
Effluent Pumping	Piping & Valves	BUTTERFLY VALVE HAND WHEEL ACTUATOR	1979	30	33	1	-3	2	4	**-6**
Filtration	Piping & Valves	NON-POTABLE PUMP CHECK VALVE	1990	50	22	1	28	2	2	**33**
Effluent Pumping	Pumps	NON-POTABLE WATER PUMP	1979	30	33	1	-3	4	5	**-9**
Effluent Pumping	Instruments & Controls	NPW PUMP INSTRUMENTATION	1979	20	33	1	-13	4	5	**-17**

FILTER BUILDING 1

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Effluent Pumping	Electrical	NON-POTABLE WATER PUMP MOTOR	1979	20	33	1	-13	3	5	**-17**
Effluent Pumping	Piping & Valves	CLAY VALVE NPW PRESSURE REGULATOR	1979	30	33	1	-3	3	5	**-9**
Effluent Pumping	Process Equipment	AUTOMATIC STRAINER	1979	30	33	1	-3	3	5	**-9**
Effluent Pumping	Process Equipment	AUTOMATIC STRAINER GEAR REDUCER	1979	30	33	1	-3	3	5	**-9**
Effluent Pumping	Electrical	AUTOMATIC STRAINER MOTOR	1979	20	33	1	-13	3	5	**-17**

FILTER BUILDING 2

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Filtration	Buildings & Grounds	FILTER BUILDING #2	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	BFV 084 FILTER Influent STOP (WEST)	1990	50	22	1	28	3	2	**28**
Filtration	Piping & Valves	BFV 084 CHAIN ACTUATOR	1990	30	22	1	8	3	3	**8**
Filtration	Process Equipment	WC-FB2-1-458-TRAIN #5	1990	30	22	1	8	2	2	**11**
Filtration	Buildings & Grounds	FILTER #5-10 CONCRETE STRUCTURE	1990	50	22	1	28	2	1	**33**
Filtration	Piping & Valves	FILTER #5-10 EFFLUENT VALVE	1990	50	22	1	28	3	4	**23**
Filtration	Piping & Valves	EFFLUENT VALVE GEARED ACTUATOR	1990	30	22	1	8	3	4	**5**
Filtration	Electrical	EFFLUENT VALVE ELECTRONIC OPERATOR	2009	20	3	1	17	2	2	**19**
Filtration	Instruments & Controls	EFFLUENT VALVE INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Filtration	Piping & Valves	FILTER #5-10 BACKWASH VALVE	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	BACKWASH VALVE GEARED ACTUATOR	1990	30	22	1	8	3	3	**8**
Filtration	Electrical	BACKWASH VALVE ELECTRONIC OPERATOR	1990	20	22	1	-2	2	2	**0**
Filtration	Instruments & Controls	BACKWASH VALVE INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Filtration	Piping & Valves	FILTER #5-10 INFLUENT VALVE	1990	50	22	1	28	2	3	**28**
Filtration	Piping & Valves	INFLUENT VALVE GEARED ACTUATOR	1990	30	22	1	8	2	3	**8**
Filtration	Electrical	INFLUENT VALVE ELECTRONIC OPERATOR	1990	20	22	1	-2	2	2	**0**
Filtration	Instruments & Controls	INFLUENT VALVE INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Aeration	Piping & Valves	LP AIR TO FILTER #5-10 VALVE	1990	50	22	1	28	2	2	**33**

FILTER BUILDING 2

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Aeration	Piping & Valves	LP AIR TO FILTER #5-10 AT MANIFOLD	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	FILTER #5-10 BACKWASH DRAIN VALVE	1990	50	22	1	28	2	2	**33**
Filtration	Instruments & Controls	DRAIN VALVE INSTRUMENTATION	1990	20	22	1	-2	3	4	**-4**
Disinfection	Piping & Valves	CL2 SOLUTION TO FILTER #5-10 VALVE	1990	50	22	1	28	3	3	**28**
Disinfection	Piping & Valves	CL2 SOLUTION TO FILTER #5-10 INFLUENT VALVE	1990	50	22	1	28	3	3	**28**
Filtration	Instruments & Controls	#5-10 FILTER FLOW INDICATING TRANSMITTER	1990	20	22	1	-2	3	4	**-4**
Filtration	Instruments & Controls	#5-10 FILTER LEVEL INDICATING TRANSMITTER	1990	20	22	1	-2	3	4	**-4**
Filtration	Instruments & Controls	#5-10 FILTER LOSS OF HEAD PRESSURE TRANSMITTER	1990	20	22	1	-2	3	4	**-4**
Filtration	Piping & Valves	MOTORIZED LP AIR STOP FOR FB2	1990	50	22	1	28	3	4	**23**
Filtration	Piping & Valves	MANUAL LP AIR STOP TO FB2	1990	50	22	1	28	2	4	**23**
Disinfection	Piping & Valves	CL2 SOLUTION TO FILTER BUILDING #2	1990	50	22	1	28	3	3	**28**
Filtration	Piping & Valves	SUMP PUMP #3 CHECK VALVE (EAST)	1990	50	22	1	28	2	4	**23**
Filtration	Piping & Valves	SUMP PUMP #3 CHECK VALVE (WEST)	1990	50	22	1	28	2	4	**23**
Filtration	Piping & Valves	SUMP PUMP #4 CHECK VALVE (EAST)	1990	50	22	1	28	2	4	**23**
Filtration	Piping & Valves	SUMP PUMP #4 CHECK VALVE (WEST)	1990	50	22	1	28	2	4	**23**
Filtration	Piping & Valves	SUMP PUMP DISCHARGE STOP	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	SUMP PUMP #4 DISCHARGE	1990	50	22	1	28	2	2	**33**
Filtration	Piping & Valves	SUMP PUMP #3 DISCHARGE	1990	50	22	1	28	2	2	**33**

FILTER BUILDING 2

Process	Group	Object Description	In-Service Date	Standard Expected Life	Age of Asset	Use Factor	Initial Remaining Life	Condition Ranking	Performance Ranking	Remaining Useful Life
Filtration	Pumps	SUMP PUMP#3	1990	30	22	1	8	2	3	**8**
Filtration	Electrical	SUMP PUMP#3 MOTOR	1990	20	22	1	-2	2	4	**-4**
Filtration	Pumps	SUMP PUMP#4	1990	30	22	1	8	2	3	**8**
Filtration	Electrical	SUMP PUMP#4 MOTOR	1990	20	22	1	-2	2	4	**-4**

CITY OF AUSTIN
WALNUT CREEK WWTP
TERTIARY FILTER REHABILITATION PROJECT

TM2 ALTERNATIVE FILTRATION TECHNOLOGIES

CITY OF AUSTIN CIP ID: 3023.025
B&V PROJECT NO. 168622

JULY 18, 2011

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ATTACHMENT TM2-A	ALTERNATIVE FILTRATION TECHNOLOGIES WORKSHOP POWERPOINT PRESENTATION
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ATTACHMENT TM2-E	ENGINEER’S OPINION OF PROABABLE CONSTRUCTION COST
ATTACHMENT TM2-F	NOVA WATER TECHNOLOGIES PRELIMINARY DESIGN REPORT

1.0 INTRODUCTION

1.1 Background

This TM2 presents the assessment and evaluation of various alternative filtration technologies for incorporation into the existing filter complex at the Walnut Creek WWTP (WCWWTP) as a replacement to the existing granular media filters. The following information is summarized in the sections below:

- Historical plant operational data on filter performance reviewed to form the basis of design for the filter system
- Design criteria for the alternative filtration technologies systems
- A summary of available alternative filtration technologies
- Evaluation of the alternative filtration technologies and resulting selection of the two technologies for detailed assessment
- Conceptual design and costs for two alternative technologies: Cloth Media Filters and NOVA Ultrascreen
- Considerations for future expansion

Potential alternative filtration technologies were discussed during a workshop held with the City on June 21, 2011 and subsequent follow-up meetings. Each technology presented during the workshop is summarized in this TM2, and a detailed evaluation, including costs, is summarized for each of the two alternatives selected by City.

2.0 REVIEW OF HISTORICAL DATA

2.1 Description of Existing Filtration Facilities

In 1974 Contract IV resulted in the construction of Filter Building 1. The secondary facilities were rated for an average day design flow of 18 mgd and a maximum day design flow of 36 mgd. The design of the filter complex at the completion of this project included filters 1 through 4, designed as dual media filters with 22-inches of anthracite over 12-inches of sand. Figure TM2-1 shows Filter 2 as it has completed a backwash cycle.

Figure TM2-1 – Filter in Filter Building 1

The sand is supported on 10-inches of support gravel which is constructed on clay tile filter underdrains. Each filter cell is 30 ft by 36 ft (1,080 sqft). Based on the flow rates the following were established as the operating and design conditions:

- Average flow (all filters in operation) – 2.87 gpm/sf
- Average flow (with one filter in backwash) - 3.82 gpm/sf
- Peak flow (all filters in operation) – 5.74 gpm/sf
- Peak flow (with one filter in backwash) – 7.64 gpm/sf

In May 1987 Filter Building 2 was constructed providing 6 additional mono media anthracite filter bays (32 ft x 34 ft). The design documents do not provide information on the selection of the anthracite as the filter media for Filters 5 through 10. Figure TM2-2 shows filters from the Filter Building 2 complex.

Figure TM2-2- Filter in Filter Building 2

The Walnut Creek Wastewater Treatment Plant 75 mgd upgrade in 2002 indicated that the filter complex can treat 120 mgd peak flow and 75 mgd average annual flow with nine cells in operation and 5 feet of head loss through the filters. Therefore, the current design hydraulic throughput rating on the filters is as follows:

- Average flow (all filters in operation) – 4.78 gpm/sf
- Average flow (with one filter in backwash) - 5.31 gpm/sf
- Peak flow (all filters in operation) – 7.65 gpm/sf
- Peak flow (with one filter in backwash) – 8.51 gpm/sf

2.2 Discharge Requirements

The Walnut Creek WWTP has two discharge requirements that pertain to the effluent filter system. The Texas Pollution Discharge Elimination System (TPDES) permit has a 30 day average total suspend solids (TSS) effluent discharge requirement of 15 mg/L and peak day limit of 40 mg/L based on 24 hour composite sampling. Figure TM2-3 shows the influent and effluent TSS concentrations have been in compliance with this requirement for the past five years, due to the considerable efforts of the plant staff. This data indicates that the average concentration discharged from the final clarifiers is 7 mg/L TSS. In addition, the data shows that influent TSS concentrations discharged to the filters over the past 12 months have averaged 10 to 12 mg/L. While influent concentrations appear to be increasing, the effluent concentrations are well below the permit limit of 15 mg/L.

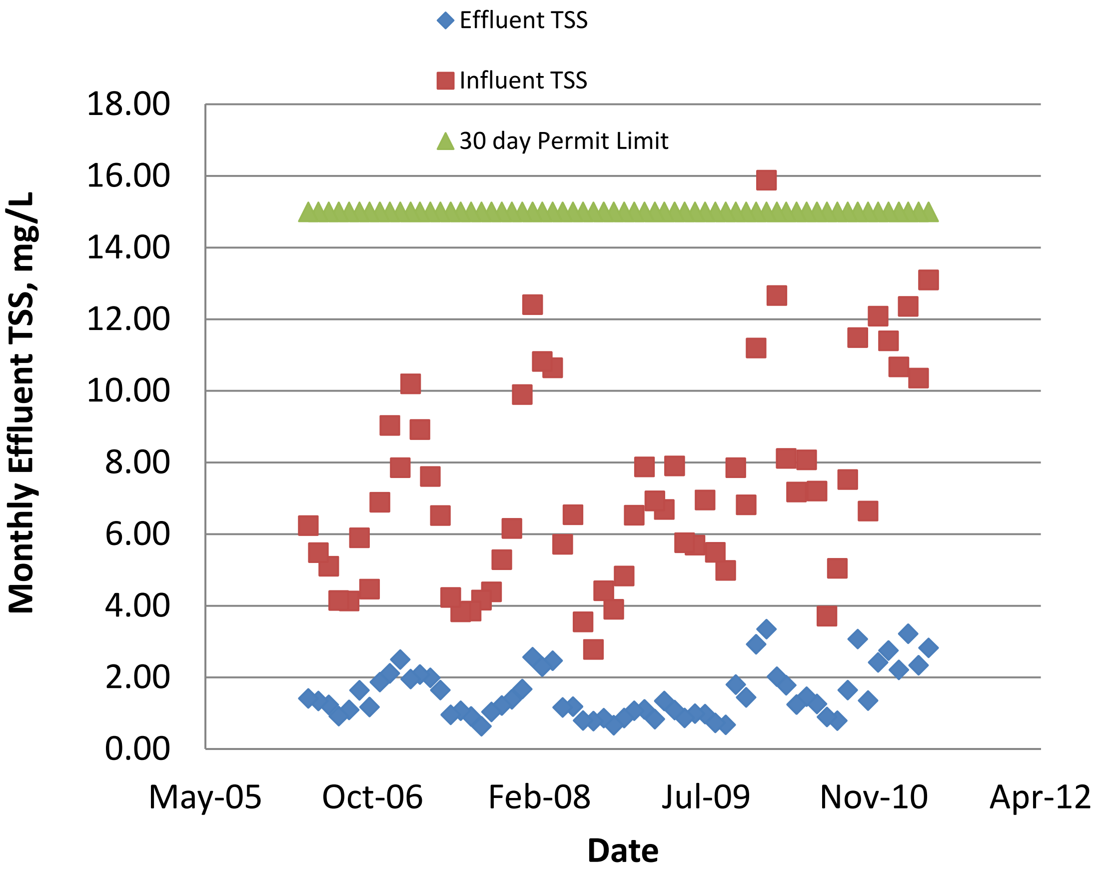


Figure TM2-3 - Historical TSS Concentrations

The permit limit for reuse water includes a 30 day average turbidity discharge requirement of 3 NTU based on a minimum of two grab samples per week. As shown in Figure TM2-4 the average monthly turbidity has been below 3 mg/L since 2006. However the plant did report a 2.98 mg/L monthly average turbidity concentration in February 2011. An overall observation from the figure indicates higher effluent turbidity values (above 2 NTU) during the winter versus lower turbidity values (less than 1.5 NTU) during the summer.

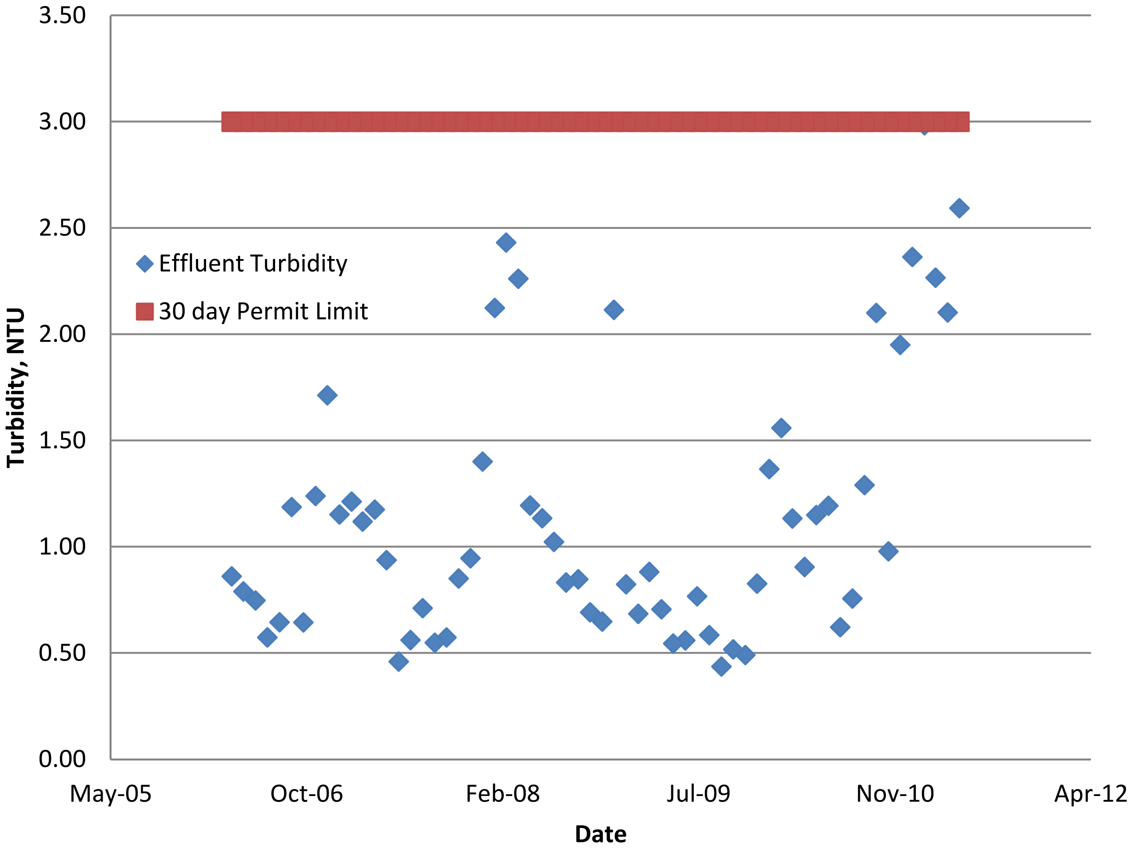


Figure TM2-4 - Monthly average Turbidity Values

2.3 Hydraulic Loading Rates

One of the key design parameters for granular filtration is the average and peak hydraulic loading rates. A review of the hydraulic loading rates based on the plant flow records submitted to Texas Commission on Environmental Quality (TCEQ) is shown on Figure TM2-

5. It appears that the hydraulic loading rate is a function of the flow arriving at the WCWWTP. Hydraulic rates are higher during wet periods and lower during dry periods. Data from one month, February 2010, indicated that the filters were operating near the average design throughput rate of 4.78 gpm/sf.

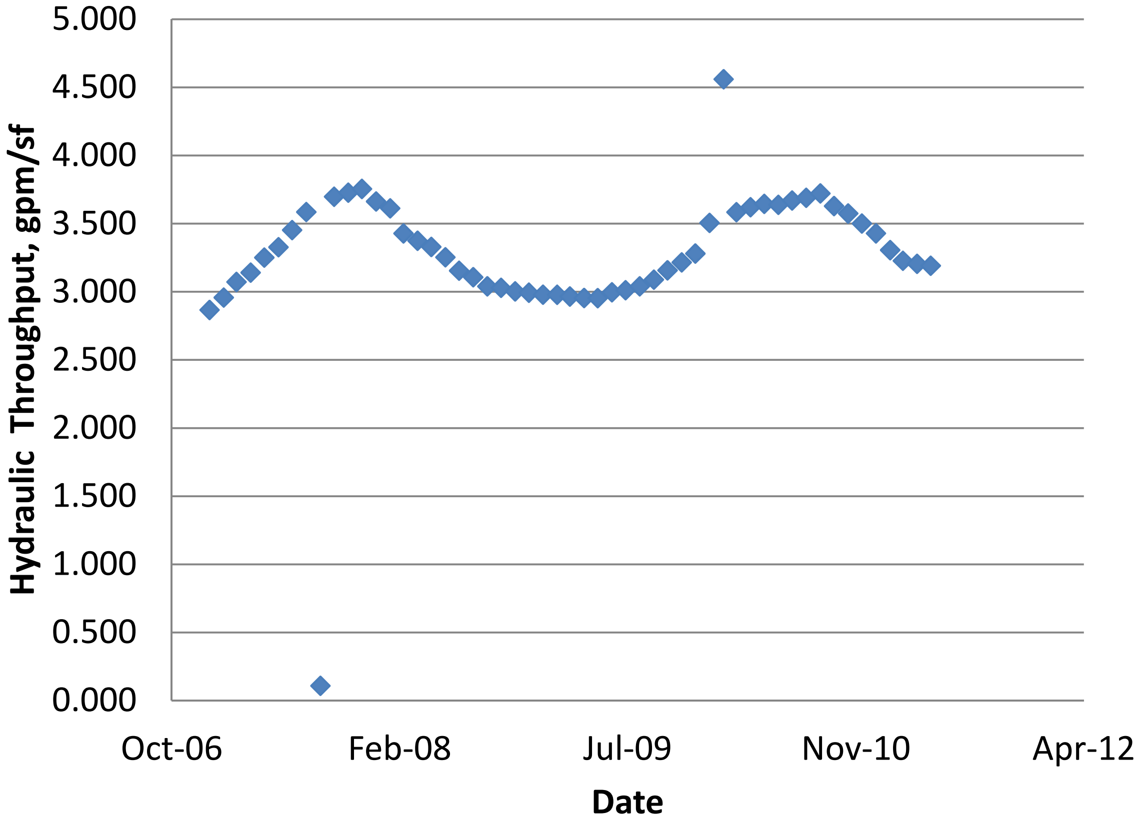


Figure TM2-5 – Historical Hydraulic Throughput rates

Flow data indicates that peak day flows of 127 mgd (September 2010) and peak two hour flows of 163 mgd (September 2010) have been reported. With the design capacity of the filter system established at 120 mgd, flows in excess of the design would have bypassed the filter system.

2.4 Solids Removal Rates

A second key design and operation parameter for the existing filters is solids loading rate. Figure TM2-6 shows the average solids loading rate based on the flow reported on the discharge monitoring report (DMR) submitted to TCEQ. The solids loading rates are quite low, generally under 0.50 ppd/sf.

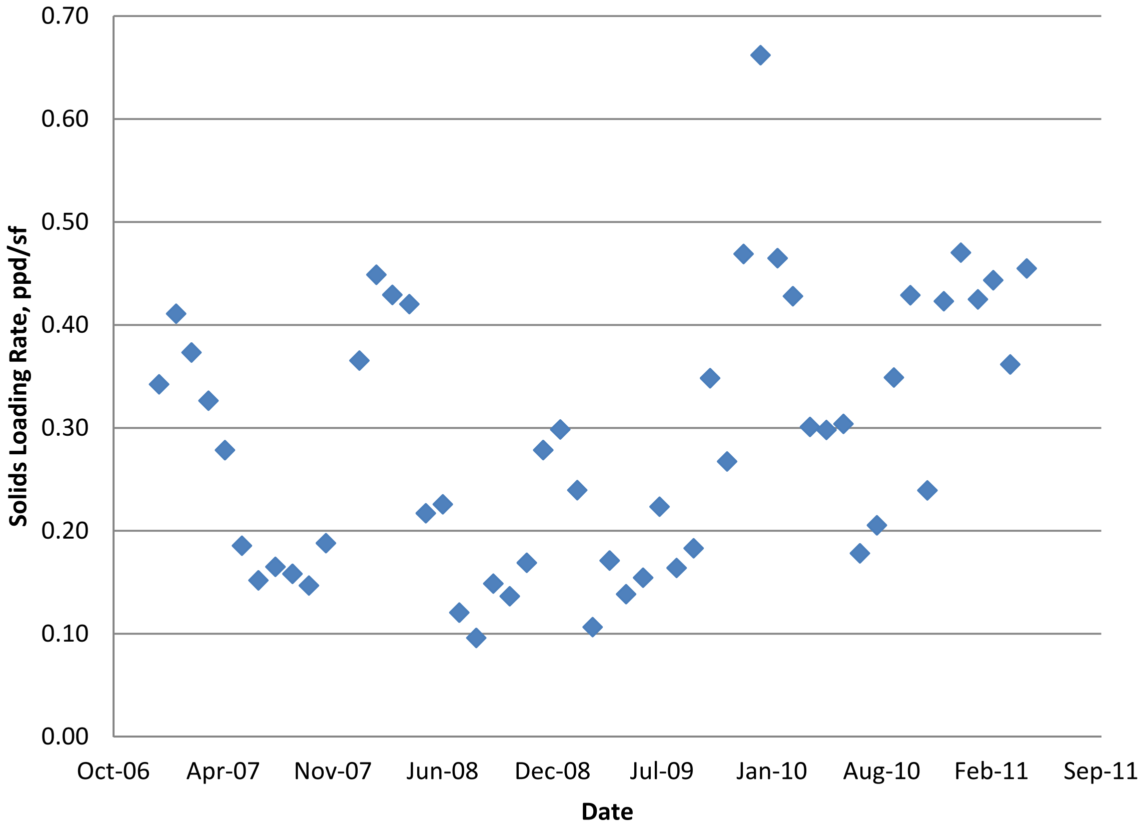


Figure TM2-6 - Historical Solids Loading Rate

2.5 Backwash Requirements

Through field testing it was determined there may be some issues with the accuracy of the flow meters, therefore it was very difficult to establish the actual backwash volume used. Based on testing conducted as part of TM1 it appears that 2% - 200,000 gallons - of backwash water was required after running at 5 mgd for 48 hours (3.2 gpm/sf). A further discussion of the development of the backwash requirements is provided in TM3.

3.0 DESIGN CRITERIA

The peak and average flow rates used for this evaluation were based on the plant design conditions of 75 mgd average and 120 mgd peak flow. Therefore, alternatives to the existing filters were also based on providing a system that has the same capacity.

Filter systems would also need to achieve the same effluent TSS and turbidity as detailed in the discharge permits. The more critical of these is the 30 day average of 3 NTU based on 2 grab samples a week. Concepts for alternative filtration technologies were based on achieving or exceeding that permit requirement.

4.0 SUMMARY OF ALTERNATIVE FILTRATION TECHNOLOGIES

4.1 Effluent Filtration Technology

Figure TM2-7 illustrates the all inclusive Filtration Spectrum and filtration technologies.

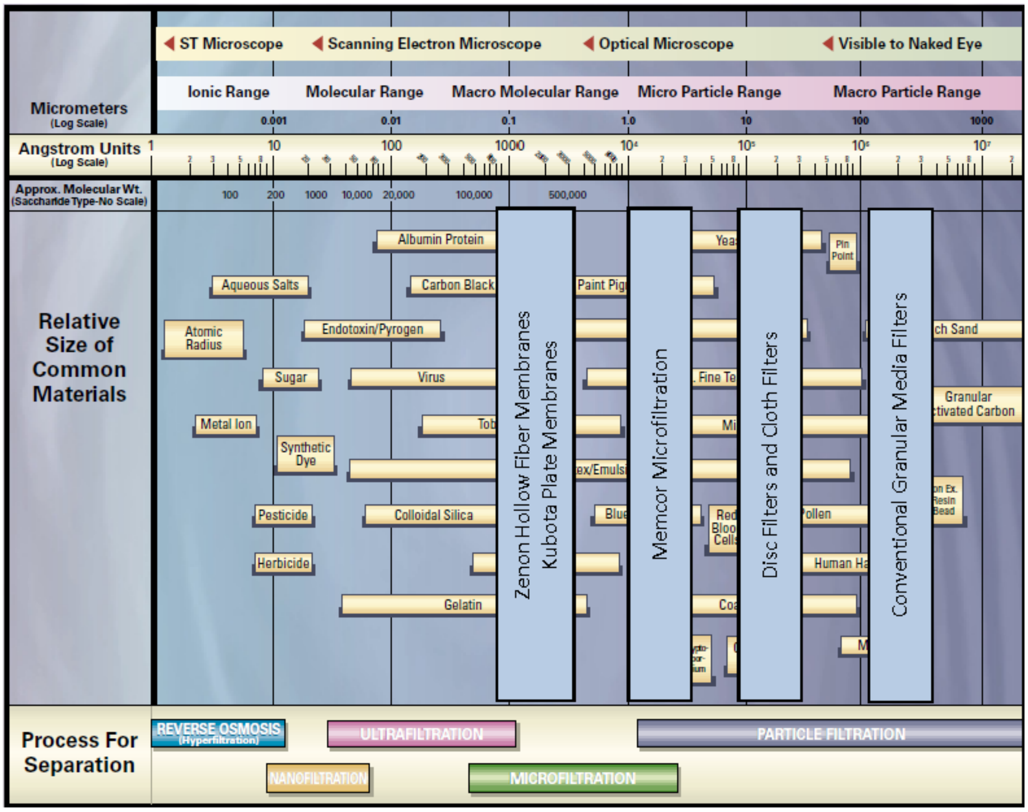


Figure TM2-7 Filtration Spectrum with Applicable Filtration Methods

The general separation processes shown on Figure TM2-7 and described below include: (1) Particle Filtration, (2) Microfiltration, (3) Ultrafiltration, (4) Nanofiltration, and (5) Reverse Osmosis.

- Particle Filtration. Particle filtration covers the range of micro particles (from about 1 micron to about 50 micron) to macro particles (from about 50 micron to about 1,000 micron). Conventional granular media filtration falls in the 100 micron to 300 micron particle range. Single media (sand or anthracite or granular activated carbon), dual media (anthracite over sand or granular activated carbon over sand), and multi-media (anthracite over sand over garnet or granular activated carbon over sand over garnet) all fall within the macro particle filtration range. This would include such filtration technologies as traveling bridge and upflow technologies. Newer surface filtration technologies, such as the Disc Filters and other cloth/stainless steel media filters use synthetic polyester membranes and operate in the larger pore opening microfiltration range (10 micron to 20 micron). Compressible media filtration (CMF) works using the same principles of granular filtration but using a synthetic media

- Microfiltration. Microfiltration (MF) is normally used in the macro molecular range (from about 0.5 micron to about 1 micron) to the lower end of the micro particle range (from about 1 micron to about 3 micron). Microfiltration uses synthetic polyester or other types of membranes to filter out the smaller particles. Higher operating pressures are required for use of microfiltration membranes as compared to conventional granular media or cloth media filtration. Memcor, Koch and other manufacturers supply this type of membranes.

- Ultrafiltration. Ultrafiltration (UF) is normally used in the molecular to macro molecular range (from about 0.03 micron to about 0.1 micron). Because ultrafiltration operates to remove molecular particles, higher operating pressures are normally required for this type of pressure filtration. Hollow fiber ultrafiltration membranes with larger pore openings are used by some manufacturers. Hollow fiber membranes create a vacuum induced filtration through the larger pore openings and require smaller differential pressures as compared to pressures needed to filter through smaller pore openings in other ultrafiltration membranes.

Submerged ultrafiltration membranes are sometimes used for filtration of mixed liquor suspended solids (MLSS) and are used in place of the normal sedimentation/clarification process normally used in secondary treatment. Zenon, Kubota, Koch, Hydranautics and other manufacturers supply these types of Ultrafiltration membranes.

- Nanofiltration. Nanofiltration is normally used in the lower end of the ionic range (about 0.001 micron) to the upper end of the molecular range (about 0.008 micron). Nanofiltration requires higher differential pressures because of filtration through very small pore openings. Nanofiltration is not used for clarified effluent filtration.

- Reverse Osmosis. Reverse Osmosis membranes are used in the lower end of the ionic range (about 0.0001 micron to 0.001 micron). Reverse Osmosis membranes are primarily used in brackish water filtration and in desalination of sea water. Reverse Osmosis membranes require significantly higher operating pressures and are not used for clarified effluent filtration.

Also shown on the filtration spectrum are specific filtration technologies including:

- Zenon Zee-Weed Hollow Fiber membrane
- Kubota Plate membrane
- Memcor Microfiltration membrane
- Disc and Cloth filters by Aqua Aerobics, Siemens, Veolia and others
- Conventional granular filtration systems.

Conventional filtration approaches are similar to the existing filtration system and will be discussed in TM3. The following alternative filtration technologies are described in detail below.

- Traveling Bridge
- Upflow
- Compressible Media filters
- Cloth media
- NOVA (Stainless Steel media)

4.2 Traveling Bridge Filters

Traveling bridge filters are continuously operating down flow filters in which filtering of effluent and backwashing of the filters take place simultaneously. A shallow bed of granular media is used primarily for surface filtration in Traveling Bridge Filters. In this type of filter, the filter bed is partitioned into a number of 12” to 18” wide filter cells, each extending the full width of the filter bed. Incoming water is allowed to enter and flood the filter bed, flow downwards through the granular media in the filter cells, and then enter an effluent channel. The effluent channel supplies backwash water and also discharges filtered water into a clearwell normally located under the filter.

A slow moving traveling bridge carrying a backwash pump and a backwash hood stops over each filter cell, covers the cell top and isolates it. The backwash pump (installed on the traveling bridge) draws filtered water from the effluent channel and supplies it for backwashing from underneath the filter bed. Backwash water moving up through the filter bed washes the filter media in that isolated cell while filtration continues in the other filter cells, uninterrupted. Once the backwashing of that filter cell is completed, the bridge, hood and backwash pump moves slowly over to the next filter cell and initiates backwash of the new cell. During this movement from one end of the filter to the other, filtering operation of all the cells, except the one being backwashed, is maintained. Because of this continuous backwash process, no set limit for turbidity breakthrough or maximum terminal headloss through the filter bed is used for backwash in traveling bridge filters. Figure TM2-8 illustrates a schematic of the traveling bridge filter and Figure TM2-9 shows a traveling bridge in service.

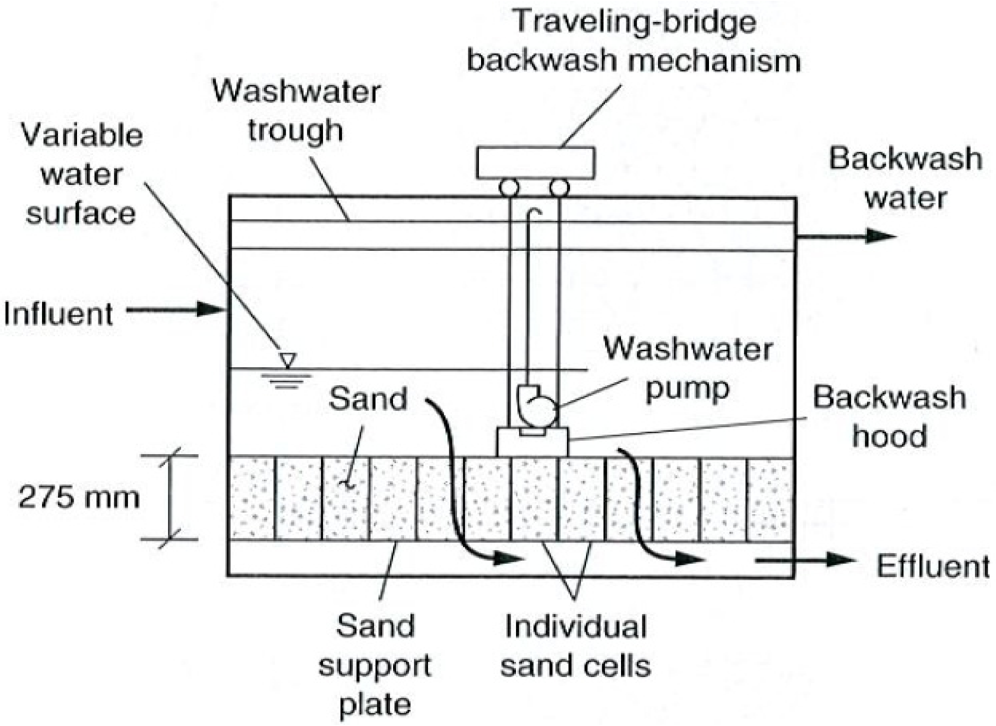


Figure TM2-8 - Schematic of the Traveling Bridge Filter

Figure TM2-9 - Automatic Traveling Bridge Filter System

Advantages/Disadvantages. The traveling bridge filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Proven technology
- Filter remains in service during backwash
- Low backwash rates between 2 to 5 percent of total throughput
- Low Headloss through filter
- Backwash water equalization is not required

Disadvantages:

- Complex mechanical equipment
- Higher maintenance requirements
- Reduced effluent quality due to shallow media depth

4.3 Upflow Granular Media Filtration

4.3.1 Intermittent Backwash Granular Media Filtration

This method of filtration uses a stratified media consisting of one to two layers of gravel supporting two or more layers of sand. Normally a coarse layer (30 mm to 40 mm size) of gravel supports a finer layer (10 mm to 15 mm size) of support gravel. On top of the support gravel lays a coarse layer (2 mm to 4 mm size) of sand which in turn supports a deep bed fine layer (1 mm to 2 mm size) of sand. A buried restraining grid is used to form sand arches to create a tight filter bed. Influent for filtration is supplied from the bottom of the bed.

The bed is drained prior to backwashing with effluent. Air scouring with low pressure air is used first to break up the sand arches. Air scouring is followed by a combined air/water backwash. Backwashing is followed by filter media settling (stratification) and a pre-filtration period to assure effluent clarity. Higher filtration rates (6 gpm/ft2 to 12 gpm/ft2) have reportedly been obtained (WEF MOP 8) with this type of upflow filtration. Figure

TM2-10 illustrates the process flow schematic of the Upflow Intermittent Backwash Granular Media Filter.

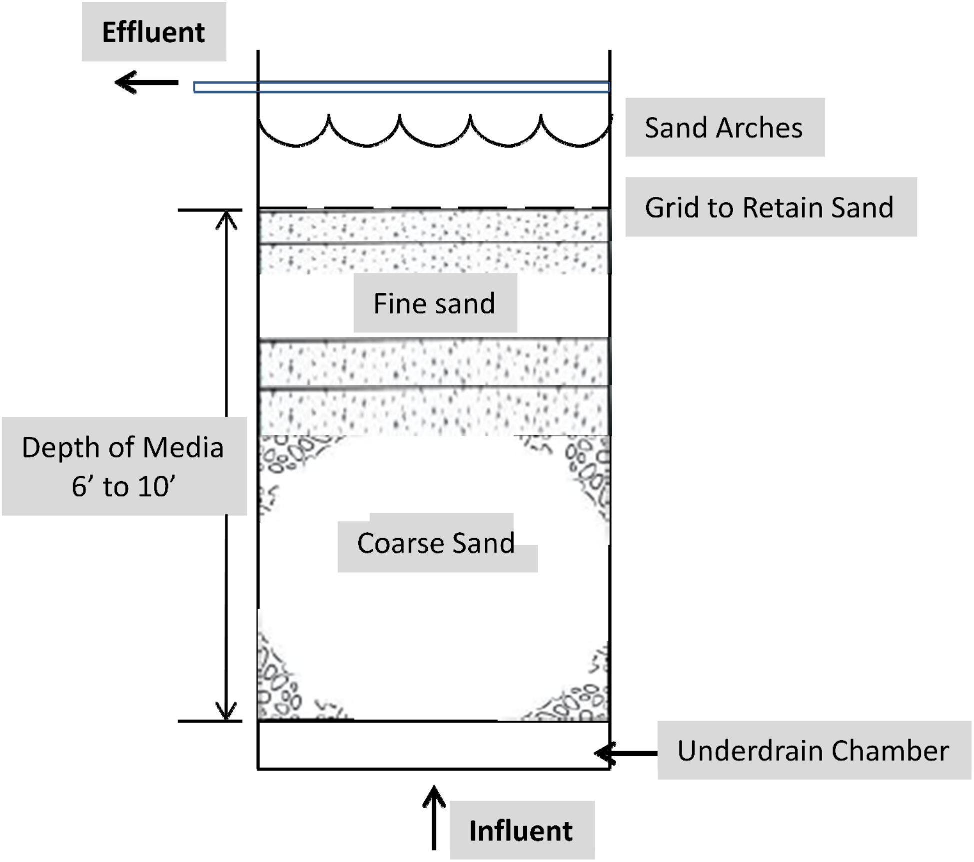


Figure TM2-10 - Upflow Intermittent Backwash Granular Media Filter

4.3.2 *Continuous Backwash Upflow Granular Media Filtration*

In continuous upflow filtration, wastewater is introduced at the bottom of the filter bed and flows upwards through the granular media. The flow is distributed uniformly through the media using mechanical means. Wastewater effluent flows up through a downward moving granular media. The filtered water exists from the media and overflows a weir into an effluent pipe. An air lift system is used to lift the granular media and solids removed into a sand washer. As the granular media is lifted to the top of the filter media, solids are separated from the granular media due to abrasion of the particles. A sand washer is used to washout the solids over a weir. The granular media is continuously cleaned while a filtrate stream and a reject washwater stream is continuously produced. Figure TM2-11 illustrates the process flow schematic of the Upflow Continuous Backwash Granular Media Filter. Figure TM2-12 shows an operating upflow filtration system.

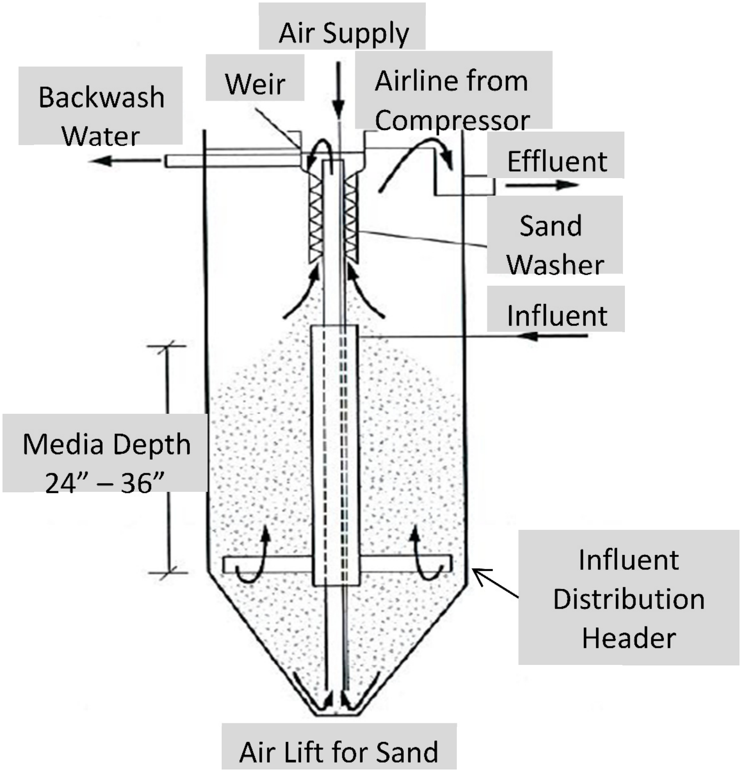


Figure TM2-11 - Upflow Continuous Backwash Granular Media Filter

Figure TM2-12 - Upflow Filtration System

Advantages/Disadvantages. The upflow continuous backwash filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Established technology
- Can handle higher TSS concentrations without blinding
- Low maintenance due to no moving mechanical parts
- Filter remains in service while backwashed
- Lower backwash rates between 5 to 10 percent of total throughput
- Equalization of backwash water is not required

Disadvantages:

- Foreign objects can plug airlift pipe

- Higher headloss through filter
- Proprietary equipment, could be difficult for competitive bidding

4.4 Compressible Media Filtration

The compressible media filter (CMF) uses compressible fiber media set between two plates. The porosity of the filter media can be adjusted by changing the compression level of the media. Fluid flows through the media as opposed to around the media in conventional filters in either an upflow or downflow configuration. Significantly higher surface loadings are possible due to the porosity of the media. These filters are designed based on peak hydraulic loading rates between 20 to 30 gpm/sf. The depth of the media bed is typically in the range of 24 to 30 inches. During a backwash cycle, the compression plates are opened allowing the media to expand. The direction of flow in the filter is reversed and air is introduced to help scour the media. A typical backwash rate is approximately 10 gpm for 30 minutes. Figure TM2-13 shows a picture of the respective media (orange being downflow and pink being upflow) from the respective CMF vendors. Figure TM2-14 shows an operating CMF facility.

Figure TM2-13 - CMF Media

Figure TM2-14 – CMF Installations

Advantages/Disadvantages. The compressible media filtration technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Smallest footprint
- Design for significantly higher hydraulic loading rates
- Reduced backwash rates
- Porosity of media is adjustable

Disadvantages:

- Developing technology
- Process reliability has not been established
- Life span of media is unknown
- Filter must be taken out-of-service for backwashing

4.5 Cloth Media Filter

The cloth media filter uses a high density cloth membrane as the filter media. The cloth membrane is attached to pie-shaped hollow disks mounted vertically on a common effluent tube that conveys filtered process water from the filter basin. Two types of configuration are available on the market. Flow direction in the first configuration moves from the outside of the media to the inside. The second configuration filters from the inside of the media to the outside. The cloth covered disks are stationary and submerged in the filter basin during normal operation. Various types of media can be used ranging from a cloth pile (shown in Figure TM2-15) to a synthetic media. Heavier solids are allowed to settle in the filter basin and periodically pumped from the basin. This reduces the solids load on the membranes and the required frequency of the backwash cycle.

The disks also remain submerged and in operation during a backwash cycle. Suction heads located on each side of the filter disk draw filtered water back through the cloth membrane removing the entrapped particles as the disc rotates at a speed of 1 fps. A high pressure spray backwash cycle is also used approximately once per week to control bio-growth on the cloth media. The cloth media filters are typically designed for peak hydraulic loading rates as high as 6 gpm/sf. Figure TM2-16 shows a cloth media installation.

Figure TM2-15 - Example of Cloth Media

Figure TM2-16 - Cloth Media Filter Installation

Advantages/Disadvantages. The cloth media filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Small footprint
- Low headloss through filter
- Very low backwash water requirements, less than 2- 3 % of throughput
- Filter remains in service while backwashed

Disadvantages:

- Developing technology
- Equipment reliability not yet established
- Proprietary equipment, could be difficult for competitive bidding
- Cloth media may not be compatible with polymer if required for filter performance optimization

4.6 NOVA Filter Technology

The NOVA Ultrascreen Filter is an "inside to out" disk filter system. This means that the flow to be filtered enters between the disks on the inside and the filtered effluent is on the outside of the disks. The disks rotates continuously as shown in Figure TM2-17.

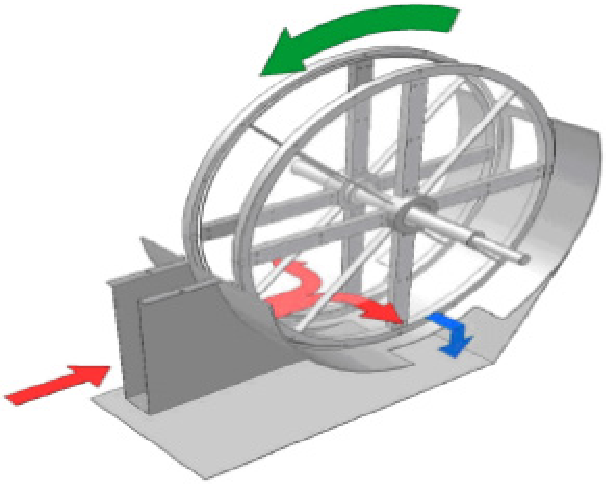


Figure TM2-17 - Schematic of Ultrascreen Filter

The premise of this filter is that it uses the principle of "dynamic tangential filtration." Dynamic tangential filtration means that the rotation of the disks allows for higher hydraulic throughput compared to static cloth media disk systems. The Nova system contains multiple disk units similar to other disk filter systems. One disk unit is comprised of two disk units with approximately 24 inches separating each disk. Each is composed of six parts, similar to other disk systems. The major difference between the Ultrascreen and other cloth systems is that the media is a stainless steel mesh. By having each disk composed of multiple pieces allowing ease of maintenance.

Since the area between each disk is open it allows for easy access for removal of debris should any material need to be removed. This open area between disk units allows for the installation of a backwash channel for removal of backwash solids.

As headloss builds up on the media a backwash cycle is initiated by the use of two level sensors (high water level and low water level). When the water level reaches the high level sensor, a backwash cycle is initiated. Spray nozzles located on the outside of the media spray clean water though the media removing the captured material on the inside of the filter disk. Source water for each backwash water is either filtered water or from other non-potable water sources. If filtered water is used, a solids strainer needs to be used to protect the backwash nozzles from plugging. Water from backwashing is collected in a trough located in the open area between each disk and is connected to a main backwash channel to remove the backwashed solids. Based on the design of the filter, all rotating bearings are located above the water level.

Advantages / Disadvantages. The Nova filter technology has the following advantages and disadvantages relative to the other filtration technologies under consideration.

Advantages:

- Small footprint
- Low headloss through filter
- Very low backwash water requirements, less than 1 % of throughput
- Filter remains in service while backwashed

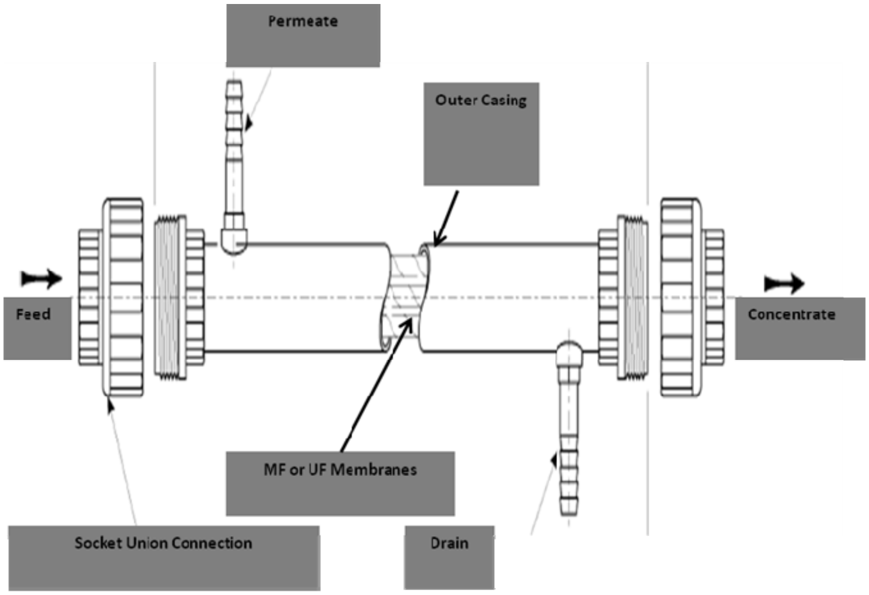
Disadvantages:

- Developing technology
- Equipment reliability not yet established
- Proprietary equipment, could be difficult for competitive bidding

4.7 Membrane Filtration

Microfiltration (MF) and Ultrafiltration (UF) membranes may also be used for separation of particles by straining and/or sieving on a surface. As mentioned above Microfiltration membranes are normally used to remove particles in the range of 0.5 micron to 3.0 micron while Ultrafiltration membranes are used for removing particles in the 0.03 to 0.4 micron range.

Both MF and UF membranes are used for filtration in unsubmerged tubular configurations and Submerged Hollow Fiber and Submerged Plate configurations. In tubular MF and UF configurations, the membranes are encased in an outer casing. MLSS or clarified effluent to be filtered is pumped through the membrane tubes. Under pressure, solids and other particles are retained inside the membrane tubes and water (called permeate) passes through the micro pores into the outer casing. An example of tubular MF and UF Filters is presented in Figure TM2-18.



FigureTM2-18 - Example of tubular MF and UF Filters

Submersible MF and UF membranes are used as either tubular hollow fiber filters or plate filters. Hollow fiber membranes are used with the water passing through the pore openings from outside of the fiber strand to the inside under a vacuum induced trans-membrane pressure. Figure TM2-19 illustrates a submersible hollow fiber strand, a filter module built of many such strands and cassettes makes up many modules.

Submersible plate membranes are used similar to the hollow fiber membranes except these membranes work under pressure. Figure TM2-20 illustrates a submersible plate membrane.

Both MF and UF membranes shown above have been used for MLSS and effluent filtration. Required pressures for these types of membranes are higher than other types of filtration discussed. These types of membrane filtration systems are much more expensive (in both capital and operating costs) as compared to other filtration methods described earlier in this section and require considerably more operations and maintenance. Because of these reasons MF and UF membrane filtration systems are not normally used for secondary effluent filtration.

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Figure TM2-19 - Example Submersible Hollow Fiber strand

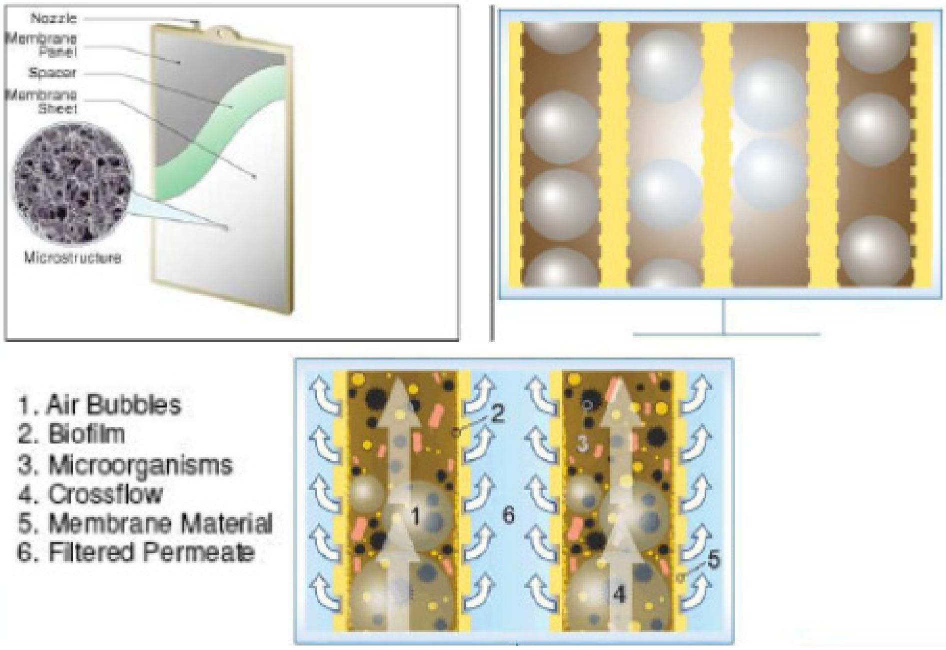


Figure TM2-20 - Schematic of Submersible Plate Membrane

5.0 EVALUATION OF ALTERNATIVES FILTRATION TECHNOLOGIES

5.1 Description of Evaluation Criteria

A workshop was held June 9, 2011 to discuss various alternative filtration technologies and select two of the filter technologies for further evaluation. At the outset of the workshop various criteria important to the City were discussed. Results of this discussion indicated that membrane filtration alternatives (microfiltration, ultrafiltration, and reverse osmosis) would not be included in the evaluation. This was due to the cost and over all complexity of these types of systems.

Each filter system was discussed during the workshop and then decisions made on the specific criteria. The workshop presentation slides are included as reference in Attachment TM2-A.

5.2 Results of Evaluation

Table TM2-1 summarizes the results of the discussions on each of the criteria during the workshop. Based on the discussion the Aqua cloth media filter was decided to be one of the technologies to be considered for WCWWTP. The meeting concluded with the WWETCO compressible media filter and the Nova Ultrascreen requiring additional research.

Table TM2-1

Evaluation of Alternative Filtration Technology

Filtration Technology	Criteria						
	Experience at WCWWTP Flows	Modify into Existing Structure	Optimize Existing Facilities	Flexibility for Expansion	Flexibility for Future Regulations	Energy Optimization	Reliability/ Complexity
Conventional	•	•	•		•		•
Traveling Bridge	•						
Upflow					•	•	•
CMF		•	•	•	•		•
Cloth	•	•	•	•	•	•	•
NOVA		•	•	•	•	•	
Staff indicated during the Workshop that Microfiltration and Reverse Osmosis would not be evaluated							

Additional information was presented to City Staff on June 23 on both filter systems and is included in Attachments TM2-B and TM2-C. Based on the discussion with the City, the NOVA Ultrascreen was selected as the second alternative filtration technology for evaluation during this study. The Nova system was selected based on the following criteria:

- Received conditional acceptance from the California Department of Public Health
- Stainless Steel construction
- Similar concept to other disc filtration technology

5.3 Selected Alternative Technologies for WCWWTP

Based on the outcome of the workshop and subsequent discussions with the City, the following two filtration technologies were selected for detailed evaluation as alternatives to the existing granular media filters at the WCWWTP:

- Cloth Media Filtration

- NOVA Ultrascreen

6.0 CONCEPTUAL DESIGN OF SELECTED FILTRATION ALTERNATIVES

The alternative filtration technologies were selected for evaluation in part because they are suitable for retrofitting into the existing filter boxes at the filter complex, and that is the approach used for the conceptual design of the alternatives. Cloth media filters are offered by several different manufacturers, and the details of the layout are specific to each manufacturer. To expedite this conceptual design, equipment from Aqua Aerobics was selected for the cloth media alternative. The stainless steel mesh screen is offered only by NOVA and their input was solicited for that design.

For both alternatives, the filter influent conduits that convey flow from the chlorine contact basins to the filter complex were assumed to be left in service. This includes the overflow boxes that divert secondary effluent to the plant outfall in the event the capacity of the screens is exceeded. Likewise, the existing conduit that conveys filter effluent to the outfall was left in service for both alternatives. Refer to TM3 for a discussion of the hydraulic capacity of these conduits. The backwash drain line that returns spent backwash from the filter complex to the flow equalization basins was left in service for both alternatives, and the existing connection of the Water Reclamation Initiative (WRI) low service pump station to the north clearwell was assumed to remain in service. Thus the improvements described for each alternative are confined to the filter complex itself.

6.1 Cloth Media Alternative

The cloth media alternative is described in detail in the Preliminary Design Report prepared by Aqua Aerobics dated July 12, 2011 attached to this TM2 as Attachment TM2-D. This design report recommends the installation of 24 AquaDisk Model #ADFSC-54X12E-PC units. The size of these units is such that they can be installed with four units to one of the existing filter boxes. Thus six existing filter boxes would be retrofitted to provide 75 mgd of firm filter capacity.

6.1.1 Description of Improvements

These units are configured as outside-in filters, so the disk units will be submerged in concrete boxes that contain filter influent. Separate channels will be constructed within each box to remove filter effluent from the center shaft and convey the combined effluent to the existing filter gullet and thence to the clearwell. In order to accomplish this retrofit and maintain some of the existing filters in service, it is recommended that filter boxes 5 through 10 be retrofitted with these units, with filters 1 through 4 remaining in service throughout construction to provide the basic filtration needs for the WRI and non-potable system, as well as filter a portion of the plant effluent. The following paragraphs describe the modifications to the existing filter complex for the Cloth Media Alternative.

Mechanical. The existing piping systems in the gallery for backwash supply, backwash drain, low pressure air and surface wash would be completely demolished and removed. The existing 36-inch filter influent conduits to each filter box would be retrofitted to remove the existing 36-inch valve and install a tee connection. Each filter box will be served by two 18-inch filter influent lines off of this tee. The filter influent piping will be routed down to a lower level in the filter gallery where it is accessible and each 18-inch feed will be provided with a magnetic flow meter and throttling valve to move the filter flow control to the influent side of these units. Each 18-inch influent line will feed two AquaDisk units, the split of flow between those two units will be accomplished with fixed weirs inside the filter box.

On the effluent of each filter, the flow from all four units will be collected in the existing filter gullet and will be routed into the gallery using the existing 30-inch piping connection. The existing flow meter and throttling valve on the effluent will be removed and a new isolation valve installed to allow isolation of each filter box from the common effluent channel. The existing filter effluent channel and clearwell will remain in service.

Backwash for these units is accomplished using one pump for each pair of AquaDisk units. Each pump is connected to eight electrically actuated valves which cycle on and off in conjunction with the pump and disk drive to clean the cloth media based on differential head across the filters. The pumps and valves are located within the filter gallery adjacent to each filter. The suction piping from each pump consists of a manifold of eight valves that are connected to backwash shoe assemblies that are submerged within the filter boxes. The discharge from each pump will be metered and routed to the existing spent filter backwash piping which is routed under the slab of the gallery.

Periodically, solids that settle to the bottom of the concrete basins are removed by opening an electrically actuated plug valve that will direct solids to the spent backwash drain. One solid waste valve is provided in the gallery for each pair of AquaDisk units. Scum is removed from each filter box by periodically allowing the water level in the box to increase above the normal operating level until flow reaches a fixed scum drawoff weir. Flow is allowed to go over this weir to the spent backwash drain for a period of time before the filter is returned to normal operation.

Structural. Structural modifications will be required in order to install these AquaDisk units into filter boxes 5 – 10. These modifications include removal of all of the media, backwash troughs, concrete sub-floor that contains the underdrain nozzles, and the baffle walls that support the sub-floor. New structural concrete will be placed to form the influent channels, filter boxes and effluent channels within each filter box. Access platforms with grating will be installed to allow access to the units for replacement of filter media.

These units have a significant amount of equipment located within the existing filter boxes, which are currently exposed. It is recommended that these basins be covered in order to protect the equipment and plant personnel who will be maintaining the equipment. The proposed basin covers consist of a structural steel framing system supporting a flat roof that is located at the same elevation of the roof of the control building. The existing fascia system around the control building that gives the plant its distinctive “Aztec” architecture will be removed and a similar fascia will be constructed around the full perimeter of the filter complex. This fascia system will be situated over the existing perimeter walls to provide the illusion of a completed structure, but in fact there will be an open area of approximately 5.5 feet vertically around the entire perimeter. The flat roof will be provided with roof drains to direct rainwater to storm drains and will be provided with lighting in the form of high-bay task lights for night work as well as skylights that will admit natural light into the filter boxes.

Electrical and Controls. The equipment offering provided by Aqua Aerobics includes twelve control panels, one for each pair of AquaDisk units. These panels will be located in the filter control building on the operating floor. The panels include a Programmable Logic Controller (PLC) that controls all of the valves and motors associated with each pair of units. These panels include variable frequency drives for the sludge pumps and motor starters for the disk drive units. Power will be supplied to these units from a central MCC which will also power lighting, HVAC and other building loads. A Graphic User Interface (GUI) will be provided with each unit to allow operator control.

6.1.2 Construction and Operating Costs

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM2, limited to work within the existing filter complex related directly to the installation of Cloth Media Filters. Demolition of existing equipment and piping that is no longer in service is included in these costs. However, these costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM2-E includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM2-2 lists the capital cost for the Cloth Media Alternative.

Table TM2-2

Capital Costs for the Cloth Media Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	361,000
Division 3 – Concrete	606,900
Divisions 4 through 9 – Filter Superstructure and Metals	1,065,500
Division 13 – Special Construction (Aqua Aerobics)	8,680,000
Division 15 – Mechanical	355,900
Division 16 – Electrical	159,900
General Conditions, Overhead and Profit	2,245,800
Contingencies	5,390,000
Total Capital Cost	**18,865,000**

The operating and maintenance cost for this alternative is based on maintaining a significant number of highly mechanized units. There will be 24 drive units, each driving 12 disks. Each of the 288 disks installed will be fitted with a mechanical dewatering shoe, and those will be marshaled into a total of 72 electrically actuated drain valves. Twelve backwash pumps will be installed along with 12 drain valves. This is a significant installation of equipment and will require operator attention. The following assumptions have been made regarding the operating and maintenance costs of this equipment:

- The overall efficiency of these filters is 98%, so that 2% of the influent flow is recycled through the spent filter backwash system. Electrical power costs are calculated based on information from Aqua Aerobics, 363 kw-hr/day for the backwash pump and 60 kw-hr/day for the disk drive unit. These costs are all captured as cost of backwash.
- Routine operation costs are estimated at four hours per day, similar to the cost of granular filters with a new control system in place.
- Routine maintenance of equipment is estimated at eight hours per week to cover all equipment lubrication, calibration of instrumentation, and general maintenance.
- Filter cloth media has a life of seven years. The annual costs are calculated based on replacing 42 disks per year with a material replacement cost of $1,614 per disk and 1.5 staff-hours per disk.
- Main V-ring seal has a life of ten years. The annual costs are calculated based on replacing 2.5 units per year with a material replacement cost of $1,000 per unit and four staff-hours per unit.

A summary of the operating and maintenance costs associated with this alternative are summarized in Table TM2-3.

Table TM2-3

Operating and Maintenance Costs for the Cloth Media Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$26,600
Labor Costs	$52,900
Replacement Parts and Materials	$73,700
Total Annual Cost	**$153,200**

6.2 NOVA Ultrascreen Alternative

The NOVA Ultrascreen alternative is described in detail in the Preliminary Design Report prepared by NOVA Water Technologies dated July 14, 2011 attached to this TM2 as Attachment TM2-F. This design report recommends the installation of 14 NOVA Ultrascreen Disk Filters, Model #UL1612CS. The size of these units is such that they can be installed with two units to one of the existing filter boxes. Thus seven existing filter boxes would be retrofitted to provide 75 mgd of firm filter capacity.

6.2.1 Description of Improvements

These units are configured as complete, covered filters, with all flow contained within the unit and piping connections required. Therefore the area now occupied by the filter boxes will be converted into concrete floor space to house the new mechanical equipment. Separate piping connections will be made to the inlet, outlet, drain, and overflow from each box and this pipe will be routed to the appropriate location within the filter gallery. In order to accomplish this retrofit and maintain some of the existing filters in service, it is recommended that filter box renovation begin with filter 10 and proceed from east to west, keeping filters 1 through 4 in service to provide the basic filtration needs for the WRI and non-potable system, as well as filter a portion of the plant effluent. The following paragraphs describe the modifications to the existing filter complex for the NOVA Ultrascreen Alternative.

Mechanical. The existing piping systems in the gallery for backwash supply, backwash drain, low pressure air and surface wash would be completely demolished and removed. The existing 36-inch filter influent conduits to each filter box would be retrofitted to remove the existing 36-inch valve and install a flow meter and throttling valve. The new filter influent piping will provide flow control to a pair of units on the influent side. Each influent line will feed two filter units; the split of flow between those two units will be accomplished within the filter mechanism.

On the effluent of each filter, the flow from each pair of units will be collected in a new piping system that is routed into the gallery and connected to the filter effluent conduit connection through the gallery wall. The existing flow meter and throttling valve on the effluent will be removed and isolation valves will be installed to allow isolation of each filter unit from the common effluent channel. The existing filter effluent channel and clearwell will remain in service.

Washing of the screen units for these units is accomplished using a skid-mounted booster pump and nozzle arrangement on each of the filter units. These booster pumps take suction from the filtered water within the unit and supply spray nozzles within the filter boxes. The discharge from the nozzles and the solids washed off the screens are collected in a backwash trough that will be connected to the existing backwash waste piping in the gallery.

Periodically, solids that settle to the bottom of the units can be removed by opening an electrically actuated solids valve that will direct solids to the spent backwash drain.

Structural. Structural modifications will be required in order to install these Ultrascreen units into Filter Boxes 4 through 10. These modifications include removal of all of the media, backwash troughs, concrete sub-floor that contains the underdrain nozzles in filters 5 through 10, and the baffle walls that support the sub-floor in Filters 5 through 10. In filter 4, the existing underdrains will be removed down to structural concrete. A layer of compacted sand fill will be used to raise the grade up to within a foot of the new operating deck, and new structural concrete will be placed to form the deck within each filter box. Access to this deck will be provided with stairs and railings.

These units have a significant amount of equipment located within the existing filter boxes, which are currently exposed. It is recommended that these basins be covered in order to protect the equipment and plant personnel who will be maintaining the equipment. The proposed basin covers consist of a structural steel framing system supporting a flat roof that is located at the same elevation of the roof of the control building. The existing fascia system around the control building that gives the plant its distinctive “Aztec” architecture will be removed and a similar fascia will be constructed around the full perimeter of the filter complex. This fascia system will be situated over the existing perimeter walls to provide the illusion of a completed structure, but in fact there will be an open area of approximately 5.5 feet vertically around the entire perimeter. The flat roof will be provided with roof drains to direct rainwater to storm drains and will be provided with lighting in the form of high-bay task lights for night work as well as skylights that will admit natural light into the filter boxes.

Electrical and Controls. Control panels will be provided for the system and be located in the filter control building on the operating floor. The panels include a Programmable Logic Controller (PLC) that controls all of the valves and motors associated the units. Power will be supplied to these units from a central MCC which will also power lighting, HVAC and other building loads. A Graphic User Interface (GUI) will be provided with each unit to allow operator control.

6.2.2 Construction and Operating Costs

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM2, limited to work within the existing filter complex related directly to the installation of NOVA Ultrascreen Filters. Demolition of existing equipment and piping that is not longer in service is included in these costs. However, these costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM2-E includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM2-4 lists the capital cost for the NOVA Ultrascreen Alternative.

Table TM2-4

Capital Costs for the NOVA Ultrascreen Alternative

Description	**Capital Cost**
Division 2 – Sitework and Demolition	$361,000
Division 3 – Concrete	$187,100
Divisions 4 through 9 – Filter Superstructure and Metals	$1,431,300
Division 13 – Special Construction (Aqua Aerobics)	$7,560,000
Division 15 – Mechanical	$265,900
Division 16 – Electrical	$123,800
General Conditions, Overhead and Profit	$1,985,800
Contingencies	$4,766,000
Total Capital Cost	**$16,680,900**

The operating and maintenance cost for this alternative is based on maintaining a significant number of highly mechanized units. There will be 14 drive units, each driving 24 disks. Each of the 336 disks installed will be fitted with eight filter panels and 18 spray nozzles. Each unit has two drive motors that run continuously and a backwash pump that operates intermittently. This is a significant installation of equipment and will require operator attention. The following assumptions have been made regarding the operating and maintenance costs of this equipment:

- The overall efficiency of these filters is 99%, so that 1% of the influent flow is recycled through the spent filter backwash system. Electrical power costs are calculated based on information from NOVA, 216 kw-hr/day/unit for the drive motors and 36 kw-hr/day/unit for the backwash pump. These costs are all captured as cost of backwash.

- Routine operation costs are estimated at four hours per day, similar to the cost of granular filters with a new control system in place.

- Routine maintenance of equipment is estimated at eight hours per week to cover all equipment lubrication, calibration of instrumentation, and general maintenance.

- Filter panels have a life of 15 years. The annual costs are calculated based on replacing 22 disks per year with a material replacement cost of $2,400 per disk and four staff-hours per disk.

- Filter lateral seals have a life of five years. The annual costs are calculated based on replacing 34 sets of seals per year with a material replacement cost of $450 per set and two staff-hours per set.

- Filter spray nozzles have a life of 11 years. The annual costs are calculated based on replacing 550 nozzles each year with a material replacement cost of $30/nozzle and 0.5 staff hours per nozzle.

A summary of the operating and maintenance costs associated with this alternative are summarized in Table TM2-5.

Table TM2-5

Operating and Maintenance Costs for the NOVA Ultrascreen Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$137,600
Labor Costs	$62,600
Replacement Parts and Materials	$86,900
Total Annual Cost	**$287,100**

6.3 Hydraulic Considerations and Future Expansion

Two common features of these alternative filtration technologies are that they have less head loss and less space requirement than granular media filtration. These two features could provide benefits to the plant that are not quantifiable with the cost information provided for a 75 mgd retrofit. This section describes the potential benefits to the plant for either alternative filtration technology compared to granular media filtration.

6.3.1 Hydraulic Considerations

The filter complex is currently capable of treating a peak hydraulic flow of 120 mgd with a total loss through the granular filters of eight feet, even when the Colorado River is at the 100 year flood stage (refer to TM3 for a description of the hydraulic analysis). As additional flow is routed through the plant, less head is available for filtration, to the point that granular filtration becomes limited by the head available and flow must be bypassed around this process. If either of the alternative filtration technologies described in this section are implemented, the required head for the filtration process would be reduced to approximately 3 feet maximum. This would free up approximately five feet in the hydraulic profile which could be used to ensure more flow is filtered under high flow conditions.

To make this hydraulic improvement, the existing weir in the filter clearwell would have to be raised above its current elevation. This will require raising the roof of the clearwell, which is constructed below filters 1 and 3 in filter building 1, or constructing a new filter effluent structure. Given that neither of these alternatives will require the space afforded by filter boxes 1 and 3, raising the roof of the clearwell would seem the best choice. This would also increase the storage available for the WRI system and the non-potable system.

The costs associated with this potential improvement have not been included in this TM2, as the goal is to describe a filter improvements project rated for 75 mgd maximum month flow and both alternatives can fit into the existing hydraulic profile without this modification. If expansion to 100 mgd maximum month flow is considered, then this modification will become necessary to convey the increased flow from the filter complex to the plant outfall.

6.3.2 Future Plant Expansion

The next expansion of the Walnut Creek WWTP is envisioned to be a 25 mgd expansion to a total maximum month capacity of 100 mgd. Since only 60 to 70 percent of the existing filter area is used for these filtration alternatives, space is available to add more filter units within the existing footprint and achieve this filtration capacity. It is assumed that the peak hydraulic capacity of a plant rated at 100 mgd maximum month would be approximately 200 mgd, which is the rated capacity of the plant outfall. Under normal river stage, it is possible to route this entire flow through the alternative filtration technologies described in this section without bypassing, provided improvements are made to the clearwell effluent weir. If the Colorado River is at the 100 year flood stage and the total plant flow is 200 mgd, a significant amount of flow will have to bypass the filters even with this alternative technology.

However, expansion of the existing filter complex to a rated capacity of 100 mgd maximum month may not be practical. This expansion will also require secondary treatment improvements, which will likely be constructed south of the existing secondary treatment train. It may not be practical to route secondary effluent from the south side of the plant back to the effluent conduit system that exists on the north side of the plant. This evaluation is beyond the scope of the filter improvements project.

ATTACHMENT TM2-A
ALTERNATIVE FILTRATION TECHNOLOGIES WORKSHOP POWERPOINT PRESENTATION

9 June 2011

SAR/WC WWTPs JOINT FILTRATION TECHNOLOGY WORKSHOP

CITY OF AUSTIN, TEXAS

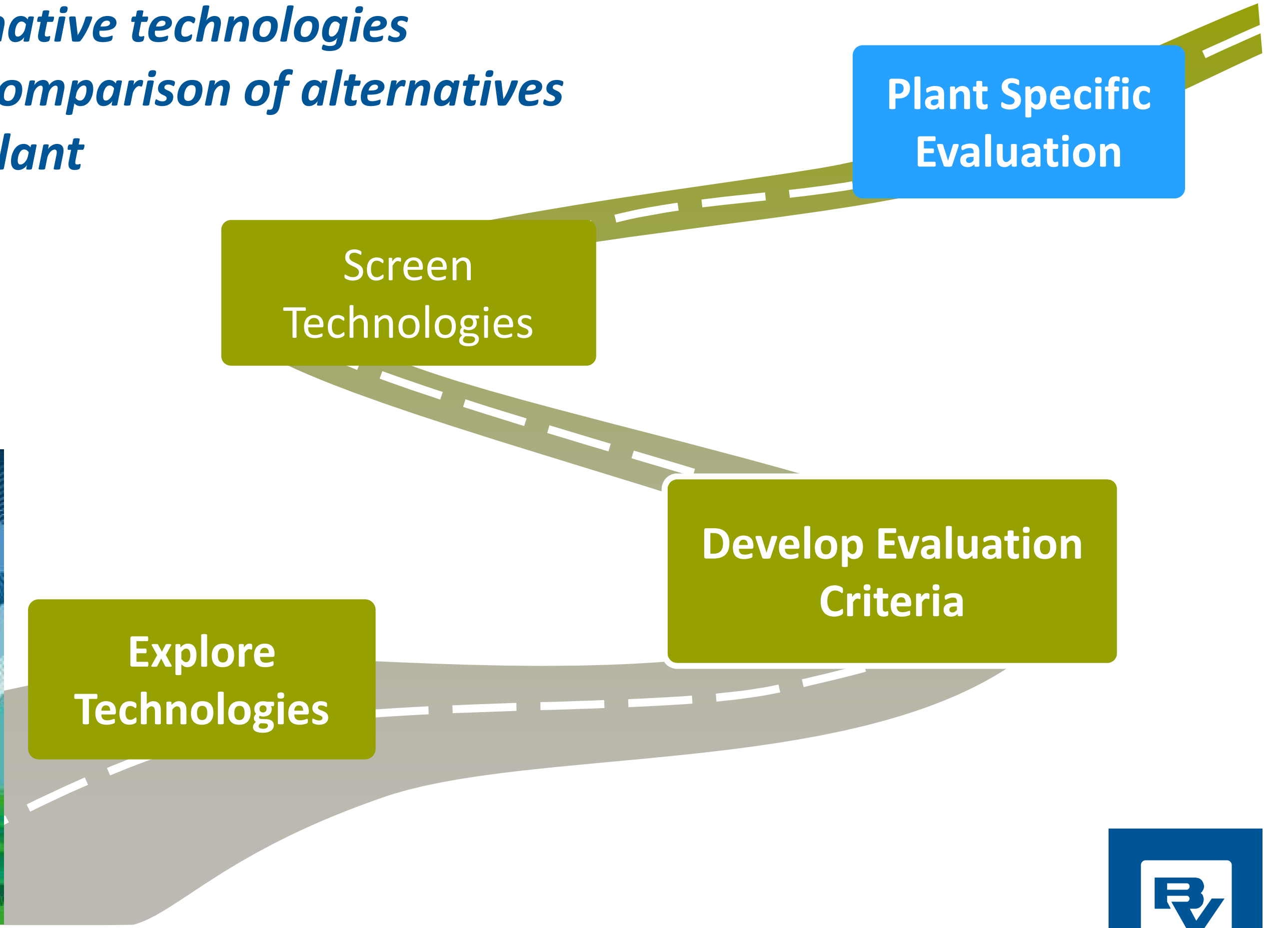
Austin Water

BLACK & VEATCH
Building a world of difference.

AECOM

BEGIN WITH THE GOAL IN MIND

1. *Explore available filtration technologies*
2. *Review general evaluation criteria*
3. *Screen technologies: Existing + up to two alternative technologies*
4. *Detailed comparison of alternatives for each plant*



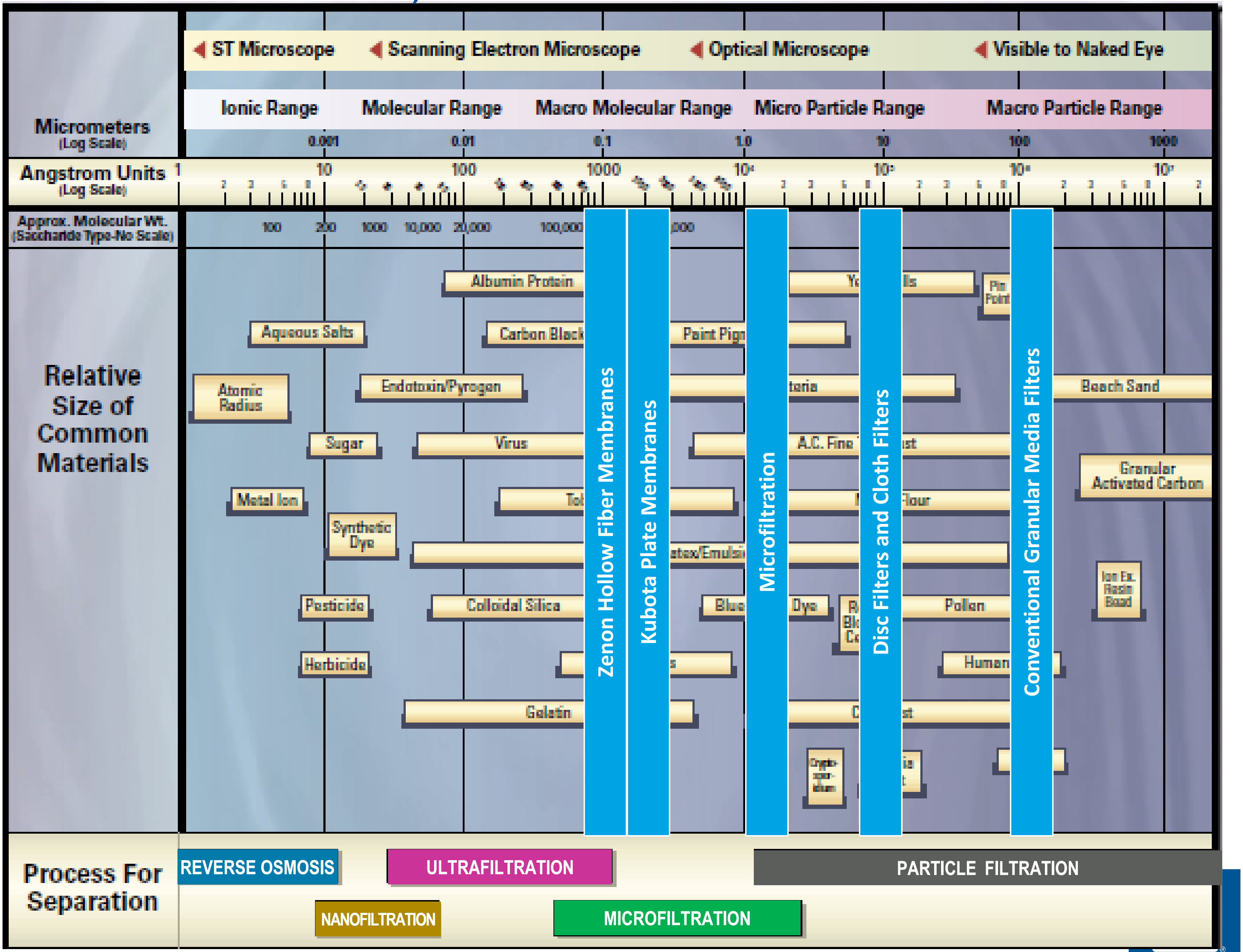
Explore Technologies

Develop Evaluation Criteria

Screen Technologies

Plant Specific Evaluation

CONVENTIONAL, DISC AND MEMBRANE FILTRATION SPECTRUM



EFFLUENT FILTRATION TECHNOLOGIES

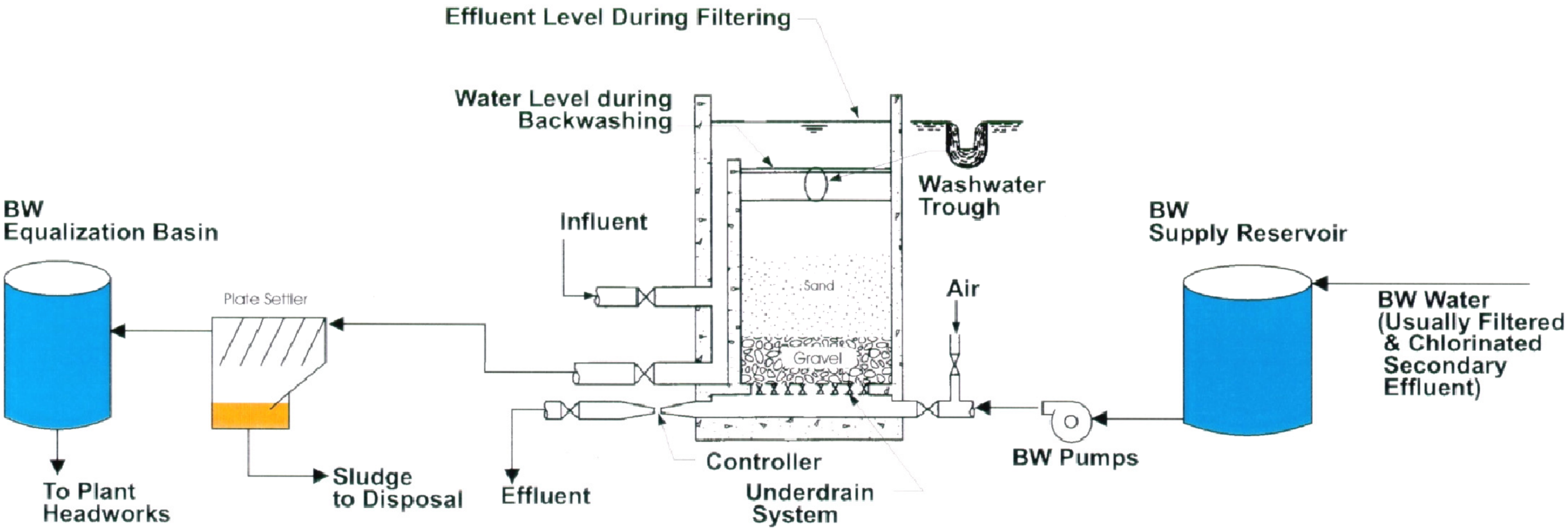
FILTRATION METHOD	FILTRATION RANGE	APPLICATION
DOWNFLOW DEPTH FILTRATION		
Conventional Granular Media Filtration Single Media Deep Bed Filters Dual Media Filters Multi-Media Filters **Traveling Bridge Filters**	100 to 200 microns	• Tested and proven old technology • Used extensively in Effluent Filtration • Very low pressures (2 to 5 psi)
UPFLOW MEDIA FILTRATION		
Continuous Backwash Granular Media Filtration **Compressible Media** **Intermittent Backwash Granular Media Filtration**	100 to 200 microns	• Tested and proven technology • Traditionally used in smaller WWTPs • Very low pressures (2 to 5 psi)
SURFACE FILTRATION		
Cloth Media Filtration **Nova** **Diatomaceous Earth Filtration**	10 to 20 microns	• Newer technology • Very low pressures (1 to 2 psi) • Often used for upgrading Granular Media Filters in older WWTPs
MEMBRANE FILTRATION		
Microfiltration	0.5 to 3.0 microns	• Tested and proven technology • Requires higher operating pressures (10 to 20 psi)
Reverse Osmosis	0.0001 to 0.001 microns	• Normally not used in Effluent Filtration • Requires very high operating pressures (200 to 500 psi)

WHAT TECHNOLOGY FITS BOTH PLANTS?

	Size of Plant	Existing Structure	Optimize Facilities	Future Reg			
Conventional							
Traveling Bridge							
Upflow							
Compressible Media							
Cloth Media							
Nova							
Microfiltration							
Reverse Osmosis							

DOWNFLOW DEPTH FILTRATION

CONVENTIONAL DEEP BED FILTER



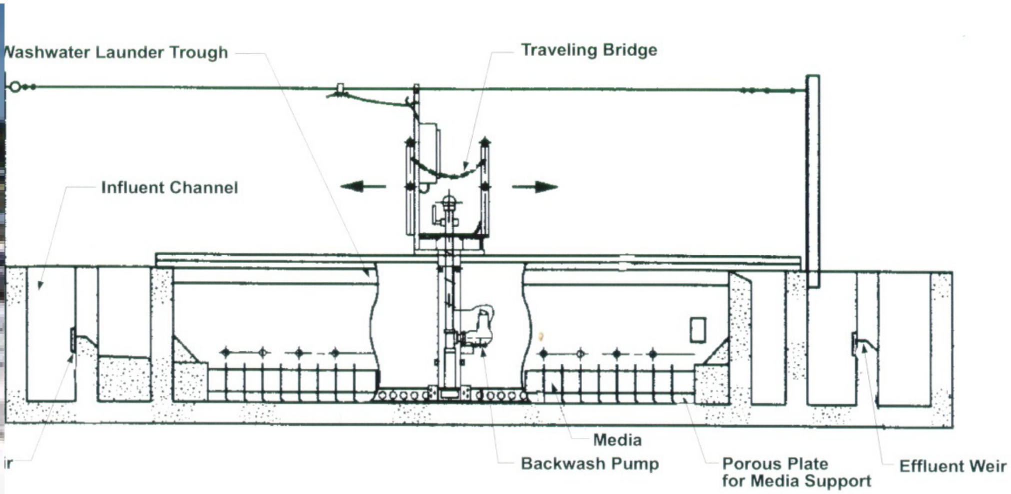
Advantages

- Proven and reliable technology for large plants
- Higher quality effluent
- Can handle a wide range of flow and load variations
- Staff familiar with technology

Disadvantages

- Requires complex ancillary facilities for backwash
- Higher O&M on ancillary equipment
- Higher headloss through filter compared to disc technology

TRAVELING BRIDGE FILTER



Advantages

- Automatic backwash operation
- Low headloss through filter compared to Conventional
- Backwash water equalization is not required
- Proven at larger flows

Disadvantages

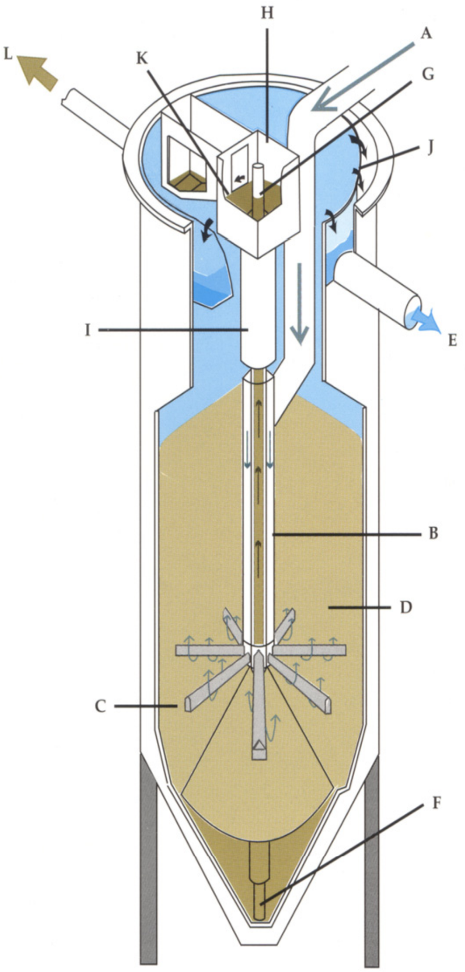
- Complex mechanical equipment
- More operator attention
- Higher maintenance requirements
- Reduced effluent quality due to shallow media depth
- Restricted hydraulic overflow rates
- Configuration not compatible with existing plant

UPFLOW MEDIA FILTRATION

UPFLOW MEDIA FILTRATION

CONTINUOUS BACKWASH DEEP BED FILTERS

Parkson Dynasand Filter



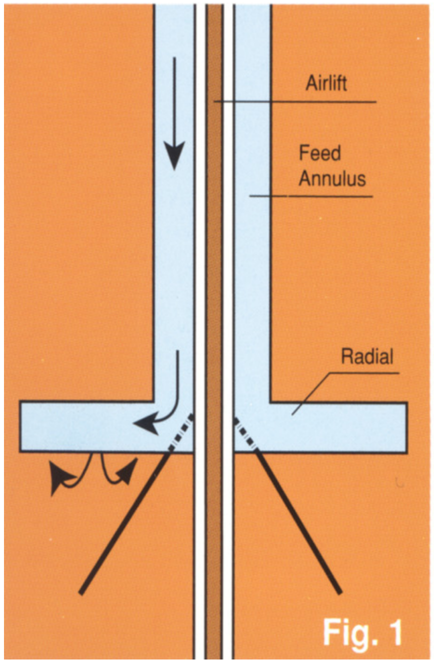


Fig. 1

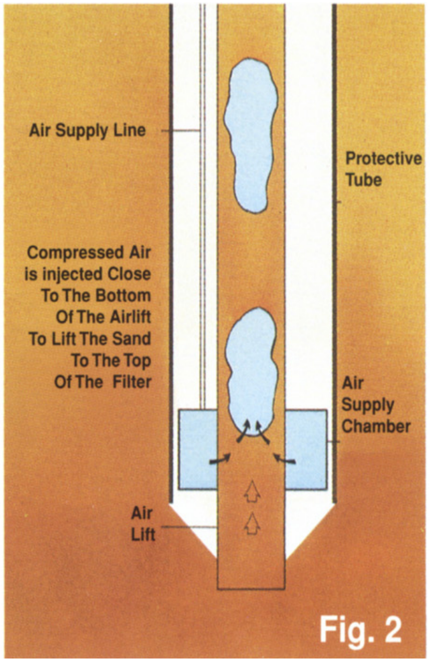


Fig. 2

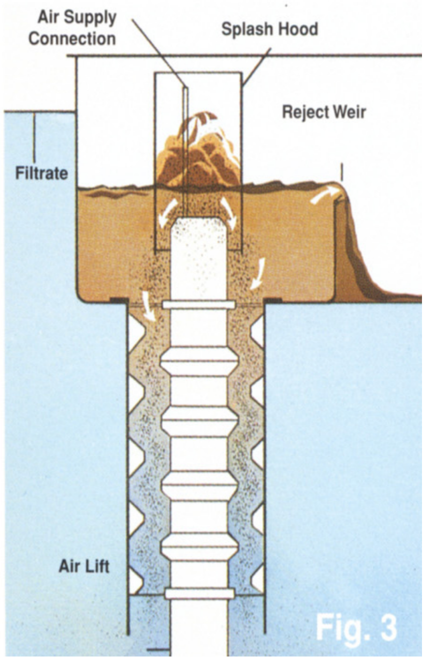
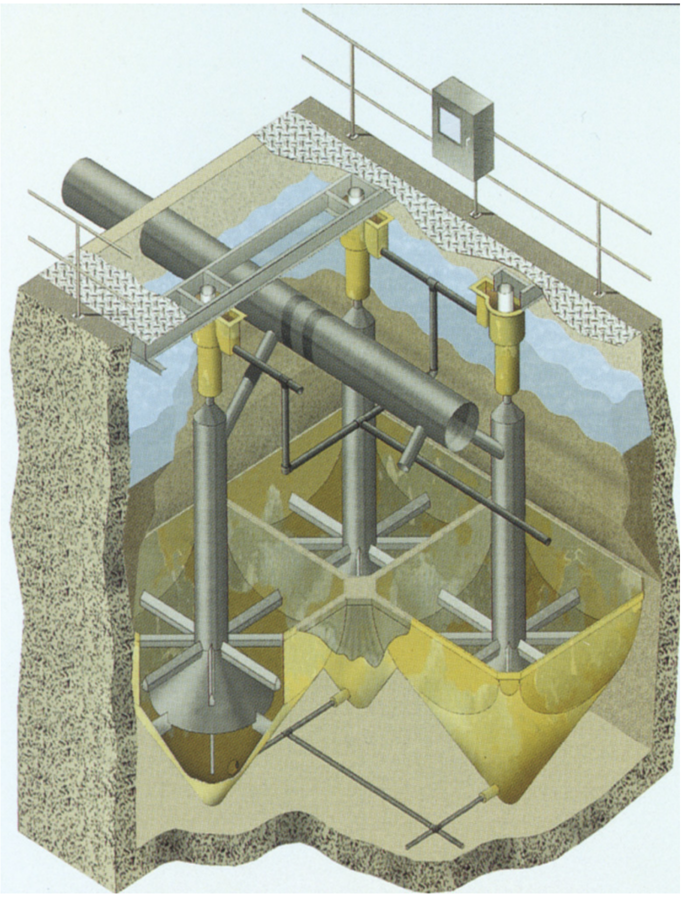


Fig. 3

DYNASAND FILTER INSTALLATION OPTIONS

Steel Tanks



Concrete Basins

CONTINUOUS BACKWASH DEEP BED FILTERS

Advantages

- Can handle higher TSS concentration without blinding
- Low maintenance due to no moving mechanical parts
- Continuous backwash operations
- Equalization of backwash water is not required

Disadvantages

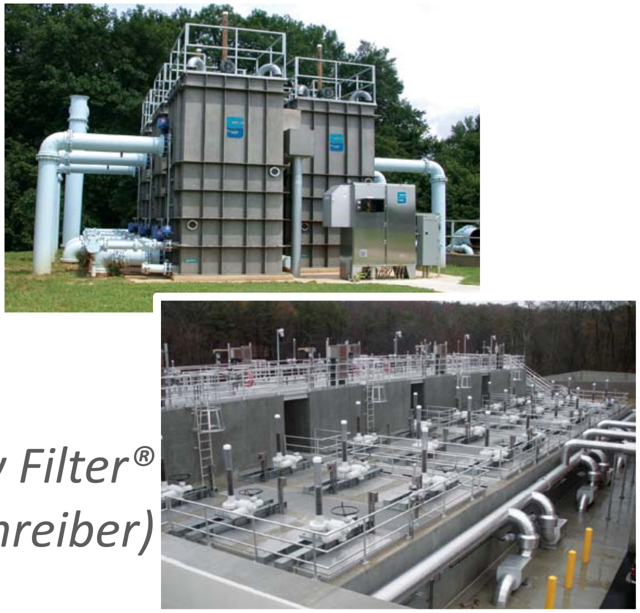
- Foreign objects can plug airlift pipe
- More complicated to operated
- Proprietary equipment
- Typically used at smaller plants

COMPRESSIBLE MEDIA

- **Synthetic fibers bundled together with stainless steel ring to form 1 to 1½ inch spheres**
- **30-inch bed depth**
- **Solids removal down to ~4 microns**
- **Long life (10+ years) with negligible degradation**

Filter bed porosity can be altered by compressing the media

TWO SUPPLIERS CURRENTLY PROVIDING COMPRESSIBLE MEDIA SYSTEMS



Fuzzy Filter®
(Schreiber)

WWETCO
FlexFilter™
(WesTech)

Advantages

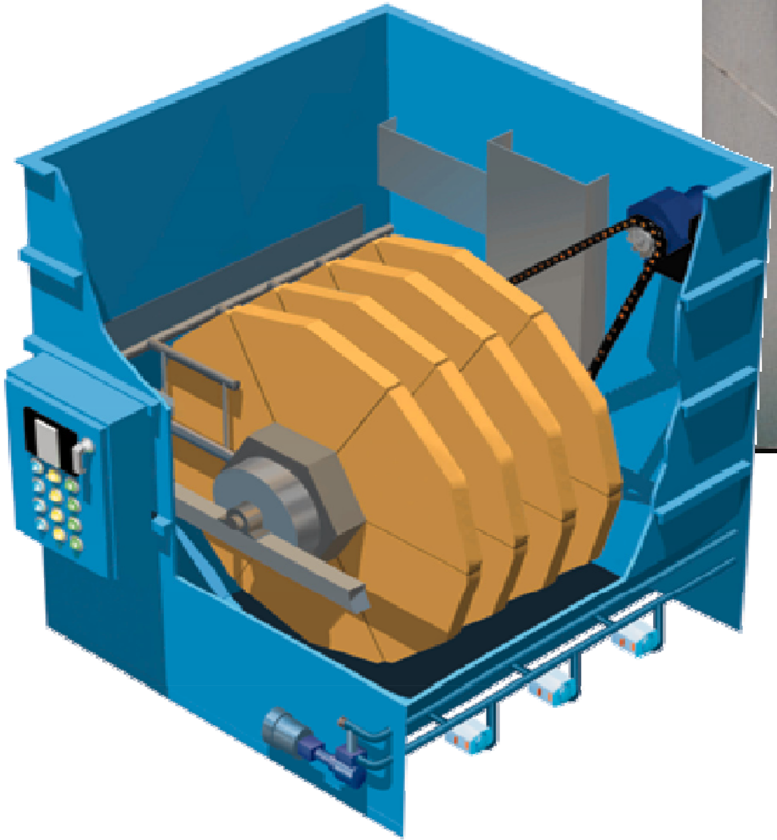
- Higher hydraulic throughput
- Generally upflow

Disadvantages

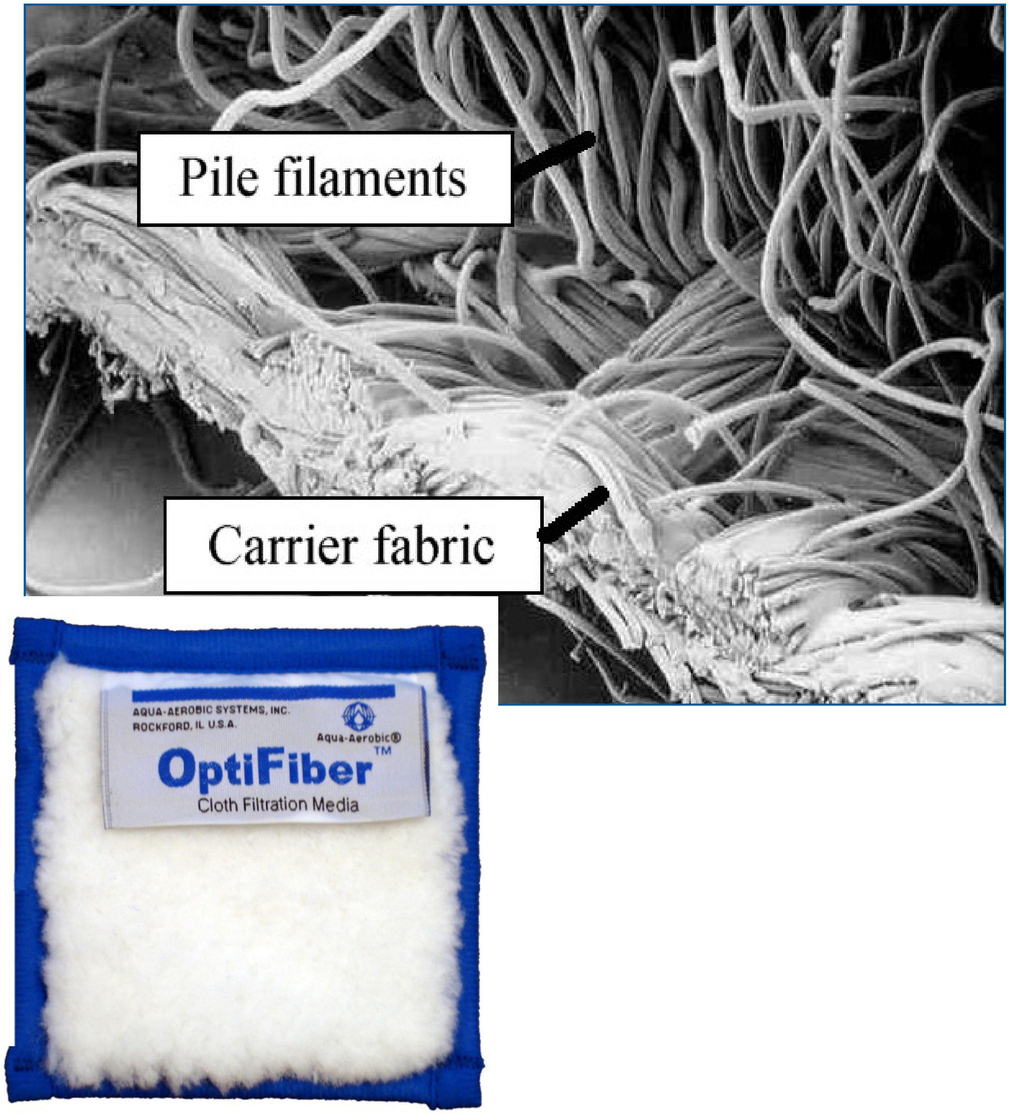
- Typically used at smaller plants
- Limited manufactures
- Maintenance intensive (upflow)

SURFACE FILTRATION

DISC CLOTH MEDIA FILTERS



CLOTH MEDIA — THE KEY COMPONENT



DISC CLOTH MEDIA FILTER

Advantages

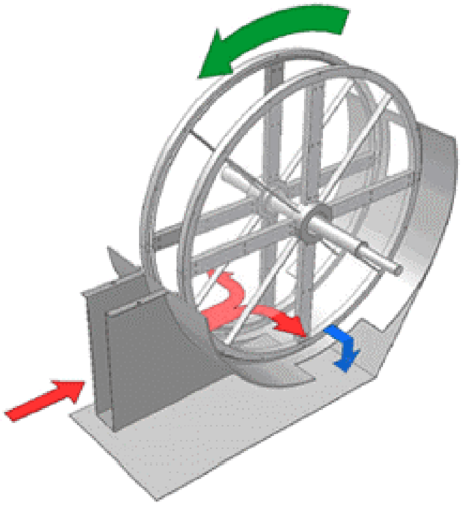
- Easy to retrofit into existing facilities
- Automatic backwash operation
- Low headloss through filter compared to conventional

Disadvantages

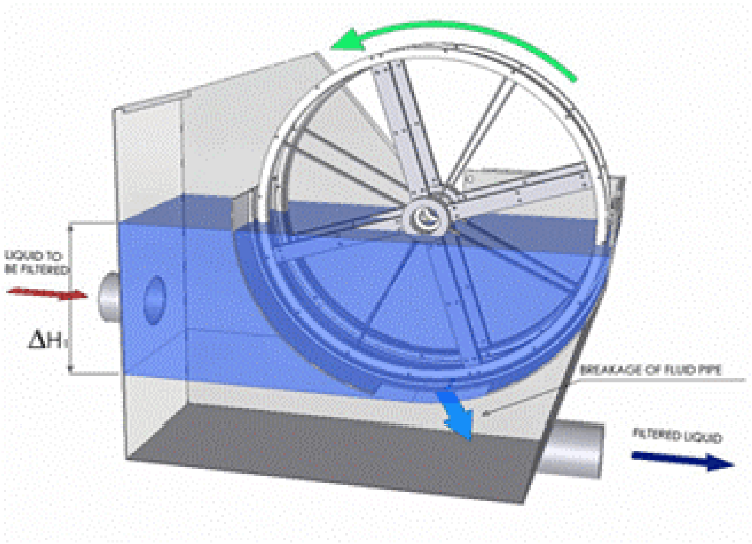
- Media replacement
- Hydraulics
- More mechanical equipment

MICROFILTER — NOVA

The Ultrascreen Microfilter®
Flow Patterns



The Ultrascreen Microfilter®
Disk Submergence



Advantages

- Stainless steel fabric
- Automatic backwash operation

Disadvantage

- Not fully proven technology
- Limited installation
- Maintenance history unknown

DISCUSSION AND EVALUATION

RELATIVE COST COMPARISON

	Cost	O&M					
Conventional							
Traveling Bridge							
Upflow							
Cloth Media							
Compressible Media							
Nova							
Microfiltration							
Reverse Osmosis							

Building a **world** of difference.®

Together

BLACK & VEATCH

ATTACHMENT TM2-B
WWETCO FILTER TECHNOLOGY EVALUATION

Introduction

A number of alternative filtration technologies were discussed at the alternative technology workshop held on June 9, 2011. One of the technologies was the WWETCO Flexfilter manufactured by Westech. The purpose of this memo is to provide City of Austin staff additional information on this technology and make a recommendation regarding whether or not this type of filter should be included as an alternative to granular filtration as part of the Walnut Creek WWTP Filter Improvements. Attached for additional information is (1) a copy of the brochure provided by the manufacture and (2) a 3D rendering of the implementation of the WWETCO filter into one of the filter boxes at the Walnut Creek WWTP.

Description of the Technology

Typically compressible fiber media is placed between two plates. In the WWETCO Flexfilter the water flows down through the media. The porosity of the filter media can be adjusted by changing the compression level of the media. Fluid flows through the media as opposed to around the media in conventional filters. Significantly higher surface loadings are possible due to the porosity of the media. These filters are design based on a peak hydraulic loading rates between 20 to 30 gpm/sf with average rates around 6 gpm/sf based on achieving reuse quality effluent. The depth of the media bed is typically in the range of 24 to 30 inches. During a backwash cycle, the compression plates are opened allowing the media to expand. The WWETCO Flexfilter uses pressure on a synthetic bladder to cause the media to expand during backwashing The direction of flow in the filter is reversed and air is introduced to help scour the media. A typical backwash rate is approximately 10 gpm for 30 minutes. Figure 1 shows the WWETCO Flexfilter in filtration and backwash modes.

Filtration Mode **Backwash Mode**

Figure 1 – WWETCO Flexfilter

Conditional Acceptance by the State of California

The state of California has a program to evaluate new technologies to be used in reuse application within the State. This program includes testing of filtration equipment to determine whether or not the equipment is capable of the same performance as granular media filtration. If the equipment passes the test, it receives a conditional acceptance for use in treatment plants that produce reuse water. The WWETCO Flexfilter has not been tested nor has it received conditional acceptance by the California Department of Public Health. The upflow version of this technology, the “Fuzzy Filter” manufactured by Scrieber, does have conditional acceptance for reuse applications in the state of California.

Installations

Currently a 100 mgd WWETCO filter system for high rate treatment of combined sewer overflows is being designed for the City of Springfield, OH. A full installation list is being obtained from the manufacturer.

Summary of Advantages and Disadvantages

Advantages of the WWETCO Flexfilter System:

- Higher hydraulic throughputs rates compared to conventional filter systems (up to an average rate of 5 gpm/sf with a peak of 10.6 gpm/sf)
- No mechanical parts within the filter
- Lower percent of backwash water used compared to other filtration sytems
- Can handle higher solids loading and maintain effluent quality

Disadvantages of the WWETCO Flexfilter System:

- Few large installations
- No experience at the design flowrates for the Walnut Creek system
- Limited long term maintenance requirements

Recommendation

The WWETCO Flexfilter appears to be a promising filtration technology. If the City wishes to collect additional information the following are recommended:

1. A Trip be made to Columbus, GA to visit an operating WWETCO filter system.
2. Conduct a full scale demonstration study to assess operating and maintenance requirements.

However, due to the limited schedule, it may not be possible to conduct the site visit or the demonstration study. If it is not possible to conduct these items, then it recommended that the WWETCO Flexfilter manufactured by WesTech ***not*** be considered for further evaluation for this project due to a lack of experience at the flow rates at the Walnut Creek plant, increased maintenance requirements, and increased power requirements.

ATTACHMENT TM2-C
NOVA FILTER TECHNOLOGY EVALUATION

Introduction

A wide range of filtration technologies were discussed at the filtration alternative workshop held on June 9, 2011. One of the technologies was the Ultrascreen Disk Filter manufactured by NOVA water Technologies, LLC. The purpose of this memo is to provide City of Austin staff additional information on the this technology and offer a recommendation on whether it should be included as one of the alternative technologies that will be compared to granular filtration as part of the Walnut Creek WWTP Filter Improvements Project. Attached for additional information is (1) a copy of the brochure provided by the manufacture and (2) a copy the slides presented to Black & Veatch at a seminar on June 16, 2011.

Description of the Technology

The Ultrascreen Filter is an "inside to out" disk filter system. This means that the flow to be filtered enters between the disks on the inside and the filtered water is on the outside of the disks. The disks rotate continuously as shown in Figure 1.

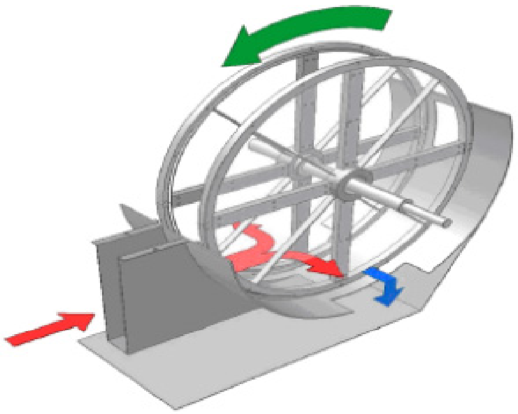


Figure 1 Isometric View of Ultrascreen Filter

This filter utilizes the principle of "dynamic tangential filtration." Dynamic tangential filtration means that with the rotation of the disks allows for higher hydraulic throughput compared to static cloth media disk systems. The Nova system contains multiple disk units similar to other disk filter systems. One disk unit is comprised of two disk units with approximately 24 inches separating each disk. Each disk unit is composed of 6 parts similar to other disk systems. The major difference between the Ultrascreen and other cloth systems is that the media is a stainless steel mesh. Maintenance of the filter is simplified because each disk is composed of multiple pieces.

Since the area between each disk is open, this configuration allows for easy access to remove debris that accumulates upstream of the disk. This open area between disk units also allows room for a backwash channel that conveys backwash solids removed from the disks to waste. As headloss builds up on the media a backwash cycle is initiated by the use of two level sensors. When the water level inside the disk unit reaches the high level sensor, a backwash cycle is initiated. Spray nozzles located on the outside of the media spray clean water through the media removing the captured material on the inside of the filter disk. Source water for each backwash water is either filtered water or other non-potable water sources. If filtered water is used, a solids strainer needs to be used to protect the backwash nozzles from plugging. Backwash water is sprayed from the outside of the filter to the inside of the filter to clean the media. Water from backwashing is collected in a trough located in the open area between each disk and is connected to a main backwash channel to remove the backwashed solids. Based on the design of the filter, all rotating bearings are located above the water level.

Conditional Acceptance by the State of California

The state of California has a program to evaluate new technologies to be used for reuse application within the State. This program allows filtration equipment to receive "conditional acceptance" and be used for treatment of reuse water within the state. The testing conducted as part of this program is designed to demonstrate that the equipment is capable of the same performance as granular media filtration. The Ultrascreen filter has been tested and received conditional acceptance by the California Department of Public Health.

Conditions of the acceptance by the California Department of Public Health include:

1. Filter screen specified as AISI 316 steel micronic screen mesh with a nominal size rating of 20 microns (down to 10 micron when using "dynamic tangential filtration".

2. Filtration rate not to exceed 6 gpm/ft2 when complimented with a disinfection process which has been demonstrated to achieve **4-log** inactivation of plaque-forming units of F-specific bacteriophage MS2, or polio virus, in the filtered wastewater.

3. Filtration rate not to exceed 16 gpm/ft2 when complimented with a disinfection process which has been demonstrated to achieve **5-log** inactivation of plaque forming units of F-specific bacteriophage MS2, or polio virus in the filtered wastewater.

4. Required schedule of inspection and assessment of the screen condition.

5. Operations plans shall provide for assurances that adequate sludge wasting is practiced to ensure against excessive solids buildup in the filter vessel.

Installations

The manufacture indicates that 36 of these system have been installed or being installed in the US. Of these installations only one has a design capacity greater than 20 mgd. The production office for Nova is located in the Jacksonville, FL area with 5 of the operating filter systems being local to the Jacksonville area.

Summary of Advantages and Disadvantages

Advantages of the Nova Filtration System:

- Higher hydraulic throughputs rates (up to average rate of 6 gpm/sf with a peak of 16 gpm/sf)
- Long life with stainless steel materials of construction
- Lower percent of backwash water used compared to other filtration systems

Disadvantages of the Nova Filtration System:

- Few large installations
- No experience at the design flowrates for the Walnut Creek system
- Limited long term maintenance requirements
- Maintenance of auxiliary equipment

Recommendation

The Ultrascreen filter appears to be an promising filtration technology. If the City wishes to collect additional information the following are recommended:

1. A trip be made to Jacksonville, Fl to visit the Nova production facility and operating filter systems in the Jacksonville area.
2. Conduct a full scale demonstration study to assess operating and maintenance requirements.

However, due to the limited schedule, it may not be possible to conduct the site visit or the demonstration study. If it is not possible to conduct these items, then it is recommended that the Ultrascreen Filter manufactured by Nova ***not*** be considered for further evaluation in this project due to lack of experience with this technology for plants as large as the Walnut Creek plant, increased maintenance requirements, and increased power requirements.

ATTACHMENT TM2-D
AQUA-AEROBIC, INC. PROCESS DESIGN REPORT

PROCESS DESIGN REPORT

AQUA-AEROBIC
SYSTEMS, INC.

AUSTIN CITY OF - WALNUT CREEK TX

Design#: 128917

Option: Preliminary Design

Designed By: Eric Roundy on Tuesday, July 12, 2011

Design Notes

Filtration

- The cloth media filter recommendation is based upon the following conditions (as shown on the design sheet): 15 mg/l average daily influent TSS, 20 mg/l peak influent TSS, and an acceptable upstream process such as an activated sludge plant with a minimum of SRT of 5 days.

- The anticipated filtered effluent quality is based on the filter influent conditions as shown under "Design Parameters" of this Process Design Report. In addition, the filter influent should be free of algae and other colloidal solids that are not filterable through a nominal 10 micron pore size media. Provisions to treat algae and condition the solids to be filterable are the responsibility of others.

- The anticipated effluent quality is based upon filterable influent solids.

- For this application, pile filter cloth is recommended, which has a nominal pore size of 10 microns.

- A minimum of twelve (12) composite samples per month shall be obtained for turbidity analysis.

- The following filter recommendation has been designed in accordance with the Texas Administrative Code Chapter 210.33 related to reclaimed water. The cloth media filters shall provide a 30 day average filtered effluent of 3 NTU or less.

Equipment

- Aqua-Aerobic Systems, Inc. (AASI) is familiar with the Buy American provision of the American Recovery and Reinvestment Act of 2009 as well as other Buy American provisions (i.e. FAR 52.225, EXIM Bank, USAid, etc.). AASI can provide a system that is in full compliance with Buy American provisions. As the project develops AASI can work with you to ensure full compliance with a Buy American provision, if required. Please contact the factory should compliance with a Buy American provision be required.

AquaDISK Tertiary Filtration - Design Summary

DESIGN INFLUENT CONDITIONS

Pre-Filter Treatment: Secondary

Avg. Design Flow	= 75 MGD	= 52083.33 gpm	= 283500 m³/day
Max Design Flow	= 120 MGD	= 83333.3 gpm	= 453600 m³/day

DESIGN PARAMETERS

	Influent	mg/l	Effluent Required	<= mg/l	Anticipated	<= mg/l
Avg. Total Suspended Solids:	TSSa	15	--	--	--	--
Max. Total Suspended Solids:	TSSm	20	--	--	--	--
***Turbidity:**	--	--	NTU	3	NTU	3

*Note: Tubidity represented in Nephelometric Turbidity Units (NTU's) in lieu of mg/l.

AquaDISK FILTER RECOMMENDATION

Qty Of Filter Units Recommended	= 24
Number Of Disks Per Unit	= 12
Total Number Of Disks Recommended	= 288
Total Filter Area Provided	= 15494.4 ft² = (1439.48 m²)
Filter Model Recommended	= AquaDisk Concrete: Model ADFSC-54 x 12E-PC

AquaDISK FILTER CALCULATIONS

Filter Type:

Vertically Mounted Cloth Media Disks featuring automatically operated vacuum backwash.

Average Flow Conditions:

Average Hydraulic Loading = Avg. Design Flow (gpm) / Recommended Filter Area (ft²)
= 52083.3 / 15494.4 ft²
= 3.36 gpm/ft² (2.29 l/s/m²) at Avg. Flow

Maximum Flow Conditions:

Maximum Hydraulic Loading = Max. Design Flow (gpm) / Recommended Filter Area (ft²)
= 83333.3 / 15494.4 ft²
= 5.38 gpm/ft² (3.66 l/s/m²) at Max. Flow

Solids Loading:

Solids Loading Rate = (lbs TSS/day at max flow and max TSS loading) / Recommended Filter Area (ft²)
= 20016 lbs/day / 15494.4 ft²
= 1.29 lbs. TSS /day/ft² (6.30 kg. TSS/day/m²)

Cloth Media Filters

AquaDisk Tanks/Basins

24 AquaDisk Model # ADFSC-54x12E-PC Concrete Filter Basin Accessories consisting of:

- Concrete basin(s) (by others).
- 304 stainless steel support brackets.
- Effluent seal plate weldment.
- 316 stainless steel anchors.

24 Effluent Weir Installation(s) consisting of:

- Effluent weir(s).
- 316 stainless steel anchors.

AquaDisk Centertube Assemblies

24 Centertube(s) consisting of:

- 304 stainless steel centertube weldment(s).
- Centertube driven sprocket(s).
- Dual wheel assembly(ies).
- Rider wheel bracket assembly(ies).
- 304 stainless steel centertube support beam(s).
- Centertube bearing kit(s).
- Effluent centertube lip seal(s).
- Pile cloth media and non-corrosive support frame assemblies.
- Disk segment 304 stainless steel support rods.
- Neoprene media sealing gaskets.
- Cloth will be chlorine resistant.

AquaDisk Drive Assemblies

24 Drive System(s) consisting of:

- Gearbox with motor.
- Drive spocket(s).
- Drive chain(s) with pins.
- Stationary drive bracket weldment(s).
- Adjustable drive bracket weldment(s).
- 316 stainless steel anchors.
- Chain guard weldment(s).
- Warning label(s).

AquaDisk Backwash/Sludge Assemblies

24 Backwash System(s) consisting of:

- Backwash shoe assemblies.
- Backwash shoe support weldment(s).
- 1 1/2" flexible hose.
- Stainless steel backwash shoe springs.
- Hose clamps.
- 304 stainless steel backwash collection manifold(s).
- 304 stainless steel union(s).
- PVC solids manifold installation(s).

12 Backwash/Solids Waste Pump(s) consisting of:

- Centrifugal pump with 7.5 HP, 3 ph. motor.
- 316 stainless steel anchors.
- 0 to 15 psi pressure gauge(s).

- 0 to 30 inches mercury vacuum gauge(s).

AquaDisk Instrumentation

12 Pressure Transducer Assembly(ies) each consisting of:

- Mounting bracket weldment(s).
- Transducer pipe weldment(s).
- Pressure transducer(s).
- Aneroid bellows.
- Stainless steel anchor kit(s).
- Nylon electrical cable tie wrap(s).

12 Vacuum Gauge(s) with Transmitter(s) consisting of:

- Vacuum transmitter(s).
- 0 to 30 inches mercury vacuum gauge(s).
- 1/4" Threaded bronze ball valve.

12 Float Switch(es) consisting of:

- Float switch mounting bracket(s).
- Float switch(es).
- Stainless steel anchor kit(s).

6 Flow Meter(s) will be provided as follows:

- 8" magnetic flow-meter and converter(s).

AquaDisk Valves

12 Set(s) of Backwash Valves consisting of:

- 4 inch (102mm) diameter Milliken 601-N0 electrically operated eccentric plug valve(s) with 125# (57kg) flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with a Auma SG07, 220 VAC, 50 hz, single phase open/close service electric actuator. Valve actuator includes local controls and compartment heater.

12 Solids Waste Valve(s) consisting of:

- 4 inch (102mm) diameter Milliken 601-N0 electrically operated eccentric plug valve(s) with 125# (57kg) flanged end connection, ASTM A-126 Class B cast iron body with welded in nickel seat, EPDM coated ductile iron plug, assembled and tested with a Auma SG07, 220 VAC, 50 hz, single phase open/close service electric actuator. Valve actuator includes local controls and compartment heater.

AquaDisk Controls w/Starters

12 Control Panel(s) consisting of:

- Selector switch(es).
- Circuit breaker with handle.
- Fuses and fuse blocks.
- Line filter(s).
- GFI convenience outlet(s).
- Control relay(s).
- Indicating pilot light(s).
- MicroLogix 1400 PLC(s).
- Ethernet switch(es).
- Power supply(ies).
- Operator interface(s).
- Motor starter(s).
- Terminal blocks.
- UL label(s).
- Air conditioner(s).
- 7 1/2 HP VFD(s).

AquaDISK: Operation & Maintenance Requirements Design# 128917

AQUA-AEROBIC SYSTEMS, INC.

Project: AUSTIN CITY OF - WALNUT CREEK TX

Qty / Model#: 24 / ADFSC54x12E-PC

Description: AquaDisk Concrete: Model ADFSC-54 x 12E-PC

Avg Flow (Gal):	75,000,000.00
Influent TSS (mg/l):	15
Qty Of Disks Per Unit:	12
Area Provided/Disk:	53.8

I. LUBRICATION REQUIREMENTS

	# of Units		Minutes/Unit		Times/Year		Hours/Year
1) Backwash / Solids Waste Pump - Routine Lubrication:	48	x	5	x	12	/ 60 =	48.00
2) Backwash / Solids Waste Pump - Drain and Refill:	48	x	30	x	1	/ 60 =	24.00
3) Drive Gear Box:	24	x	30	x	0.25	/ 60 =	3.00
4) Drive Motor:	24	x	5	x	0.25	/ 60 =	0.50

TOTAL LUBRICATION REQUIREMENTS: 75.50

II. PARTS REPLACEMENT

	Replace Interval (Years)	# of Units		Minutes/Unit		Hours Per Replacement	Material Cost Per Unit	Total Material Cost
1) Main "V-Ring" Seal:	10	24	x	240	=	96.0	$ 1,003	$ 24,072
2) Filter Media Cloths (6/Disks):	7	1728	x	15	=	432.0	$ 269	$ 464,832

III. POWER CONSUMPTION

1) Backwash / Solids Waste Pump (Kw Hours/Year):	132,668.0
2) Disk Drive Motor (Kw Hours/Year):	21,597.1

ITEM WEIGHTS
EFFLUENT SEAL PLATE = 217 LBS.
CENTERTUBE = 1073 LBS.
EFFLUENT WEIR WELDMENT = 450 LBS.
DRIVE MOTOR ASSEMBLY = 310 LBS.
DISK SEGMENT ASSEMBLY = 24 LBS.
PUMP WITH MOTOR MOUNTED ON BASE = APPROX. 325 LBS.

1. DRAWING FOR REFERENCE ONLY.
ALL NEW WALLS ARE SHOWN AT 1'.
ALL DIMENSIONS TO BE VERIFIED BY CUSTOMER.

2. AQUA-AEROBIC SYSTEMS PROVIDES PUMPS AND VALVES LOOSE FOR INSTALLATION BY THE INSTALLING CONTRACTOR. ALL INTERCONNECTING PIPING, WIRING, AND WALL SPOOL PIPES ARE PROVIDED BY THE INSTALLING CONTRACTOR.

3. IF FREEZING IS A CONCERN, AQUA-AEROBIC SYSTEMS RECOMMENDS THE FILTERS BE PLACED IN A HEATED BUILDING. IF A BUILDING IS NOT PROVIDED, ANY NECESSARY PROTECTION, INCLUDING BUT NOT LIMITED TO, HEAT TRACING AND INSULATION OF PUMPS AND PIPING, AS WELL AS PROTECTION AGAINST INTERNAL TANK FREEZING, SHALL BE PROVIDED BY THE INSTALLING CONTRACTOR.

4. THE GRAPHIC ELEMENTS OF THIS COMPUTER GENERATED DRAWING ARE DRAWN FULL SIZE. THE DIMENSIONS ARE ASSOCIATIVE. IF THE SIZE OF THE GRAPHIC ELEMENTS IS CHANGED THE DIMENSIONS WILL NOT BE CORRECT.

5. AN INFLUENT VALVE IS REQUIRED FOR ISOLATION / MAINTENCE OF EACH FILTER UNIT. INFLUENT VALVES SHALL BE PROVIDED BY OTHERS AND INSTALLED BY OTHERS.

6. WALL SPOOL PIPING SHALL BE STAINLESS STEEL. PROVIDED BY OTHERS AND INSTALLED BY OTHERS.

JOB NAME: CITY OF AUSTIN - WALNUT CREEK
JOB LOCATION: TEXAS

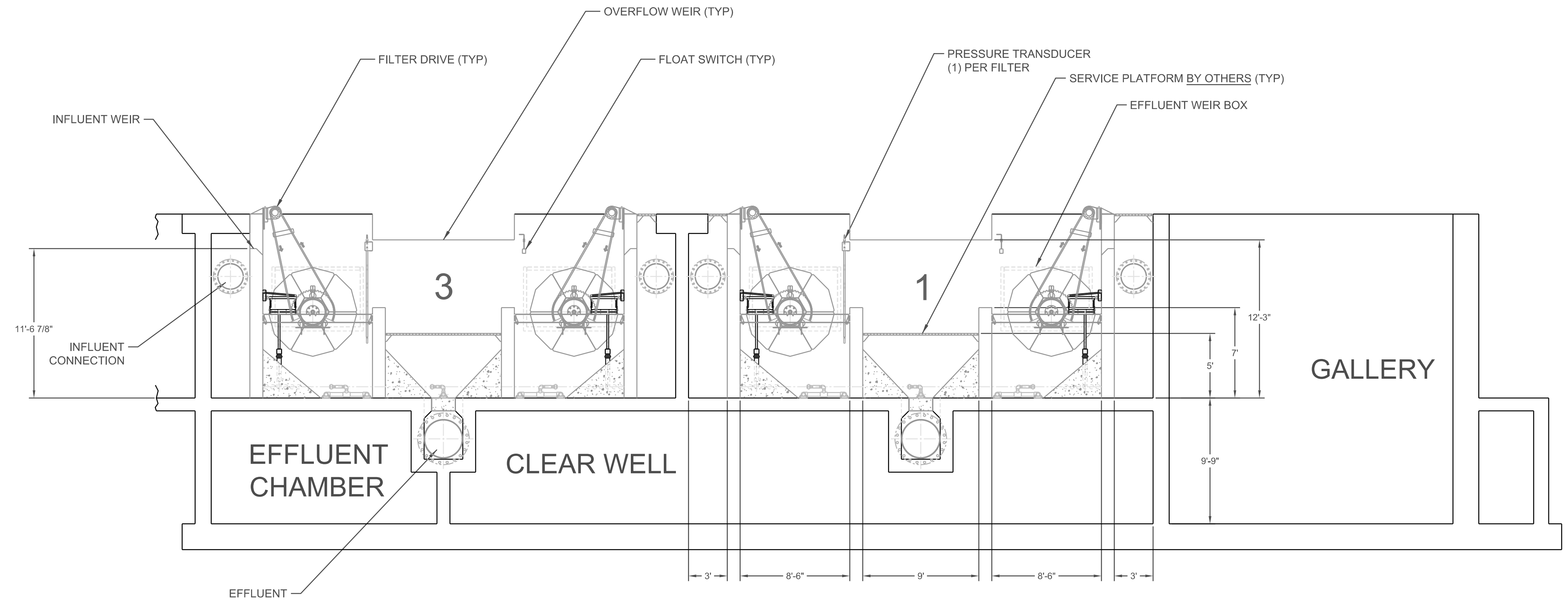
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION
B		07/12/2011	DAL	REDESIGNED PER CUSTOMER REQUEST
A		06/29/2011	DAL	WAS: (2) PUMPS / (7) VALVES

AQUA-AEROBIC SYSTEMS, INC.

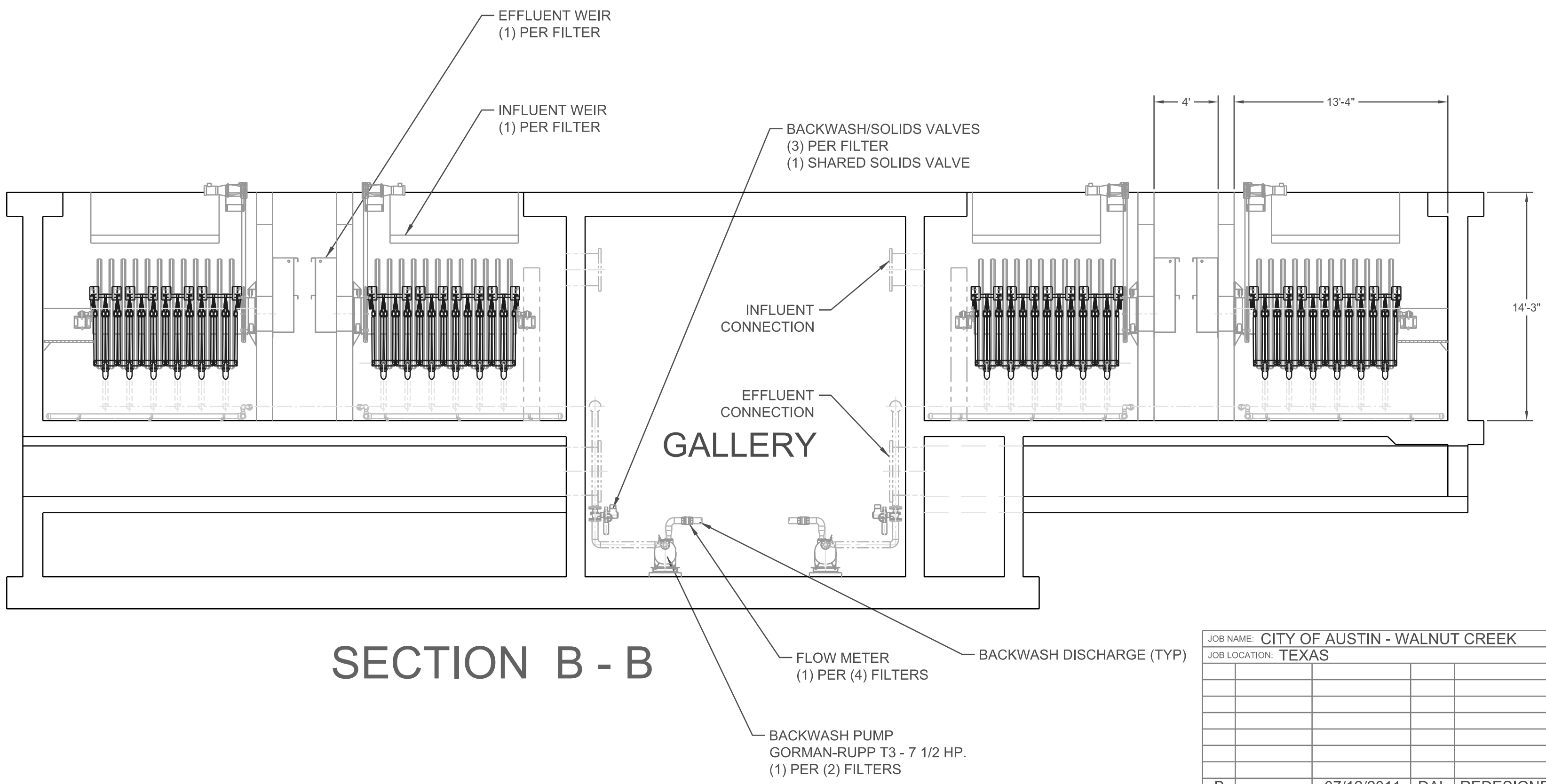
DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
FRACTIONAL DIMENSIONS +/- 1/16
ALL TWO PLACE DECIMALS +/- 0.010
ALL THREE PLACE DECIMALS +/- 0.005
ALL ANGLES +/- 1/2°
ANSI

MATERIAL:
SIMILAR TO: 2801942
TYPE: TYPE-S AQUADISK
DRAWN BY: DAL
DATE: 06/21/2011
CHECKED BY:
DATE:
WEIGHT:
SHEET: 1 OF
DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 12E-PC RETRO-FIT DESIGN
DRAWING NUMBER: 81118076001
SCALE: 1:1
SIZE: D



SECTION A - A



SECTION B - B

JOB NAME: CITY OF AUSTIN - WALNUT CREEK					AQUA-AEROBIC SYSTEMS, INC.
JOB LOCATION: TEXAS					
					DO NOT SCALE DRAWING / UNLESS OTHERWISE SPECIFIED FRACTIONAL DIMENSIONS +/- 1/16 ALL TWO PLACE DECIMALS +/- 0.010 ALL THREE PLACE DECIMALS +/- 0.005 ALL ANGLES +/- 1/2° ANSI
					MATERIAL:
					SIMILAR TO: 2801942
					TYPE: TYPE-S AQUADISK
B		07/12/2011	DAL	REDESIGNED PER CUSTOMER REQUEST	DRAWN BY: DAL — DATE: 06/21/2011
A		06/29/2011	DAL	WAS: (2) PUMPS / (7) VALVES	CHECKED BY: — DATE:
REV	ERN / ECO	DATE	BY	REVISION DESCRIPTION	WEIGHT: — SHEET: 1 OF
DRAWING NAME: AQUADISK FILTER MODEL ADFSC-54 X 12E-PC RETRO-FIT DESIGN					DRAWING NUMBER: 81118076002 — SCALE: 1:1 — SIZE: D

ATTACHMENT TM2-E
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

1.0 Overview

Engineer's Opinions of Probable Construction Cost (EOPC's) have been developed for the two alternative filtration technologies described within TM2 Alternative Filtration Technologies (TM2).

2.0 EOPC Methodology

The project improvements discussed in TM2 are at the conceptual level of development and as such, do not provide the level of design detail required for estimating on the basis of detailed quantities and unit pricing. However, the vendors who supply this equipment have provided detailed scopes of services with budget pricing. The proposals include drawings that describe the work required to implement each of these technologies. As a result, the estimates have been developed from a combination of the following estimating resources and references and adjusted, as appropriate, to provide results that represent a conservative level of cost relative to current pricing in the construction industry.

- Current budget price quotations from vendors for process equipment. In addition to the cost of equipment, the cost of equipment installation is accounted for based on a percentage of the equipment cost. In general, for all equipment except electrical equipment, the installation percentage used is 40 percent. This amount is adjusted up or down as appropriate for the amount of labor, materials and equipment anticipated for the installation.

- Allowance for electrical equipment installation has been developed based on 35 percent of the equipment and materials listed in Divisions 15 and 16. Electrical equipment cost represents an approximation of miscellaneous items electrical equipment and materials as well as the labor required to connect and start-up the equipment.

- Cost references for materials and commodities available from cost estimates for other water and wastewater related projects that have been prepared within the last several months.

- Cost references for labor and materials, equipment rental, construction aids, etc. available from building and heavy construction cost data published annually by RS Means.

- Where other references where not available, certain costs have been estimated based on previous experience and engineering judgment.

3.0 Estimate Components

The individual EOPCs have been organized and costs have been listed in accordance with the standard Construction Specification Institute (CSI) specification divisions. In addition to the base cost of equipment, labor and materials, contractors direct and indirect costs associated with contract and general requirements as well as overhead and profit have been accounted for as a single line item estimated at 20 percent of the base cost. Finally, given that the design is still in the conceptual stages of development, an overall project contingency of 40 percent has been applied to each of the cost estimates to conservatively account for the many unknowns inherent in a project in the early stages of development. The effective estimate date is July 2011.

Estimates for Operation and Maintenance Costs associated with the various alternatives have been prepared based on the assumptions given in TM2 and the anticipated operation of equipment when the facility is operating at capacity.

4.0 Attachments

The EOPCs for the two alternatives are attached as one page designated “Summary” in the footer. The Operation and Maintenance Costs for the various alternatives are attached as two pages following the EOPCs.

CITY OF AUSTIN
WALNUT CREEK WWTP FILTER IMPROVEMENTS
ALTERNATIVE FILTRATION TECHNOLOGIES

APPENDIX TM2-E PROBABLE CONSTRUCTION COST
July 16, 2011

SUMMARY OF ALTERNATIVE COSTS

Description	$
Cloth Filter Alternative	
Division 2 - Sitework and Demolition	361,000
Division 3 - Concrete	606,900
Division 4 through 9 - Filter Superstructure & Misc Metals	1,065,500
Division 13 - Special Construction (Aqua Aerobics Equipment)	8,680,000
Division 15 - Mechanical	355,900
Division 16 - Electrical	159,900
Subtotal	**11,229,200**
General Conditions/Overhead and Profit (20%)	2,245,800
Contingency (40%)	5,390,000
Total Construction Cost	**18,865,000**
Cloth Filter Alternative	
Division 2 - Sitework and Demolition	361,000
Division 3 - Concrete	187,100
Division 4 through 9 - Filter Superstructure & Misc Metals	1,431,300
Division 13 - Special Construction (NOVA Equipment)	7,560,000
Division 15 - Mechanical	265,900
Division 16 - Electrical	123,800
Subtotal	**9,929,100**
General Conditions/Overhead and Profit (20%)	1,985,800
Contingency (40%)	4,766,000
Total Construction Cost	**16,680,900**

Annual Operation and Maintenance Costs
Cloth Media Filter Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Total Volume of Backwash water	1.500		mgd				2% of 75 mgd

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pump	12	5.5	kw	25.0%	16.5	$14,900	Estimate from Aqua Aerobics
Disk Drive	12	0.9	kw	25.0%	2.7	$2,400	Estimate from Aqua Aerobics
Settled Water Pumping	1	1.500	mgd	100.0%	7.4	$6,700	Assumed head = 30 ft, Eff = 80%
Subtotal					27	$24,000	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	31	lb/day	$0.23	$2,600	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$26,600**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff	1460	$27.11	$39,600	4 hours per day split between shifts
Maintenance Staff - Routine	416	$27.11	$11,300	8 hours per day, 1 day per week
Maintenance Staff - Filter Media Cloth	63	$27.11	$1,700	42 disks/year at 1.5 hrs/disk
Maintenance Staff - Main V-ring Seal	10	$27.11	$300	2.5 units/year at 4 hrs/unit
Annual Labor Cost			**$52,900**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Filter Cloth Media	42	disks	$1,641.00	$68,900	Filter Cloth only
Filter Influent Valves	1%	percent	$233,000.00	$2,300	1% of new equipment cost each year
Main V-ring Seal	2.5	units	$1,000.00	$2,500	Material Only
Annual Replacement Parts and Materials				**$73,700**	
Total Annual Operation and Maintenance Costs				**$153,200**	

Annual Operation and Maintenance Costs
NOVA Ultrafilter Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Total Volume of Backwash water	0.750		mgd				1% of 75 mgd

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pump	14	7.5	kw	20.0%	21.0	$19,000	Estimate from NOVA
Disk Drive	14	9.0	kw	100.0%	126.0	$114,000	Estimate from NOVA
Settled Water Pumping	1	0.75	mgd	100.0%	3.7	$3,300	Assumed head = 30 ft, Eff = 80%
Subtotal					151	$136,300	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	16	lb/day	$0.23	$1,300	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$137,600**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff	1460	$27.11	$39,600	4 hours per day split between shifts
Maintenance Staff - Routine	416	$27.11	$11,300	8 hours per day, 1 day per week
Maintenance Staff - Filter Panel Replacement	88	$27.11	$2,400	22 disks/year at 4 hrs/disk
Maintenance Staff - Lateral Seal Replacement	68	$27.11	$1,800	34 sets/year at 2 hrs/set
Maintenance Staff - Spray Nozzles	275	$27.11	$7,500	550 units/year at 0.5 hrs/unit
Annual Labor Cost			**$62,600**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Filter Panel Replacement	22	disks	$2,400.00	$52,800	Stainless Steel Disks Complete
Filter Influent Valves	1%	percent	$233,000.00	$2,300	1% of new equipment cost each year
Filter Lateral Seals	34.0	units	$450.00	$15,300	Material Only
Filter Spray Nozzles	550.0	units	$30.00	$16,500	Material Only
Annual Replacement Parts and Materials				**$86,900**	
Total Annual Operation and Maintenance Costs				**$287,100**	

ATTACHMENT TM2-F
NOVA WATER TECHNOLOGIES PRELIMINARY DESIGN REPORT

Nova Water Technologies
Ultrascreen® Disk Filter

To:
Black & Veatch

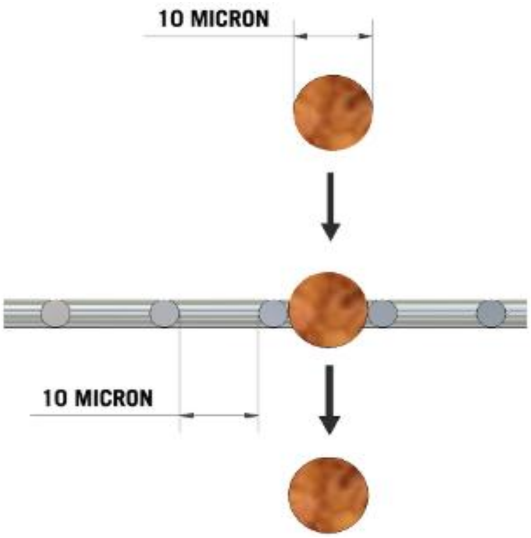
For:
Walnut Creek WWTP - Austin, TX

1.0 Introduction

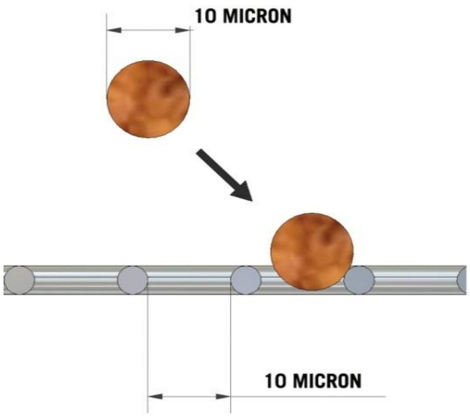
NOVA Water Technologies is pleased to offer equipment and services in accordance with our standard features. The basis of this proposal is compliant with the standard NOVA Water performance specifications and materials in 304 stainless steel. This proposal uses our Model UL1612CS disk filter.

2.0 Principle of Operation

The disks are always in slow rotation during normal operation. The water with TSS is fed at angles less than 90º, which is the basis for “dynamic tangential filtration.” The rotation allows use of precision woven wire Stainless Steel micronic mesh, with micron ratings typically between 15 and 25 microns. The disk rotation presents these openings as if they were actually smaller than in a static orientation. This allows for the removal of particles smaller than 10 micron, while requiring minimal water for cleaning. This allows the unit to operate at higher loading rates and achieve equivalent effluent quality compared to static disk filters. This same principle has been proven consistently in the operation of rotatory drum screens, as on example.



Static Filtration – Particle Path



Dynamic Tangential Filtration – Particle Path

3.0 Mechanical Principles

The feed to the disks is introduced into a zone between, or “inside”, each set of disks (see Figure No. 1 below). Each disk is sealed to the walls of the tank by long lasting EPDM rubber seals to maintain filtration integrity and to prevent any short-circuiting. The feed passes through the filter mesh and freely falls into the filtrate zone below (Figure No. 2) and flows out of the effluent outlet. As TSS is captured the liquid level in the feed zone rises until it reaches a pre-set level. A sensor then initiates operation of the wash water pump and the back of the screen mesh is sprayed by low pressure water at 2 to 4 bar for typically one minute. Once the mesh is cleaned the level in the feed zone recedes to another pre-set level where a second level sensor deactivates the wash water pump. All of the solids cleaned from the fine filtration mesh are collected in a simple trough between the disks and leaves the filter under gravity flow. The reject troughs are connected to a common outlet and the concentrated wash water (reject) is sent for further treatment.

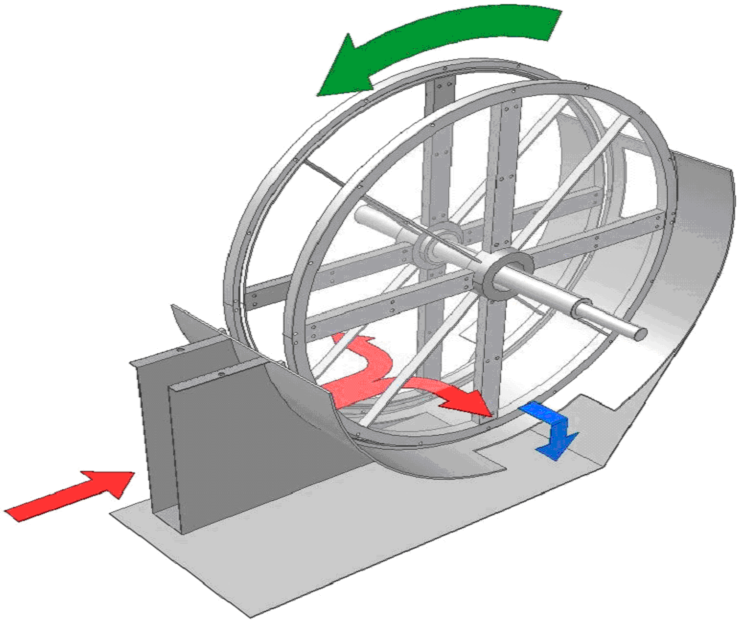


Figure No. 1
The filtration disks are arranged in pairs as show above

The level sensor is also used for turning the filter itself on and off. At low level the filter is de-energized and allowed to remain in a “filter ready” idle mode. This may occur in smaller plants during low flow periods of time. Once flow resumes the idle filter is energized and the normal filtration and wash cycles resume.

A level sensor will send a signal to the control panel when a high level condition or overflow situation occurs.

A situation such as this may occur when there is a significant upset in the plant or during a power outage.

The graphic below represents the typical flow condition during operation.

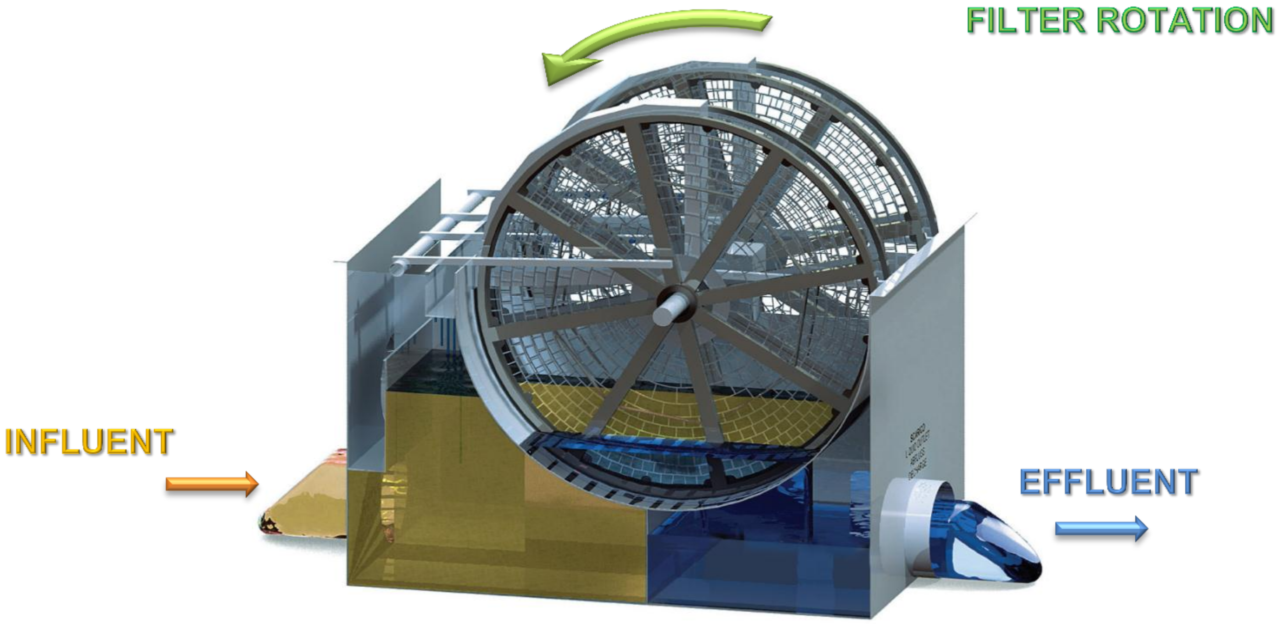


Figure No. 2
Improved filter design hydraulics results in significant increases in capacity

Walnut Creek WWTP - Austin, TX
Date: 7/14/2011

4.0 Plant Design Information

The filter is to be sized for:

	GPM	(MGD)
Average Daily Flow	52083	(75.00)
Peak Daily Flow	83333	(120.00)
Redundancy Flow	83333	(120.00)
Future Daily Flow	104167	(150.00)

4.1 Design Information for Filter: UL1612CS

Number of filters	14	
Number of disks per filter	24	
Area per disk	22.0	sq.ft.
Total area per filter	528.0	sq.ft.
Loading rate at avg per filter	7.05	gpm/sq ft
Loading rate at peak per filter	11.27	gpm/sq ft
Loading rate at redundancy per filter	12.14	gpm/sq ft
Loading rate at future flow per filter	14.09	gpm/sq ft
Filter Drive	(2) 5	hp
Wash Water pump	10.0	hp
Instantaneous Wash Water demand	345.0	gpm/unit
Wash water pressure	4	bar max
Total reject backwash wash water as % of the influent feed rate	0.5 - 1.0	%
Method of feeding filter	By Gravity or Pumped	
Maximum Head requirement	25.6	inches

4.2 Filter Performance Characteristics:

	Influent	**Effluent**
TSS	Avg. 15 mg/L	Less than 5 mg/L
NTU	5	2

5.0 Scope of Supply: UL1612CS

Image of Four (4) Model UL-1606-CS shown

- Qty (14) UL1612CS Ultrascreen® Disk Filter
- 304 stainless steel tank
- 316L stainless steel filter mesh
- Qty (14) backwash pump (10 hp)
- Internal spray wash piping and nozzles
- Qty (14) Automatic sludge valve
- 304/304L stainless steel filter disks
- Ball valves and gauges as required
- NEMA compliant control panel with SS enclosure, 480 VAC, 3 Phase, 60 Hz
- Chain & Sprocket drive system
- Filter Level Control Sensor as required
- 304SS covers with two handles per section for easy removal
- Qty (1) year manufacturer's standard warranty

6.0 Budgetary Equipment Cost Estimate

Budgetary Price Estimate for the scope of equipment as shown above is $ 5,400,000 USD

Any taxes or fees are not included.

Equipment freight to the jobs site, engineering submittals, and start-up services are included in the budget pricing. Budgetary estimates are valid for 180 days.

7.0 Typical Drawings: See attached

Project: Walnut Creek WWTP - Austin, TX
Model : UL1612CS
Qty: 14

Operation & Maintenance Cost Breakdown

Electricity

Gear Drive
9.00 kW Hours / yr: 8760 hrs

*operating consumption is 60%, motor sizing is based on starting torque requirements

Backwash Pump
7.5 kW Hours / yr: 1752 hrs

Parts

Filter Lateral Seals
Expected Life Span: 5 yr
Cost per set: 450.00 USD
Sets of Seals per Unit: 12 sets

Filter Stainless Steel Mesh Panels
Expected Life Span: 15 yrs
per unit: 192 qty
Cost per Panel: 300.00 USD

Backwash Spray Nozzles
Expected Life Span: 11 yrs
per unit: 432 qty
Cost per Nozzle: 30.00 USD

Filter Bearings

Expected Life Span: 11 yrs
per unit 5 qty
Cost per Bearing 410.80 USD

Basket Strainer

Expected Life Span: 12 yrs
per unit: 1 qty
Cost per Stainer: 273.00 USD

Wash Pump

Expected Life Span: 12 yrs
per unit: 1 qty
Cost per Pump: 3,550.00 USD

Grease & Oil

Shaft Bearings: 5 qty
Gear Drive Anti-Friction Bearings: 1 qty
Gear Drive to be Oiled: 1 qty

Project : Walnut Creek WWTP - Austin, TX
Filter Model : UL1612CS
Qty : 14

nova
water technologies llc.

Operation & Maintenance
Man Hours Breakdown

	Time	Time/year
1. Drive System:		
- Change fluid in the SEW gear reducer(2) every 2 years	2.0 hr / 2 yr	1.0 hr
- Inspect Chain & Sprocket, and tensioner	1.0 hr / 3 mon	4.0 hr
- Lubricate Chain	0.4 hr / 3 mon	1.6 hr
- SEW Eurodrive MOVIMOT (20+ yr life)	0.0	0.0 hr
- Triple Chain & Sprocket (20+ yr life)	0.0	0.0 hr
2. Bearings:		
- Grease bearings(5) every 4 months	0.5 hr / 4 mon	1.5 hr
- Filter bearings (11+ yr life)	10.0 hr / 11 yr	0.9 hr
3. Spray Nozzles:		
- Inspect nozzles(432) every month for proper function. Signs of blockage/malfunction include low amounts of reject water, irregular spray patterns, frequent backwash, and overflow.	1.2 hr / 1 mon	14.4 hr
- Replace & Clean Spray Nozzle (avg. 2yr between cleanings)	14.4 hr / 2 yr	7.2 hr
4. Lateral Seals:		
- Inspect seals(24) every 6 months. Check for tears, puckering, or any damage. Signs of failure include increase strainer cleanings and higher TSS effluent levels	1.2 hr / 6 mon	2.4 hr
- Lateral seal replacement (5+ yr life)	3.6 hr / 5 yr	0.7 hr
5. Strainers:		
- Check pressure guage daily, optimal 50psi (+/-5)	5.0 min / 1 day	30.4 hr
- Strainer blow-off for temporary cleaning	5.0 min / 1 week	4.3 hr
- Replace & Clean Basket Strainer (3mon between cleanings)	15.0 min / 3 mon	1.0 hr
6. Wash Pump:		
- Inspect pump every month for abnormal noise & vibration (gravelly sound "cavitation", metallic whining/humming "bearing failure")	0.2 hr / 1 mon	2.4 hr
- General pump maintenance (wear plate, seal, bearings)	1.6 hr / 1 yr	1.6 hr
- Wash pump replacement (12+ yr life)	3.0 hr / 12 yr	0.3 hr
7. Pressure Transducer:		
- Should be rescaled annuall by plant integrator to guarantee accurate readings	1.0 hr / 1 yr	1.0 hr
- Pressure transducer (20+ yr life)	0.0	0.0 hr

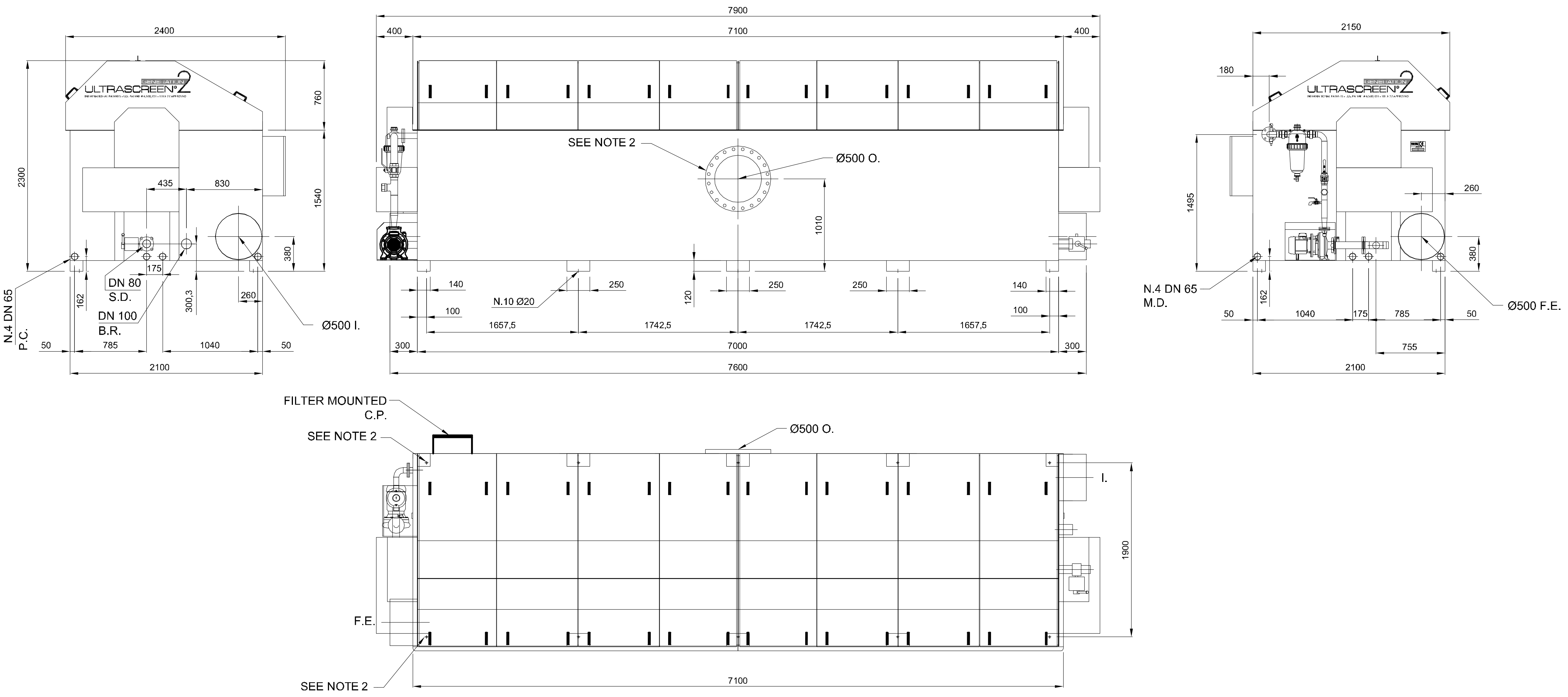
8. Control Panel:			
- The heater block and timers should be inspected annually for correct operation	1.0 hr	/ 1 yr	1.0 hr
9. Filter Media Panels:			
- Visual inspection of panels(192) from effluent side of filter	0.8 hr	/ 1 mon	9.6 hr
- Media Panel replacement (15+ yr life)	0.1 hr	/ panel / 15yr	1.3 hr

Total manhours per year per filter =	87 hr
Total manhours per year for (14) filters =	1213 hr

* The maintenance items listed above are standard for most filter technologies, except for the life of the media panels and drive system.

* NOVA's drive system uses the SEW Eurodrive MOVIMOT, which has an internal VFD and inverter duty motor. Both of these help provide a longer life especially since the motor only has start/stops for maintenance compared to other filter technologies that start/stop for every wash cycle.

* NOVA's media panels are provided in stainless steel frames with tensioned 316L stainless steel precision woven mesh, that is also microwelded to the frames and epoxied for longer life. Polyester blend meshes, common to Static Disk Filter Inside-Outside flow filters, are estimated to have a maximum 5yr life expectancy.



DRY WEIGHT: 7,200 kg

WORKING WEIGHT: 24,200 kg

ABBREVIATION SUMMARY

I.	INLET	B.R.	BACKWASH REJECT
N.F.	NOZZLE FEED	S.D.	SEDIMENT DRAIN
P.F.	PUMP FEED	O.	OVERFLOW
F.E.	FILTERED EFFLUENT	C.P.	CONTROL PANEL
M.D.	MAINTENANCE DRAIN		

NOTES:

1) ANCHOR BOLTS TO BE PROVIDED BY CONTRACTOR. GROUT AS NECESSARY TO ENSURE FILTER IS LEVEL AND PLUM.

2) BOLT INSTALLATION DETAILS:
FLANGE BOLT TYPE =M20x2.5 STAINLESS STEEL.
USE OF "SLIC-TITE" SEALANT OR EQUIVALENT REQUIRED.

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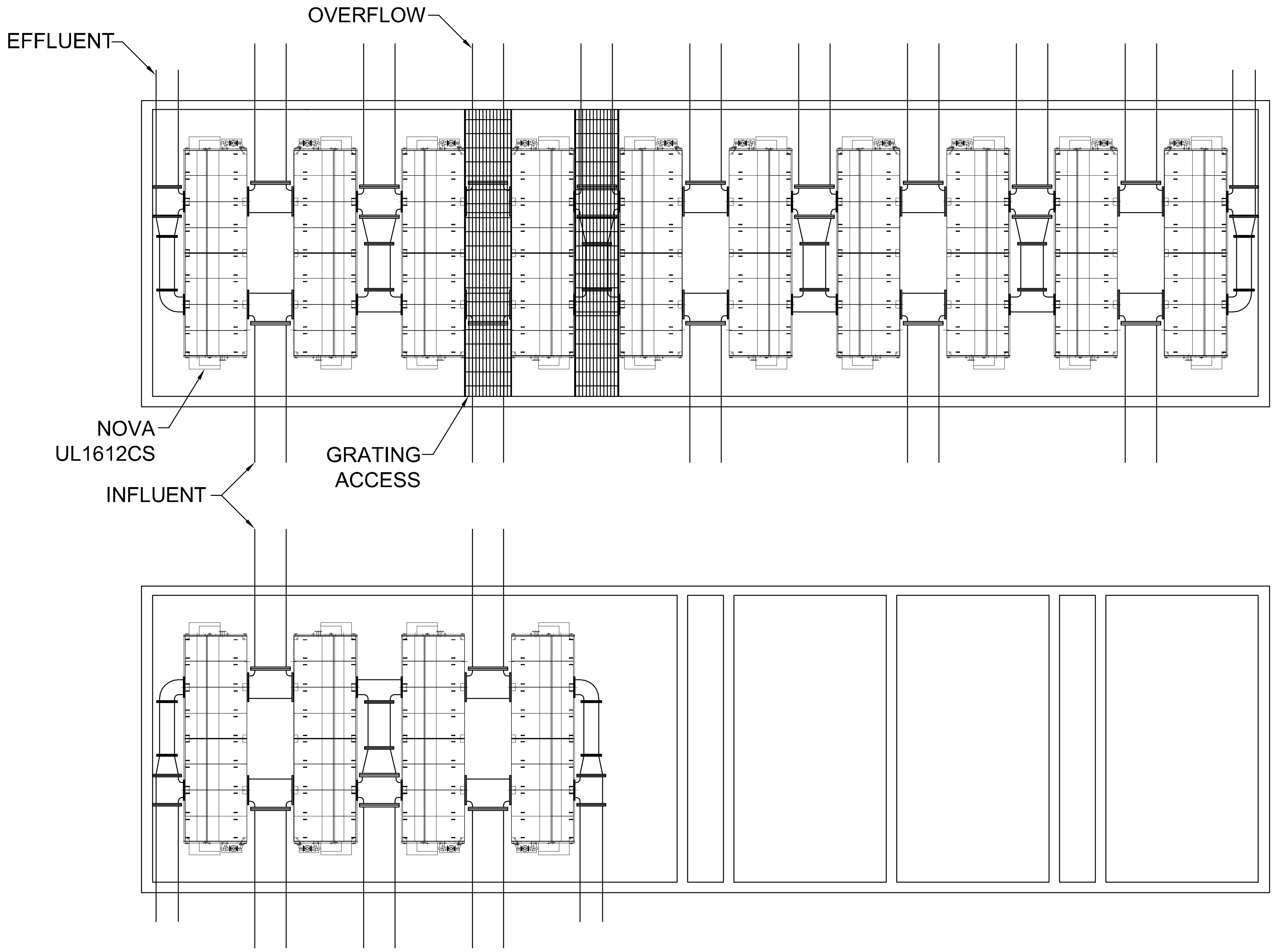
NOVA #: UL1612CS-S
DATE: 2/23/2011
DIMENSIONS: METRIC
PROJECT ENGINEER: B.L. & A.G.

UL1612CS
ULTRASCREEN MICROFILTER
GENERAL ARRANGEMENT DRAWING
FOR
NOVA WATER TECHNOLOGIES, LLC.

NUOVE ENERGIE
ADVANCED TECHNOLOGY

nova
water technologies llc
P.O. BOX 23523, TAMPA FL 33623
P: 813.288.0533, F: 813.289.3566

DRAWING NO.
1



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NOVA #:
DATE: 7/14/2011
DIMENSIONS: SAE
PROJECT ENGINEER: B.L.

UL1612CS
ULTRASCREEN DISK FILTER
PRELIMINARY LAYOUT
FOR
WALNUT CREEK WWTP

NUOVE ENERGIE®
ADVANCED TECHNOLOGY

nova
water technologies llc
P.O. BOX 23523, TAMPA FL 33623
P: 813.288.0533, F: 813.289.3566

DRAWING NO.

1

CITY OF AUSTIN
WALNUT CREEK WWTP
TERTIARY FILTER REHABILITATION PROJECT

TM3 ALTERNATIVE GRANULAR FILTRATION IMPROVEMENTS

CITY OF AUSTIN CIP ID: 3023.025
B&V PROJECT NO. 168622

JULY 15, 2011

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ATTACHMENT TM3-A – FITER COMPLEX HYDRAULIC ANALYSES

ATTACHMENT TM3-B – CONSTRUCTION AND OPERATING COSTS FOR ALTERNATIVES

ATTACHMENT TM3-C – FILTER BACKWASH HYDRAULIC ANALYSES

1.0 INTRODUCTION

This Technical Memorandum Number 3 (TM3) presents alternatives for repair or replacement of the existing granular filter treatment system at the Walnut Creek Wastewater Treatment Plant (WCWWTP) Filter Complex. The system includes three major components which are evaluated separately in this TM3: (1) filter underdrains and media, (2) the low-pressure air system, and (3) the backwash supply system. Improvements to these system components are required in order to ensure the successful long-term operation of the filter complex utilizing granular filter technology.

TM3 has been prepared in accordance with the requirements of the Scope of Services for the Preliminary Engineering Phase of the Walnut Creek WWTP Filter Improvements Project. Consistent with that scope, a “Do Nothing” alternative is described for each system to identify the expected consequences if improvements are not made to these alternatives.

In addition to the system components evaluated within this TM3, the scope of this project includes two additional systems within the filter complex for which improvements will be described. Those systems are: Non-potable Water System and Standby Power System. The full development of these systems will be done during the preparation of the Preliminary Engineering Report, since the scope of the improvements required for these two systems will not be impacted by the selection of the process alternative.

The intent of this TM3 document is to present preliminary recommendations focused on improving filtration using granular media technology for the WCWWTP. TM2 – Alternative Filter Technologies describes two alternative types of filtration technologies that could replace granular filter media at the WCWWTP. The results and recommendations developed in TM3 will be compared to the results and recommendations developed in TM2 so that the City can ultimately choose the improvements that will be designed to improve filtration at WCWWTP. TM 4 will document the comparison of TM2 and TM3 data and recommendations and the resulting selection determined by the City.

2.0 FILTER MEDIA AND UNDERDRAIN IMPROVEMENTS

There are currently 10 granular media filters operating in the filter complex. Filters 1 through 4 are dual-media filters constructed with a gravel support bed on filter block underdrains that were not designed for combined air-water backwash. Filters 5 through 10 are mono-media filters constructed with a nozzle underdrain system and concrete plenum designed for combined air-water backwash. These two sets of filters receive influent from a common header and discharge into a common clearwell.

2.1 Filter Hydraulics

The current configuration of the conduits that convey secondary effluent to the filter complex, the configuration of the filter complex itself, and the conduits that convey the filtered effluent to the Colorado River have been evaluated for multiple flow scenarios. This evaluation focused on the available head for filtration and identification of bottlenecks within the system.

A spreadsheet based hydraulic model was developed using elevations and information obtained from as-built drawings for the various plant expansions and improvement projects dating back to 1979. A hydraulic profile of this system is shown on Figure TM3-1 from the plant outfall working upstream to the junction box on the west side of the filter complex. This figure depicts water surface elevations for selected model runs that are described in this section.

Various Colorado River flood stages and plant flow scenarios were identified and evaluated with the hydraulic model. The flow cases evaluated are summarized below in Table TM3-1. These flow cases were developed to cover the range of current flow conditions based on the capacity of the plant and the outfall as stated in contract documents for previous plant projects. The 60 mgd flow utilized for Cases 1 and 7 reflects the maximum month flows for the past 5 years of record. The 75 mgd flow utilized in Cases 2 and 8 reflects the design maximum month flow of the filtration complex. The 120 mgd filter flow used for many of the runs reflects the current peak hydraulic capacity of the filter complex. The 165 mgd plant flow used for Cases 5 and 11 reflect the current peak capacity of the settled water pumps. The 200 mgd total plant flow used for cases 6 and 12 reflects the peak hydraulic capacity of the plant outfall. The hydraulic model uses an iterative process to calculate the allowable headloss through the filters using the overflow weir at the junction box to the west of the filter building as the controlling upstream elevation.

A detailed listing of the water surface elevations calculated at the various hydraulic junctions within the model are listed in Appendix TM3-A.

Table TM3-1

Flow Scenarios evaluated with the Hydraulic Model [1]

Case	Colorado River Water Level (ft)	Flow to River (mgd)	Total Flow to Filters (mgd)	Filter Bypass Flow at CL Contact Basins (mgd)	Max Filter Headloss w/o overflow at Junction Box (ft)
1	432 (100 yr)	60	60	0	12.4
2	432 (100 yr)	75	75	0	11.5
3	432 (100 yr)	120	75	45	11.5
4	432 (100 yr)	120	120	0	8.0
5	432 (100 yr)	165	120	45	5.9
6	432 (100 yr)	200	120	80	1.3
7	420 (and below)	60	60	0	12.4
8	420 (and below)	75	75	0	11.5
9	420 (and below)	120	75	45	11.5
10	420 (and below)	120	120	0	8.0
11	420 (and below)	165	120	45	7.9
12	420 (and below)	200	120	80	7.8

[1] All flow conditions assume the filter effluent butterfly valve is set at 80% open.

The table above indicates that the existing infrastructure can convey the majority of the flow conditions and river stages evaluated. The modeling showed that the existing infrastructure can operate normally up to a total filter flow of 120 mgd and a total plant flow of 200 mgd with up to 8.0' of allowable headloss through the filters for river stages at or below an elevation of 420 ft.

Hydraulic cases 1 through 6 were run with the Colorado River at the 100 year flood elevation 432 to evaluate plant hydraulics under the design condition required by regulations. As shown in Case 6, a total plant flow of 200 mgd and a filter flow of 120 mgd are not possible at the 100 year flood stage without overflow at the junction box because the maximum allowable filter losses is only 1.3 ft. However, the current plant flow rate of 165 mgd with 120 mgd filtered allows for 7.9 feet of headloss through the filters.

The main bottlenecks identified in the hydraulic analysis are the small effluent weir length (13.75 feet) at the outlet of the filter clearwell and the short length of 72-inch diameter filter effluent conduit that connects the clearwell to the outfall conduit. These bottlenecks can be eliminated by increasing the total effluent weir length or decreasing the flow over the existing weir by adding an additional clearwell and weir. Paralleling the 72 inch filter effluent pipe with another pipeline would decrease the velocity and head loss in the filter effluent conduit system thereby increasing the head available for filtration.

2.2 “Do Nothing” Alternative

The existing filters have been operating at about 70 percent of their rated capacity for the past 5 years. They are manually controlled during operation and during backwash, which results in some unusual operating conditions. Since the filters are not automatically controlled, the best the operator can do is to set the position of the filter effluent valve manually and then monitor the flow in an attempt to balance flow to each filter. Because this activity consumes so much time, it is generally not done, and the filters are left to operate as best they can. During the field work for this project filter levels ranged from above the filter backwash troughs to below the top of the media, with influent flow falling from the backwash troughs directly onto the top of the media.

Seasonally, these filters have difficulty complying with the permitted value of 5 mg/L total suspended solids (TSS). This could be due to a number of factors, but the current condition of the filter media and underdrains, as well as the lack of automation for these filters, is a significant reason for the operational challenges. The operators do not monitor individual effluent turbidity due to the amount of effort required to do so, and the measurement of head loss through the filters is hit or miss due to lack of accurate flow metering. Therefore, it is impossible to ascertain whether the filters are being backwashed too often or not often enough. It is also not possible to determine whether the filter runs should be terminated on head loss or turbidity, and whether or not the filters 1 through 4 should be backwashed more or less frequently than filters 5 through 10. These operational issues will become more pronounced as the filter complex nears its rated capacity.

Because backwash is conducted manually, it is initiated on the basis of elapsed time and executed using only a peak flow rate for as long as the operator thinks is necessary based on years of experience. Thus there is no stratification of the media in filters 1 through 4, sand can be seen on top of the anthracite in these dual-media filters. The amount of cleaning that occurs within each filter appears to be highly variable, as noted with the media samples taken from filters 8 and 9. Filter 9 had a significant number of mud balls that were small, soft and should have been easily broken up during backwashing, while filter 8 did not.

2.2.1 Operating Costs

Operating costs for the current operation have been estimated to establish the baseline case for the filter media and underdrains. The annual operating costs have been prepared based on 2011 costs and reflect continued manual operation of the filters. The following assumptions have been made in preparing these costs:

- Each filter is backwashed every 48 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 36 hours. Each filter backwash includes 18 minutes of backwash flow at a rate of 22 mgd, for a total volume of 275,000 gallons. This volume of backwash water is pumped from the clearwell by running one backwash pump and recycled to the settled water pump station where this flow is treated in the secondary complex.
- An operator must be in attendance during each filter backwash, which takes a total of 45 minutes per filter by the time the filter is taken off-line, allowed to drain, backwashed, and placed back into service. All together this complex requires approximately 5hours of operator attention each day.
- Maintenance is required for filter control valves and instruments to maintain their continued operation. This requires an instrument technician working in the filter complex three days a week for 8 hours.
- The filter media will require replenishment to maintain the current average of 2.7 ft of media depth. The annual cost of media replacement is calculated based on “topping off” one filter per year by adding 18-inches of media to the top of the bed. The total annual volume of media required is 60 cubic yards (approximately 71 tons).
- Replacement parts for valves, pumps and other systems will be required with great frequency given the age of the existing assets. The annual cost for replacement or refurbishment of existing assets is assumed to be 10% of the cost of replacement as identified in the construction cost estimates for backwash pumps, valves and instruments.

Table TM3-2 lists the estimated annual operating costs for the "Do Nothing" Filter Media and Underdrain Alternative. A detailed breakdown of these costs is included in Attachment TM3-B.

Table TM3-2
Operating Costs for the "Do Nothing" Filter Media and Underdrain Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$29,700
Labor Costs	$83,300
Annual Replacement of Parts and Materials	$54,500
Total Annual Cost	**$167,500**

2.2.2 Evaluation Against Project Goals

The "Do Nothing" Filter Media and Underdrain Alternative will maintain the status quo for the filter complex. As the assets that are in service in this facility and currently past the end of their useful life continue to remain in service, this complex will become less reliable and require additional maintenance costs. As the loading increases to each of these filters, they will become less reliable and more prone to exceeding the permitted turbidity limit in the effluent. This can be offset by backwashing the filters more frequently, but this will increase the operating costs associated with these units.

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* The "Do Nothing" alternative will result in the lowest cost and schedule as minimal or no work would be completed for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* The "Do Nothing" alternative will not meet this goal, as the filters will continue to operate manually and no improvement will be made to the efficiency of the complex.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* The "Do Nothing" alternative will not meet that goal and will leave the plant with aging assets that are at a high risk of failure, as described in TM1.

2.3 Nozzle Underdrains and Mono-Media Filter

This alternative will result in ten filters that perform in a similar fashion, making the operation and control of the filter complex simpler and more efficient. Although mono-media filters are described with the nozzle underdrains as part of this alternative, there is no reason that dual-media filters could not be made to work with this type of underdrain.

2.3.1 Description of Improvements

The existing media and underdrains in filters 1 through 4 will be demolished down to concrete and replaced with nozzle type underdrains in a cast in place concrete subfloor similar to Filters 5 through 10. The filter beds will be constructed with 3” gravel support and 4 feet of anthracite media. The filter backwash troughs in Filters 1 – 4 will be raised to accommodate expansion of the filter bed upon backwashing. Filters 1 through 4 will be equipped for combined air-water backwash, all surface wash piping and equipment will be removed. The filter media in filters 5 through 10 will remain, but the level will be brought up to a full 4-foot depth. Figures TM3-2 and TM3-3 depict the demolition of existing filter equipment and installation of new equipment within Filter 3.

Mechanical. This alternative relies upon implementation of one of the low pressure air alternatives in Section 3.0 to bring an air supply of 2,200 scfm to each of the new filters. The capital and operating cost for that air supply is covered under the low pressure air alternatives. Otherwise, all piping and valves within the gallery that serve filters 1 through 4 will remain unchanged as part of this alternative, except for those assets that are near the end of their useful life as noted in a separate section of TM3.

Structural. The structural improvements required for this alternative include the construction of the concrete sub-floor that contains the filter nozzles. This new concrete construction will be anchored to the existing concrete floor and installed as one monolithic pour within each filter box for filters 1 through 4. In addition, raising the backwash troughs will require that the existing concrete wall that forms the backwash drain/influent channel be modified. This wall will be demolished to the bottom of the existing backwash troughs and capped off with a vertical section that will accept the new backwash troughs at a higher elevation. The top elevation of the wall will be raised accordingly.

Electrical and Controls. The required electrical and controls for this alternative are similar to those envisioned for the existing filters as described in Section 5.0 Filter Complex Control

System, no additional electrical loads or control elements will be required to implement this Nozzle Underdrain and Mono-media Filter alternative.

2.3.2 Construction and Operating Costs

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM3, limited to the work within the filter boxes. These costs only include a portion of the total work required and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-3 lists the capital cost for the Nozzle Underdrain and Mono-media Filter Alternative.

Table TM3-3
Capital Costs for the Nozzle Underdrain and Mono-Media Filter Alternative

Description	Capital Cost
Filters 1 through 4	
Division 2 – Sitework	$119,600
Division 3 – Concrete	$90,700
Division 13 – Filter Underdrains and Media	$1,064,000
Filters 5 through 10	
Division 13 – Additional Filter Media	$180,800
General Conditions, Overhead and Profit	$291,000
Contingencies	$698,400
Total Capital Cost	**$2,444,500**

The annual operating costs have been prepared based on 2011 costs and reflect automatic operation of the filters. Therefore, the improvements listed in this TM3 for control system modifications and replacement of assets near the end of their useful life must also be implemented. With these improvements in place, the following assumptions have been made in preparing these costs:

- Each filter is backwashed every 60 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 48 hours. Each filter backwash includes a total volume of 200,000 gallons and includes a combined air-water cycle as well as a low flow setting. The increased filter run times and reduced backwash requirements compared to the "Do Nothing" alternative are a direct result of the improvements to the filters.

- An operator can initiate the backwash from the plant control room, and the filters are in automatic control. Operator's time is reduced to approximately 4 hours per day to monitor the operation of this unit process.
- Maintenance is required for the new filter control valves and instruments to maintain their continued operation. This requires an instrument technician working in the filter complex one day a week for 8 hours.
- The filter media will require replenishment to maintain the design 4 foot of media depth. The annual cost of media replacement is calculated based on "topping off" one filter per year by adding 12-inches of media to the top of the bed. The total annual volume of media required is 40 cubic yards (approximately 47 tons). The reduced volume compared to the "Do Nothing" alternative is based on better control of the filter flows during backwashing.
- Replacement parts for valves, pumps and other systems will be much less frequent for the new assets. The annual cost for replacement or refurbishment of existing assets is assumed to be one percent of the cost of replacement as identified in the opinions of probable construction cost for backwash pumps, valves and instruments.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-4.

Table TM3-4

Operating Costs for the Nozzle Underdrains and Mono-Media Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$19,800
Labor Costs	$50,900
Annual Replacement of Parts and Materials	$14,100
Total Annual Cost	**$84,800**

2.3.3 Evaluation Against Project Goals

The Nozzle Underdrain and Mono-media Filter Alternative will improve the performance and operability of the filter complex by bringing all ten filters up to the design standard that was used for filters 5 through 10 originally. As the loading increases to these filters, the plant will have more flexibility regarding the ability to meet the permitted turbidity limit in the effluent even with upsets to the secondary process.

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* The Nozzle Underdrain and Mono-media Filter Alternative can meet that criteria based on the original Business Case Evaluation completed for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative, combined with improvements described later in this TM3, will ensure automatic operation of the facility with ten filters that operate identically which should yield a very constant effluent quality.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* The existing filter underdrains and media in filters 1 through 4 have reached the end of their useful life and, therefore, this alternative fully meets this project goal.

2.4 Filter Block Underdrains and Dual-Media Filters

This alternative will result in ten filters that are similar in operation and performance utilizing a dual-media design similar to that originally installed in filters 1 through 4. Although the dual-media option is described as part of the filter block alternative, there is no reason why the dual-media cannot be used with the nozzle underdrain system or vice versa.

2.4.1 Description of Improvements

Filters 1 through 4 will be will be demolished down to concrete and replaced with a completely new filter block style underdrain system, similar to Leopold’s “Type S” underdrain. The filter media will be a dual-media system with 22-inches of anthracite over

12-inches of sand, supported on a 12-inch graded gravel bed. Additionally, the media in filters 5 through 10 will be replaced with the same dual-media system so that all ten filters have a common media configuration. Figure TM3-4 depicts this alternative installed in Filter 3. It should be noted that the filter block manufacturers can supply a synthetic cap (Similar to Leopold's IMS Filter Cap) for the filter blocks in lieu of the graded gravel support bed, but there have been operational issues with those filter caps in wastewater applications, so this alternative utilizes the graded gravel bed similar to that installed for filters 1 through 4 in the original plant construction.

Mechanical. This alternative relies upon implementation of one of the low pressure air alternatives in Section 3.0 to bring an air supply to each of the new filters. Leopold has indicated that 2,200 scfm is the minimum air flow to ensure an even distribution using the filter block underdrain system, 4,400 scfm is preferable. However, the existing nozzle underdrain system for filters 5 through 10 was sized for 2,200 scfm. To accommodate this variability in air flow without adding or oversizing the equipment, the normal operation for the low pressure air system will be to operate both blowers when backwashing filters 1 through 4 and only one blower when backwashing filters 5 through 10. In the event that one blower is down for maintenance, filters 1 through 4 can be backwashed by only one blower at a reduced air flow rate. The capital and operating cost for that air supply is covered under the low pressure air alternatives. Otherwise, all piping and valves within the gallery that serve filters 1 through 4 will remain unchanged as part of this alternative, except for those assets that have reached the end of their useful life as described in a separate section of this TM3.

Structural. The structural improvements required for this alternative include the demolition and removal of the existing underdrains and media in filter 1 through 4, these filters will be taken down to concrete. New filter block underdrain systems will be constructed within these existing boxes by pouring a thin layer of fresh grout and then anchoring the blocks into the grout. The existing backwash troughs will be removed and new backwash troughs will be constructed at a higher elevation in order to have adequate elevation between the bottom of the trough and the top of the media. These new troughs require that the existing concrete wall that forms the backwash drain/influent channel be modified. This wall will be demolished to the bottom of the existing backwash troughs and capped off with a vertical section that will accept the new backwash troughs at a higher elevation. The top elevation of the wall will be raised accordingly.

Electrical and Controls. The required electrical and controls for this alternative are similar to those envisioned for the existing filters as described in Section 5.0 Filter Complex Control System portion of this TM3, no additional electrical loads or control elements will be required to implement this Nozzle Underdrain and Mono-media Filter alternative.

2.4.2 Construction and Operating Costs

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM3, limited to work within the filter boxes. These costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-5 lists the capital cost for the Nozzle Underdrain and Mono-Media Filter Alternative.

Table TM3-5
Capital Costs for the Filter Block Underdrains and Dual-media Filter Alternative

Description	**Capital Cost**
Filters 1 through 4	
Division 2 – Sitework and Demolition	$119,600
Division 3 – Concrete	$69,100
Division 13 – Filter Underdrains and Media	$1,010,800
Filters 5 through 10	
Division 2 – Sitework and Demolition	$71,900
Division 13 – Additional Filter Media	$448,000
General Conditions, Overhead and Profit	$343,900
Contingencies	$825,300
Total Capital Cost	**$2,888,600**

The operating and maintenance cost for this alternative is assumed to be the same as those presented for the Nozzle Underdrain and Mono-media Alternative, and the same assumptions apply to both.

2.4.3 Evaluation Against Project Goals

The Filter Block Underdrain and Dual-Media Filter Alternative will improve the performance and operability of the filter complex by bringing all ten filters up to the design standard that was used for filters 1 through 4 originally. As the loading increases to these filters, the plant will have more flexibility regarding the ability to meet the permitted turbidity limit in the effluent even with upsets to the secondary process.

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* The Filter Block Underdrain and Dual-Media alternative is consistent with the costs that were planned as part of the Business Case Evaluation for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative, combined with improvements described later in this TM3, will ensure automatic operation of the facility with ten filters that operate identically which should yield a very constant effluent quality.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* The existing filter underdrains and media in filters 1 through 4 have reached the end of their useful life and therefore this alternative fully meets this project goal.

2.5 Comparison of Filter Media and Underdrain Alternatives

The comparison of the three alternatives considered for filter media and underdrains includes both economic and non-economic factors as described below.

2.5.1 Economic Factors

The “Do Nothing” alternative has the lowest capital cost, but this alternative also carries the highest operating costs. By comparison, the Nozzle Underdrain and Mono-Media Filter Alternative is estimated to reduce operating costs by approximately $130,000 per year. The capital cost for the Filter Block Underdrain and Dual-Media Filter Alternative is higher than the Nozzle Underdrain and Mono-Media Filter Alternative primarily because the existing filter media in Filters 5 through 10 is being completely removed and replaced. Otherwise, these two alternatives are quite similar and non-economic factors will likely drive the decision.

2.5.2 Non-Economic Factors

The “Do Nothing” Alternative does not meet the project goal# 2 or #3 and, therefore, will score zero for the non-economic factors that are important to this project. The non-economic evaluation of the two remaining alternatives can be considered in two parts – (1) underdrains and (2) media.

- Underdrains: The nozzle underdrains would result in a filter complex that has similar construction throughout. Further, the nozzle type underdrains do not require a gravel support bed like the filter block underdrains. The original filter boxes for filters 1 through 4 were constructed for filter block style underdrains, and the retrofit with this type of underdrain would result in a more standard filter construction.
- Media: Both mono-media and dual-media are suitable for this application. In very general terms, mono-media filters with deep beds have a greater solids holding capacity and will be more forgiving in the event of a peak solids load to the filters. Dual-media filters will generally provide better effluent quality with the tighter sand layer below the anthracite. The dual-media design requires more attention to the backwashing sequence, as the low flow backwash at the end of the cycle is critical to re-stratifying the bed and maintaining the dual-media configuration. If there is a trend in filter design, the deep bed mono-media filters appear to have been more prevalent in recent years for this application.

3.0 LOW PRESSURE AIR SUPPLY SYSTEM

The existing low-pressure air system is currently tapped off of the main low pressure air blowers in the operations building. The air produced by these blowers is primarily devoted to the aeration basins, although a smaller volume is intended to be diverted to feed the air/water backwash process of filters five through ten through an underground pipeline to the filter buildings. This low pressure air line is reported to be leaking in multiple locations and has been isolated from the main air system to save operating costs. It has been reported that operation of the low pressure air system at 2,000 scfm during a filter backwash has required the starting of an additional aeration blower in the operations building, a significant operational cost to the plant. Further, the operating valve and the meter in the pipe gallery of Filter Building 2 are located immediately under the roof of the pipe gallery and are inaccessible.

3.1 "Do Nothing" Alternative

The low pressure air system designed to serve Filters 5 through 10 is not currently functioning, and has not been for some time. The feed line from the blowers, contained in the operations building, is broken or cracked in multiple locations, as reported by plant staff. The "Do Nothing" Alternative would result in continued operation of the filters with water only backwash, which generally does a poor job in cleaning a filter bed that is four feet deep and results in higher backwash volumes with shorter filter runs that tend to breakthrough on turbidity, not head loss.

3.1.1 Operating Cost

Operating costs for the current operation without combined air-water backwash of the filters have been estimated to establish the baseline case for the low pressure air alternatives. The annual operating costs have been prepared based on 2011 costs and reflect continued backwashing of mono-media, deep-bed filters without the use of combined air scour. The following assumptions reflect the need to provide additional backwash water during each backwash cycle where the combined air/water backwash is not utilized; the need to backwash with greater frequency because of inadequate cleaning of the deep bed mono-media filters, and the need to periodically take the filter out of service and thoroughly clean the media with repeated backwash cycles and high-pressure hoses manned from the filter deck:

- Each filter backwash includes 18 minutes of backwash flow at a rate of 22 mgd, for a total volume of 275,000 gallons. This volume of backwash water is pumped from the clearwell by running one backwash pump and recycled to the settled water pump station where this flow is treated in the secondary complex.
- Each filter is backwashed every 48 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 36 hours.
- Every six months, each filter is taken down for one day and backwashed repeatedly while operators impinge high-pressure water jets onto the surface of the filter.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-6.

Table TM3-6
Operating Costs for the "Do Nothing" Low Pressure Air Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$29,700
Labor Costs	$8,600
Total Annual Cost	**$38,300**

3.1.2 Evaluation Against Project Goals

A key component of ensuring the long term functionality of the Walnut Creek WWTP is to employ systems that can treat the current and future plant demands in an efficient manner. The lack of an air scour system would require the use of more backwash water on a daily basis, results in filters that are more susceptible to turbidity break through, and results in shorter filter runs.

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* The "Do Nothing" Low Pressure Air Alternative meets this goal.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative does nothing to improve the operation of the filters and therefore is counter to this goal.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* This alternative does not meet that goal given the air-wash system has already failed and is no longer in use.

3.2 Centrifugal Blowers within an Existing Structure

This alternative would consist of abandoning the low-pressure air feed from the Operations Building and replacing it with two new centrifugal multi-stage blowers located in the existing pipe gallery for Filter Building 1.

3.2.1 Description of Improvements

The existing backwash pumps would have to be removed under this alternative to provide space to locate two new centrifugal blowers. Therefore, this alternative requires that the backwash pumps be replaced, and would work best with the backwash supply alternative that provides a new clearwell and pump station, or the WRI backwash alternative. Figure TM3-5 is a plan view of the pipe gallery in Filter Building 1 that depicts the equipment arrangement for this alternative.

Mechanical. In order to make room for this alternative, the existing backwash pumps, piping and vacuum prime system will be demolished and removed from the gallery. Two new multistage centrifugal blowers will be installed, each capable of producing 2,200 scfm at 5 psi. Each blower would be provided with an inlet filter that would be located outside the gallery on the existing deck, inlet silencer, discharge silencer and blow-off valve. Both blowers could be operated in parallel if the filter block alternative is chosen for filters 1 through 4; only one unit would be required for the air-wash of filters 5 through 10. Piping required to provide air to filters 1 through 4 will need to be constructed as part of either filter underdrain alternative. New piping from these new blowers will be connected to the existing air piping for filters 5 through 10.

Structural. The pads for the existing backwash pumps will be demolished and the area around the new blowers modified to accept the new mechanical gear. Additional supports will be required for the low pressure air piping, and openings will have to be made in the deck to allow inlet air.

Electrical and Controls. The existing Filter Building power distribution system is inadequately sized to support the electrical service needs of the proposed air scour blowers in addition to the backwash pump, NPW pumps, and other remaining existing filter building loads. This alternative assumes the backwash pumps electrical service will be removed from the existing filter building motor control centers and separately served as described in in Section 5.0. Correspondingly, the backwash pump motor starters will be removed from the filter building motor control center lineup. Under this alternative, reduced voltage starters will be added to the filter building motor control center lineup to serve the air scour blowers.

Under this alternative, each blower and related I&C equipment will be allocated to a separate PLC. The control equipment for the blowers will be located in the control room level of the filter building and networked with the filter control system over a dual channel copper cable Ethernet data link.

3.2.2 Construction and Operating Cost

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM3, limited to work within the existing filter gallery related directly to the low pressure air supply. These costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-7 lists the capital cost for the Centrifugal Blowers within an Existing Structure Alternative.

Table TM3-7
Capital Costs for the Centrifugal Blowers within an Existing Structure Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	$20,400
Division 3 – Concrete	$700
Division 9 – Finishes	$3,000
Division 11 - Equipment	$138,600
Division 15 – Mechanical	$147,700
Division 16 – Electrical	$100,200
General Conditions, Overhead and Profit	$82,100
Contingencies	$197,100
Total Capital Cost	**$689,900**

The operating and maintenance cost for this alternative is based on the following assumptions:

- The blowers operate during each backwash cycle for a period of six minutes during the combined air/water backwash. The addition of this air reduces the total required water for each backwash to 200,000 gallons.
- The more efficient filter backwash results in longer filter runs, with runs at 60 hours for the current loading rate of 3.5 gpm/sf (55 mgd) and 48 hours for the future loading rate of 4.8 gpm/sf (75 mgd).
- Blower maintenance is calculated as one percent of the equipment cost per year, which covers routine maintenance, filter cartridge replacement, and lubrication.

A summary of the operating and maintenance costs associated with this alternative are summarized in Table TM3-8.

Table TM3-8
Operating and Maintenance Costs Centrifugal Blowers within an Existing Structure Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$19,800
Replacement Parts and Materials	$1,100
Total Annual Cost	**$20,900**

3.2.3 Evaluation Against Project Goals

The new centrifugal blowers will improve the efficiency of the filter backwash cycle by providing air scour to all ten filters. This alternative will return filters 5 through 10 to their original design and will provide the plant with filters that can accumulate more solids during each run because the solids will be more effectively removed in the backwash.

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 – *Complete the project within budget and schedule:* This alternative can meet that criteria based on the original Business Case Evaluation completed for this project.

- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative, combined with improvements described later in this TM3, will ensure automatic operation of the facility with ten filters that operate identically which should yield a very constant effluent quality.
- Project Goal #3 – *Identify assets that are at the end of their useful life and replace them:* This alternative most definitely achieves this goal by replacing an inoperative system and installing a new low pressure air system that will incorporate all ten filters.

3.3 Positive Displacement Blowers in a New Structure

This alternative would consist of abandoning the existing low-pressure air feed from the operations building and replacing it with a new system located in a new structure adjacent to the existing filter buildings. The proposed blowers for this alternative would be rotary lobe positive displacement type blowers capable of producing 2,200 scfm at 5 psi.

3.3.1 Description of Improvements

A new structure would be constructed adjacent to the filter buildings to house the new low-pressure air supply in an at-grade structure. This alternative could be constructed on the ground floor of the underground clearwell described in this TM3 as a backwash alternative. The proposed layout of this new blower facility is shown in Figure TM3-6.

Mechanical. Two positive displacement blowers would be installed in the new facility, each capable of producing 2,200 scfm at 5 psi. Each filter will be provided with an inlet filter that takes in fresh air from outside the building and discharge silencer. In the event that the filter block underdrain is chosen for filters 1 through 4, both blowers would operate in parallel when air is being provided to those filters, one unit would be required for the air-wash of filters 5 through 10. Low pressure air piping will be routed from the new structure to the existing filter gallery where it will connect to the existing air header. New piping will be provided to filters 1 through 4 as part of this alternative.

Structural. A completely new structure will be constructed for this alternative. This structure could be constructed as part of the proposed clearwell to the west of the existing filter building. The new structure will require sound attenuating features and the blower room should be isolated from other rooms that require operator access. The concrete equipment pad on which the blowers will be mounted must be capable of absorbing the vibration of the compressors.

Electrical and Controls. The required electrical and controls for this alternative are similar to those envisioned for the air scour blowers located in the existing filter building as previously described. Under this alternative however, the control equipment for the blowers would be located in the control room level of the new clearwell structure and networked to the filter building control system over a dual channel single mode fiber optic Ethernet data link.

3.3.2 Construction and Operating Cost

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM3, including the new structure and the work within the existing filter gallery related directly to the low pressure air supply. These costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-9 lists the capital cost for the Positive Displacement Blowers within a New Structure Alternative.

Table TM3-9
Capital Costs for the Positive Displacement Blowers within a New Structure Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	$26,700
Division 3 – Concrete	$15,700
Divisions 4 through 9 – Building Superstructure	$167,600
Division 11 - Equipment	$123,200
Division 15 – Mechanical	$243,200
Division 16 – Electrical	$375,000
General Conditions, Overhead and Profit	$190,300
Contingencies	$456,600
Total Capital Cost	**$1,598,200**

The operating and maintenance cost for this alternative is based on similar assumptions to those described for the Centrifugal Blowers within an Existing Structure Alternative. The operating costs for the positive displacement blowers is slightly different due to the horsepower requirements of the blowers. In addition, there will be an additional cost to maintain a new structure in addition to the existing filter gallery, including lighting and ventilation to eliminate heat load from the structure.

The operating and maintenance costs associated with this alternative are summarized in Table TM3-10.

Table TM3-10
Operating and Maintenance Costs for
the Positive Displacement Blowers in a New Structure Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$23,700
Replacement Parts and Materials	$700
Total Annual Cost	**$24,400**

3.3.3 Evaluation Against Project Goals

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 – *Complete the project within budget and schedule:* The cost for new structures to house blowers was not included in the original Business Case Evaluation completed for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative, combined with improvements described later in this TM3, will ensure automatic operation of the facility with ten filters that operate identically which should yield a very constant effluent quality.
- Project Goal #3 – *Identify assets that are at the end of their useful life and replace them:* This alternative most definitely achieves this goal by replacing an inoperative system and installing a new low pressure air system that will incorporate all ten filters.

3.4 Comparison of Low Pressure Air Alternatives

Two types of blowers are being considered for the low pressure air scour during filter backwash, multistage centrifugal blowers and rotary lobe positive displacement type blowers. Both blower types are suitable for a filter backwash application.

- Centrifugal Blowers: Centrifugal blowers consist of several stages of centrifugal impellers in series where each impeller compresses the air slightly more to achieve the desired discharge pressure at the required flow. These blowers achieve compression inside the blower housing. Due to the balance of the machine and the described internal compression, centrifugal blowers operate with little vibration, and no pulsation of flow. As centrifugal blowers do not vibrate, they can be mounted on a typical concrete equipment pad. A centrifugal blower is relatively quiet compared to a positive displacement blower with a typical sound level of 85 dBa. The noise associated with centrifugal blowers is also a more high frequency noise that can be dampened by placing acoustic panels on the walls of the room it is located in. Centrifugal blowers are generally not enclosed, other than being in a room, allowing the machine to easily be visually inspected by maintenance personnel walking through the plant.
- Positive Displacement Blowers: Positive displacement blowers consist of two rotating elements, each with two or three lobes. These blowers achieve their compression in the pipe downstream of the blower by the lobes continuing to force more air into the pipe. This type of compression will cause a certain amount of pulsation of air flow as the lobes push air in the pipe. Due to the construction of these machines having two unbalanced rotating parts, positive displacement blowers are known to vibrate more than a centrifugal blower. Positive displacement blowers in the size range required for this project typically cause enough vibration that they need to be mounted on thick concrete pads, sometimes as thick as 3 or 4 feet. Positive displacement blowers are also much louder than a centrifugal blower with sound levels exceeding 100 dBa. Typically this equipment is placed in a sound attenuating enclosure to reduce this volume level. The type of noise produced by a positive displacement blower is a low frequency, and is not dampened by acoustic paneling. The enclosures do have external ways of checking fluid levels, but they do make it more difficult for an operator to inspect the machine during a walk through.

3.4.1 Construction and Operating Cost

The "Do Nothing" Alternative clearly results in the lowest construction cost, and the operating cost difference identified in this TM3 does not justify the capital investment. However, continued operation of the filter complex without air scour as part of the regular backwash sequence will put the plant at significant risk of building up solids in the bed that could result in violation of discharge permit standards, that risk has not been quantified economically. The Centrifugal Blower in Existing Structure appears to be less costly than the Positive Displacement Blower in a New Structure, but those costs could be significantly influenced by the selection of other alternatives. The existing backwash pumps have to be demolished to allow installation of the Centrifugal Blowers in this structure, and if they are not demolished this alternative could become more expensive. The installation of positive displacement blowers in a new stand alone structure is more expensive, but if a new structure was constructed as part of a clearwell and backwash supply, those capital costs could be significantly reduced.

3.4.2 Non-Economic Factors

The "Do Nothing" Alternative will not provide the plant with a workable, long-term solution. Filtration at wastewater treatment facilities requires vigorous agitation of the filter bed during the initial stages of the backwash sequence in order to dislodge the solids from the bed so that they can be removed from the filter. The lack of air scour will result in solids build-up in the bed that will eventually cause shorter filter run times. This approach is not recommended, and has the potential to cause significant operational problems as the plant approaches its rated capacity. The two remaining alternatives will both provide a reliable, adequate supply of air to the filter complex. The selection between these alternatives will be based on City preference and the interaction between this system and the backwash supply system.

4.0 BACKWASH SUPPLY

The existing filter backwash system includes the filter clearwell, two backwash pumps and a vacuum prime system located in Filter Building 1. The existing pumps are horizontal centrifugal units that have a suction line laid on top of the buried portion of the clearwell on the east side of the gallery, necessitating the vacuum prime system. These units have constant speed motors; flow is throttled using a butterfly valve and flowmeter in the main backwash supply line. The clearwell sump located in the northeast corner of Filter Building

1 also supplies the low pressure pumps for the reclaimed water system and the non-potable pumps that supply that system.

4.1 Backwash System Hydraulics

The current piping network used to supply backwash water to the filter complex has been evaluated hydraulically. The purpose of this evaluation was to establish the current operating parameters and identify shortcomings in the filter clearwell system as a whole, including the backwash system, non-potable system, and reclaimed water system.

The existing effluent channel and clearwell arrangement has the backwash system, non-potable system, and reclaimed water system drawing off the northern clearwell and sump located to the east of Filter 2. If the combined demand from the backwash system, non-potable system, and reclaimed water system exceeds the filter output, or if there is an interruption in filter effluent, there is potential for the clearwell and sump to run dry. Additional clearwell storage for the backwash system, non-potable system, and reclaimed water system is needed to prevent interruption to plant operations.

In addition to the potential for an interruption in the non-potable water system, the effluent channel is susceptible to surge events due to the operations in the northern clearwell. When the flow rate out of the northern clearwell exceeds fifty percent of the total filter effluent flow rate, the flow in the effluent channel will reverse and flow back towards the northern clearwell. This flow reversal creates a surge wave in the effluent channel and northern clearwell that interferes with the level sensor that the backwash pumps operate from.

An evaluation of the existing backwash pump curves and the suction piping arrangement from the northern clearwell, determined that there is sufficient net positive suction head available (NPSHA) to operate the backwash system at 31 mgd. Although there is sufficient NPSHA, the suction piping arrangement requires the use of vacuum pumps that could be eliminated with an updated clearwell or piping arrangement.

The discharge piping and the headloss through the filters during backwash was also evaluated to generate a system curve (See Appendix TM3-C). Analysis of the original pump curve provided by the manufacturer shows that the existing backwash pumps are operating out on their curves well away from the best efficiency point. Additionally, the pumps are currently operating below the factory curve, indicating significant wear in the impeller and/or casing. This means that the existing units cannot deliver the design peak backwash flow rate. If the preferred method of backwash were implemented, using combined air-water with a low rate and high rate of flow, these existing pumps would operate over a wide range of conditions but would rarely operate at their best efficiency point.

The withdrawal of effluent from the northern clearwell, the layout for the backwash pump suction piping and the inefficient backwash pumping make it difficult to reliably operate the filter complex for the wide variety of flow conditions realized at the plant.

4.2 "Do Nothing" Alternative

The existing backwash pumps, associated piping and vacuum priming system would remain in service indefinitely if the "Do Nothing" Alternative is chosen. Because the pumps no longer provide the design peak backwash flow, the operation of the filters could not be optimized and filter productivity, effluent quality and reliability would suffer.

4.2.1 Operating Cost

Operating costs for the current backwash pump operation has been estimated to establish the baseline case for the backwash supply alternatives. The annual operating costs have been prepared based on 2011 costs and reflect continued backwashing of mono-media, deep-bed filters with the existing pumps taking suction from the clearwell. The following assumptions reflect the current pump capacity, which has been observed to be approximately 22 mgd, necessitating additional backwash water during each backwash cycle. In addition, the following assumptions are based on higher maintenance costs for the existing backwash pumps, valves, vacuum prime system and appurtenances.

- Each filter backwash includes 18 minutes of backwash flow at a rate of 22 mgd, for a total volume of 275,000 gallons. This volume of backwash water is pumped from the clearwell by running one backwash pump and recycled to the settled water pump station where this flow is treated in the secondary complex.
- Each filter is backwashed every 48 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 36 hours.

- The annual maintenance cost for this system is equal to 10 percent of the equipment cost for replacement equipment and valves within this system.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-11.

Table TM3-11
Operating Costs for the "Do Nothing" Backwash Supply Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$29,700
Backwash Pump Replacement Parts and Materials	$50,000
Total Annual Cost	**$79,700**

4.2.2 Evaluation Against Project Goals

A key component in meeting future demands of the plant is to provide a sufficient and reliable backwash supply. The condition of the existing backwash pumps and their inability to provide peak backwash supply is contrary to this goal. If this current system is not upgraded the plant runs the risk of losing the ability to backwash filters for an extended period of time.

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* This alternative meets this goal given no changes are made to the existing backwash system and pumps.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative does not assist in achieving this goal given how inefficient the existing backwash pumps are and the higher maintenance and operational costs associated with these older pumps. Additionally, these pumps make it difficult to improve control of the filter process since they are not capable of operating at the required future demands.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* These pumps are at the end of their useful life and need to be replaced.

Therefore, if this alternative was selected the goal of replacing end of useful life items will not be met.

4.3 Backwash Storage in a new Clear Well

This option would consist of constructing a new clearwell to the west of the existing filter complex. This structure would include storage of two backwash volumes at the hydraulic gradient of the filter effluent (below grade), with new backwash pumps located in a dry pit in between the two halves of the proposed clearwell. The design of this facility will include provisions for the future construction of four filter boxes similar to filters 1 through 4.

4.3.1 Description of Improvements

The new structure will be constructed with a split clearwell, each side with adequate storage for one backwash (two backwashes total). Gates or valves will be provided for isolating each half of the clearwell for periodic maintenance. The existing clearwell under Filter Building 1 will be converted to filtered water conduit, this conduit will be connected to the new clearwell and bulkheads added to this system such that either the north or south half of the filter complex can be removed from service without impacting the other half. A site plan of this alternative is shown in Figure TM3-7, Figure TM3-8 is a plan and section of the new structure.

The existing outfall weir and filter effluent conduit will be replaced with two longer weirs and parallel filter effluent conduits to remove the hydraulic bottleneck imposed by the existing weir and to improve reliability of the system.

Filter backwash supply will include two new variable speed pumps, each sized for 25 mgd. These pumps will be located in a dry pit with flooded suction lines that will allow the entire contents of the clearwell to be pumped out. A new magnetic flow meter will be installed in the pump discharge piping to allow precise control of flow from the pumps. New pumps for the non-potable system and new suction connections for the existing low service reclaimed water pumps would be incorporated into this clearwell. The low pressure air system alternative in a separate structure could be located on the upper floor of this structure.

Mechanical. The proposed location of the two new backwash pumps will be in a dry-pit between the two halves of the clearwell. The pumps will discharge to the east and connect to the existing 30’ blind flange at the northeast corner of the existing filter building. Two independent filtered effluent conduits will be constructed to supply the new clearwell. The first conduit will be an extension of the existing filtered effluent conduit running east/west along the north side of the filter gallery; it will connect to the northern half of the proposed clearwell. Construction of this extension will need to consider provisions to ensure that the structural integrity of the existing influent junction box immediately west of the filter building is not impacted. The second filtered effluent feed will come out of the existing clearwell at the southeast corner of the existing filter building and travel to the west along the south side of the existing filter building; it will connect to the southern half of the proposed clearwell. Both halves of the clearwell will be connected so filtered effluent can be transferred between the two halves and valves or gates will be installed to allow each half of the clearwell to be isolated, as needed.

Structural. The new clearwell and associated drypit will constitute a completely new structure founded more than 30 feet below the existing grade, approximately seven feet lower than the existing filter gallery. The clearwells will be buried, with a structural top slab designed to withstand the loading from fill placed over these units after the initial construction, but also designed to accommodate the future construction of filter boxes. Access into the clearwells will be accomplished from the dry pit area, access into the dry pit will be accomplished from the surface via stair towers that terminate in a superstructure.

Electrical and Controls. The existing backwash pumping system electrical service will be removed from Filter Building 1 motor control centers and each proposed backwash pump will receive 4160V service from the Water Reclamation Initiative (WRI) electrical building. Dedicated 4160V load break switches will be installed at the WRI Electrical building to serve a stand-alone 4160V variable frequency drive units dedicated to each backwash pump. The 4160V variable frequency drives will be located in the control room the proposed structure, at grade above the dry pit area. Alternatively, if 480V VFDs and backwash pump motors are desired, the backwash pumps can be served using 480V variable frequency drives via associated outdoor 4160V:480V transformers served from the 4160V load break switches at the WRI Electrical building. The use of 480V VFDs for the backwash pump motors will lead to increased losses compared to the use of 4160V VFDs. The proposed VFD will be a stand-alone type indoor located unit and will be furnished as an 18 pulse drive. A full voltage bypass starter is not anticipated for the backwash pump VFDs.

Alternatively, in lieu of employing a VFD for this application and in view of the anticipated run time of the backwash pumps for this facility, consideration should be given to employing the use of a 4160V full-voltage non-reversing starter for the backwash pump that is used in concert with a backwash flow modulating valve.

As a result of separating the backwash pump electrical service from the existing filter building motor control centers, the existing backwash pump motor starters will be removed from the filter building motor control center lineup.

Each backwash pump and related I&C equipment will be allocated to a separate PLC. The control equipment for the backwash pumps would be located in the control room level of the new structure and networked to the filter building control system over a dual channel single mode fiber optic Ethernet data link.

4.3.2 Construction and Operating Cost

The opinion of probable construction cost for this alternative includes the equipment and installation costs for the work described in this section of TM3, specifically the construction of a new clearwell structure, buried piping, backwash pumps, and modifications to the existing filter complex. These costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-12 lists the capital cost for the Backwash Storage in a New Clearwell Alternative.

Table TM3-12
Capital Costs for the Backwash Storage in a New Clearwell Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	$428,400
Division 3 – Concrete	$845,500
Divisions 4 through 9 – Building Superstructure	$280,500
Division 5 – Metals (Other than Superstructure)	$55,000
Division 7 – Thermal and Moisture (Other than Superstructure)	$16,100
Division 9 – Finishes (Other than Superstructure)	$7,500
Division 11 - Equipment	$700,000
Division 13 – Special Construction	$20,000
Division 15 – Mechanical (including buried piping)	$1,129,300
Division 16 – Electrical	$1,084,000
General Conditions, Overhead and Profit	$913,300

Table TM3-12
Capital Costs for the Backwash Storage in a New Clearwell Alternative

Description	Capital Cost
Contingencies	$2,191,800
Total Capital Cost	**$7,671,400**

Operating costs for the new backwash pump operation has been estimated based on utilizing a combined air-water backwash approach with precise control of the backwash through variable speed motors. The annual operating costs have been prepared based on 2011 costs and reflect improvements to the overall efficiency of the system utilizing new pumps and controls. The following assumptions apply to these operating costs:

- Each filter backwash includes 6 minutes of backwash flow at 10 mgd, 6 minutes of flow at 28 mgd, and 6 minutes of flow at 10 mgd for a total volume of 200,000 gallons. This volume of backwash water is pumped from the new clearwell by running one variable speed backwash pump and recycled to the settled water pump station where this flow is treated in the secondary complex.
- Each filter is backwashed every 60 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 48 hours.
- The annual maintenance cost for this system is equal to one percent of the equipment cost for replacement equipment and valves within this system.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-13.

Table TM3-13
Operating Costs for the Backwash Storage in a New Clearwell Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$11,000
Backwash Pump Replacement Parts and Materials	$5,000
Total Annual Cost	**$16,000**

4.3.3 Evaluation Against Project Goals

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- <u>Project Goal #1</u> - *Complete the project within budget and schedule:* This alternative will struggle to meet that goal. The original Business Case Evaluation completed for this project did not include construction of a new clearwell, and the costs associated with this work are significant.
- <u>Project Goal #2</u> – *Improve control of the filters to minimize operating costs:* This alternative will provide a reliable backwash supply to the filter complex with adequate storage to allow the plant to recover from a process upset and get back into operation quickly. Combined with other improvements described throughout TM3, this alternative will ensure automatic operation of the facility with all filters operating identically.
- <u>Project Goal #3</u> - *Identify assets that are at the end of their useful life and replace them:* This alternative achieves that goal by replacing the existing backwash pumps with new and more efficient pumps.

4.4 Backwash Supply from a New WRI Tank

This option will utilize a new tank constructed as part of the WRI system on the WCWWTP. The existing 1 MG WRI tank is scheduled to be replaced with a new tank constructed at grade adjacent to the WRI high service pump station. The volume required for the WRI system is approximately 1 MG. This alternative would increase the volume of the proposed tank to 1.5 MG, and subsequently increase the tank height. The top one-third of the tank would be dedicated to backwash storage while the lower two-thirds would be dedicated to storage for the WRI system.

4.4.1 Description of Improvements

The new WRI tank will be fed from the WRI low service pump station located northeast of the filter complex. This pump station takes suction from the existing sump located at the northeast corner of the filter building and discharges to the WRI tank. By utilizing this system for supplying backwash water via gravity to the filters as well as supplying the WRI system, the average flow will increase by approximately 1 mgd (5 filter backwashes a day at

200,000 gallons per backwash). The existing piping is adequate for this additional flow, but the rated capacity and discharge head of the existing WRI low service pumps is not adequate to accommodate this higher flow and the higher level in the tank. Therefore, this alternative includes replacement of the existing WRI low service pumps with new units. Figure TM3-9 depicts a site plan of this alternative, Figure TM3-10 shows the details of the new tank and backwash supply piping configuration.

Mechanical. The existing discharge piping from the low service pumps to the WRI tank will be used as a portion of the backwash supply header. New piping will connect from the existing WRI low service pump station discharge header to the existing 30-inch backwash conduit that penetrates the north wall of the filter gallery. The existing throttling valve and flow meter will be replaced with new devices located in the filter gallery to allow control of flow from the WRI tank. The existing backwash pumps, valves, piping and vacuum prime system will be demolished and removed from the filter gallery, allowing space for air blowers if that alternative is selected.

Because the WRI flow and backwash flow are comingled in this alternative, the chlorine required for the WRI system will also be used for the backwash flow. This chemical application point is at the inlet to the WRI tank, contained within a vertical mixing chamber that will extend 15 to 20 feet above the bottom of the tank. This will allow the upper ten feet of the tank to be withdrawn via the suction piping while the remainder of the tank can be used to feed the WRI high service pump station.

Structural. The WRI tank has been priced as a prestressed concrete tank constructed at grade on a concrete slab foundation with a total volume of 1.5 MG. The approximate dimensions of this tank will be 90 feet in diameter with a side water depth of 30 feet. Other structural improvements will be related to the piping penetrations, interior mixing chambers and baffling required for this tank.

Electrical and Controls. The existing backwash pumping system electrical service will be removed from Filter Building 1 motor control centers. The new WRI low service pumps will be fed from the WRI electrical building. This system was originally designed to be expanded and the new electrical loads for the new pumps are within the capacity of this system. Control of these pumps will remain unchanged due to these improvements, but the reversal of flow in the discharge header of this pump station will require modification of the control system. When backwashing, the low service WRI pumps will need to be disabled and the chlorine feed to the WRI tank influent will need to be discontinued. This interlock has already been recommended as part of the filter control system modifications because the low service WRI pumps tend to trip out on low suction side level when the existing backwash pumps kick on. Although this is an important feature to integrate into the control system, it should not hamper the operation of either the WRI system or the filter backwash supply.

4.4.2 Construction and Operating Cost

The opinion of probable construction cost for this alternative includes the structures, piping and equipment costs for the work described in this section of TM3 directly related to the backwash supply system. Specifically, 33 percent of the cost of the new WRI tank has been included in these costs, as that is the volume dedicated to backwash supply. Replacement of the WRI low service pumps and all other piping to supply backwash water to the filter complex are also included in these costs. These costs only include a portion of the total work required at the plant and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-14 lists the capital cost for the Backwash Supply from a New WRI Tank Alternative.

Table TM3-14
Capital Costs for the Backwash Supply from a New WRI Tank Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	$45,400
Division 3 – Concrete	$2,500
Division 9 – Finishes	$3,000
Division 11 – Equipment	$628,900
Division 13 – Special Construction (1/3 of the cost of the new WRI Tank)	$258,000
Division 15 – Mechanical	$84,800
Division 16 – Electrical	$249,800
General Conditions, Overhead and Profit	$254,500
Contingencies	$610,700
Total Capital Cost	**$2,137,500**

Operating costs for this system have been estimated based on utilizing a constant pumping rate from the filter clearwell to the new WRI tank throughout the day. Precise control of the backwash flow to the filters will be achieved by utilizing a new flowmeter and throttling valve. Since the backwash water is comingled with the WRI flow, chlorine costs have been added to the operating cost of this alternative, as the flows cannot be separately treated. The annual operating costs have been prepared based on 2011 costs and reflect improvements to the overall efficiency of the system utilizing a backwash storage tank with adequate hydraulic head to backwash the filters by gravity. The following assumptions apply to these operating costs:

- Each filter backwash includes 6 minutes of backwash flow at 10 mgd, 6 minutes of flow at 28 mgd, and 6 minutes of flow at 10 mgd for a total volume of 200,000 gallons. This volume of backwash water flows by gravity from the new WRI tank and is recycled to the settled water pump station where this flow is treated in the secondary complex. The WRI tank is filled using the WRI low service pumps operating 24 hours a day against the head of the new WRI tank.
- Each filter is backwashed every 60 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 48 hours.
- All backwash flow receives an average chlorine dose of 2.0 mg/L as it enters the WRI tank.
- The annual maintenance cost for this system is equal to one percent of the equipment cost for replacement equipment and valves within this system.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-15.

Table TM3-15
Operating Costs for the Backwash Storage in WRI Tank Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$17,200
Backwash Pump Replacement Parts and Materials	$2,600
Total Annual Cost	**$19,800**

4.4.3 Evaluation Against Project Goals

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* This alternative can meet that criteria based on the original Business Case Evaluation completed for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative will achieve more precise control of backwash flow by utilizing an elevated tank and flow control valve. This will minimize the volume of backwash water required but that flow will be more highly chlorinated that otherwise would be required. The maintenance required for this alternative should be less than that required for other alternatives with backwash pumps because one set of pumps has been eliminated.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* The existing backwash pumps are at the end of their useful life and are in need of replacement; this alternative achieves the goal of replacing those items that are at the end of their useful life.

4.5 Backwash Supply from At-Grade Storage Tank

This alternative utilizes a new at-grade tank constructed north of the filter complex dedicated to backwash supply.

4.5.1 Description of Improvements

The existing grade at the proposed site for this tank is Elevation 458, and the minimum water surface elevation required to backwash the filters by gravity is Elevation 475. The proposed tank would have an approximate diameter of 61 feet and a side water depth of 40 feet. The lower 17 feet of the tank would be dead storage whereas the upper 23 feet would store the required 500,000 gallons of backwash water, equivalent to two backwash volumes. The area to the north of the existing filter buildings would be an optimal location for the tank. The tank will be fed by two new pumps located in the piping gallery of the existing filter complex, located in the space currently occupied by the non-potable water pumps. The filters will be backwashed using gravity from the at-grade tank. Figure TM3-11 shows a site plan and section of the new tank.

Mechanical. Backwash water will be pumped from the existing filter effluent channel/clearwell to the at-grade tank. These pumps will be rated at 1,700 gpm at 58 ft TDH. It will take approximately two hours to replenish the tank following one filter backwash. The piping from the supply pumps located in the piping gallery will be routed to the main backwash supply header which will be extended to connect the proposed at-grade tank to the existing 30-inch backwash conduit that penetrates the north wall of the filter gallery. The existing throttling valve and flow meter will be replaced with new devices located in the filter gallery to allow control of flow from the at-grade tank. The meter will be magnetic and the control valve will be located where it is accessible for maintenance. The existing Non-potable pumps and piping will be demolished to make room for the backwash tank fill pumps. The existing backwash pumps, valves, piping and vacuum prime system will be demolished and removed from the filter gallery, allowing space for air blowers if that alternative is selected.

Structural. This new at-grade tank has been priced as a pre-stressed concrete tank constructed at grade on a concrete slab foundation with a total volume of 0.87 MG. The approximate dimensions of this tank will be 61 feet in diameter with a side water depth of 40 feet. The majority of the structural design will be part of the tank manufacturer’s scope of work.

Electrical and Controls. Two 40 horsepower backwash tank fill pumps will be located in the piping gallery in the space currently occupied by the non-potable water pumps, reducing the total connected load in the building by almost 300 hp. New constant speed starters will be provided for these units. Control of the backwash tank fill pumps will be based on level in the backwash tank. Control of the backwash throttling valve will be similar to the current control scheme, using a new magnetic flow meter and throttling valve designed to break the head from the backwash tank.

4.5.2 Construction and Operating Cost

The opinion of probable construction cost for this alternative includes the structures, piping and equipment costs for the work described in this section of TM3 directly related to the At-Grade Alternative backwash supply system. Attachment TM3-B includes a copy of the Engineer’s Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-16 lists the capital cost for the Backwash Supply from a new At-Grade Tank.

Table TM3-16
Capital Costs for the Backwash Supply from a New At-Grade Tank Alternative

Description	Capital Cost
Division 2 – Sitework and Demolition	$45,400
Division 5 – Metals	$2,500
Division 9 – Finishes	$3,000
Division 11 – Equipment	$86,800
Division 13 – Special Construction	$570,000
Division 15 – Mechanical	$116,100
Division 16 – Electrical	$71,000
General Conditions, Overhead and Profit	$179,000
Contingencies	$429,500
Total Capital Cost	**$1,503,300**

Operating costs for this system have been estimated utilizing a constant pumping rate from the existing filter clearwell to the new at-grade tank throughout the day. Precise control of the backwash flow to the filters will be achieved by utilizing a new flowmeter and throttling valve. The annual operating costs have been prepared based on 2011 costs and reflect improvements to the overall efficiency of the system utilizing a backwash storage tank with adequate hydraulic head to backwash the filters by gravity. The following assumptions apply to these operating costs:

- Each filter backwash includes 6 minutes of backwash flow at 10 mgd, 6 minutes of flow at 28 mgd, and 6 minutes of flow at 10 mgd for a total volume of 200,000 gallons. This volume of backwash water flows by gravity from the new at-grade tank and is recycled to the settled water pump station where this flow is treated in the secondary complex. The at-grade tank is filled using the new pumps operating 24 hours a day.
- Each filter is backwashed every 60 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 48 hours.

- The annual maintenance cost for this system is equal to one percent of the equipment cost for replacement equipment and valves within this system.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-17.

Table TM3-17
Operating Costs for the Backwash Storage in a New At-Grade Tank Alternative

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$15,800
Backwash Pump Replacement Parts and Materials	$300
Total Annual Cost	**$16,100**

4.5.3 Evaluation Against Project Goals

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* This alternative can meet that criteria based on the original Business Case Evaluation completed for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative will achieve more precise control of backwash flow by utilizing an at-grade backwash water tank and flow control valve. The maintenance required for this alternative should be less than that required for other alternatives with backwash pumps because one set of pumps has been eliminated and replaced with smaller and more efficient pumps to fill the at-grade tank.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* The existing backwash pumps are at the end of their useful life and are in need of replacement; this alternative achieves the goal of replacing those items that are at the end of their useful life.

4.6 Backwash Supply from Expanded Existing Clearwell

This alternative allows for construction of additional clearwell volume by expanding the existing clearwell the south.

4.6.1 Description of Improvements

The additional clearwell volume would be created by extending the existing clearwell located under filters 1 and 3 to the south by approximately 50 feet. The width of the extension would be identical to the existing clearwell.

The existing outlet structure would be demolished as part of the extension and a new outlet structure would be constructed. The new outlet structure would incorporate a longer weir to help decrease the headloss that occurs through the current outlet structure.

Filter backwash supply will include tow variable speed pumps, each sized for 25 mgd. These pumps will replace the existing backwash pumps. The existing pump pad will be reconstructed given the current pads appear to be structurally deficient. A new magnetic flowmeter will be installed in the pump discharge piping to allow precise control of flow from the pumps. New pumps for the non-potable water system will be installed in the same location. The location for the new air supply will have to be determined and will most likely be in a new structure located at ground level.

<u>Mechanical.</u> The existing backwash pumps would be replaced with two new backwash pumps and draw out the effluent channel as the current pumps currently do.

<u>Structural.</u> The new clearwell extension would constitute a completely new structure. Subsurface utility investigations would be critical to verify there are no unknown obstructions to the south of the existing clearwell. There is an existing non-potable water line that will have to be accounted for during construction.

<u>Electrical and Controls.</u>

4.6.2 Construction and Operating Cost

The opinion of probable construction cost for this alternative includes the structures, piping and equipment costs for the work described in this section of TM3 directly related to the new clearwell, backwash pumps, buried piping and modifications to the existing clearwell. These costs only include a portion of the total work required a the plant and are intended to be used for comparing one alternative to another. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. TM3-18 list the capital cost for the Backwash Storage in an Extended Clearwell Alternative.

Table TM3-18
Capital Costs for the Backwash Supply from the Expanded Existing Clearwell

Description	Capital Cost
Division 2 – Sitework and Demolition	$263,800
Division 3 – Concrete	$210,900
Division 4 – 9 – Superstructure	$170,000
Division 5 – Metals	$5,000
Division 7 – Thermal and Moisture Protection	$4,200
Division 9 – Finishes	$7,500
Division 11 – Equipment	$700,000
Division 13 – Special Construction	$20,000
Division 16 – Electrical	$71,000
General Conditions, Overhead and Profit	$290,500
Contingencies	$697,200
Total Capital Cost	**$2,440,100**

Operating costs for this system have been estimated utilizing a combined air-water backwash approach with precise control of the backwash through variable speed motors. The annual operating costs have been prepared based on 2011 costs and reflect improvement to the overall efficiency of the system utilizing new pumps and controls. The following assumptions apply to these operating costs:

- Each filter backwash includes 6 minutes of backwash flow at 10 mgd, 6 minutes of flow at 28 mgd, and 6 minutes of flow at 10 mgd for a total volume of 200,000 gallons. This volume of backwash water is pumped from the existing clearwell, as is currently the case, by using one variable speed pump and recycled to the settled water pump statin where this flow is treated in the secondary complex.
- Each filter is backwashed every 60 hours at the current loading rate of 3.5 gpm/sf (55 mgd maximum month flow). At the design loading rate of 4.8 gpm/sf (75 mgd maximum month flow), the filter run time will be reduced to 48 hours.
- The annual maintenance cost for this system is equal to one percent of the equipment cost for replacement equipment and valves within this system.

A detailed listing of these costs is included in Attachment TM3-B and the costs are summarized in Table TM3-19.

Table TM3-19
Operating Costs for the Backwash Storage in an Expanded Clearwell

Item	Annual Cost
Cost to Supply and Treat Backwash Air and Water	$11,000
Backwash Pump Replacement Parts and Materials	$5,000
Total Annual Cost	**$16,000**

4.6.3 Evaluation Against Project Goals

The project team has developed three overall goals and objectives for this project. The project goals and an assessment of how this alternative meets these goals are summarized below:

- Project Goal #1 - *Complete the project within budget and schedule:* This alternative can meet that criteria based on the original Business Case Evaluation completed for this project.
- Project Goal #2 – *Improve control of the filters to minimize operating costs:* This alternative does allow for more volume of backwash water.
- Project Goal #3 - *Identify assets that are at the end of their useful life and replace them:* This alternative achieves this goal by replacing the existing backwash pumps with new and more efficient pumps.

4.7 Comparison of Backwash Alternatives

Two similar alternatives and one dramatically different alternative have been presented for the backwash supply system for comparison to the current system described as the "Do Nothing" Alternative.

4.7.1 Economic Factors

The "Do Nothing" alternative has the lowest capital cost, but the inefficiencies of the daily operation and the increased maintenance cost forecast for this alternative make it more expensive in the long run. The Backwash from a New Clearwell Alternative is by far the most expensive alternative to construct, and this expenditure would have to be justified by non-economic criteria. The backwash from a WRI Alternative makes good use of existing and proposed WRI infrastructure at the plant to minimize the costs that are assigned to the filter renovation project, but the total capital cost for implementing this alternative is much higher than reported in this TM3 given the report only addresses the cost associated with providing backwash supply from the WRI tank. The remaining funding must come from an outside source. The backwash supply from a new At-Grade Tank Alternative is a reliable and economically feasible source of backwash water. This alternative meets the requirements of the plant and has the lowest capital cost of all of the alternatives except for “Do Nothing. The At-Grade Tank Alternative would require the relocation of the Non-potable system to a new location, which could result in a higher cost for that pump station. Extending the existing clearwell to the south to construct enough volume to supply two backwash cycles is feasible alternative based on this preliminary effort. The cost associated with this alternative is in line with at-grade alternative with the exception of having supply two new backwash pumps. This alternative avoids having to construct an at-grade structure to the north of the filter facility.

4.7.2 Non-Economic Factors

The “Do Nothing” Alternative does not accomplish any of the goals of this project and places the City at risk of process failure should the existing backwash system fail. This alternative requires significantly higher operating costs due to the inefficiencies of the system, and currently does not provide adequate volume of backwash water to achieve the desired peak backwash flow rate. The Backwash Storage in a New Clearwell Alternative provides significant advantages for future expansion and mitigates a serious hydraulic bottleneck identified at the outlet of the existing clearwell. This alternative would set the City up for a 25 mgd filter expansion without making major improvements to the secondary effluent or filter effluent conduits. If the secondary effluent from the next 25 mgd expansion can be reasonably routed to the existing filter influent conduits, this alternative would provide a cost effective way to expand the existing filter complex by constructing new filters over the top of the clearwell. The backwash supply from a New WRI Tank makes the most use of existing infrastructure on site and combines the WRI system with the filter backwash supply system to gain a significant shared benefit. The At-Grade Tank Alternative does not take advantage of existing infrastructure, but it does provide a reliable source of backwash water at a reduced cost compared to the New Clearwell and WRI Tank

Alternatives. Similar to the WRI alternative, the alternative which extends the existing clearwell takes advantage of the existing infrastructure and avoids having to construct a new at-grade tank north of the filter facility or the costly alternative of having to construct a below grade clearwell to the west of the filter building. From preliminary research and field visits, it appears there is room to the south to extend the existing clearwell enough to supply two backwash volumes, or 400,000 gallons.

4.7.3 Reliability

The current backwash supply system utilizes two pumps and therefore provides some level of reliability. However, both pumps take suction from the filtered water conduit/clearwell which is not capable of being isolated and which relies solely on the filtered water produced by the filters. If the filters blind off and cannot produce filtered water, there is currently no alternative source of backwash water. Therefore the “Do Nothing” alternative has the lowest level of reliability. On the other hand, the Backwash Storage in a New Clearwell Alternative has the highest level of reliability, because it includes storage of two backwash volumes in a split wetwell with a standby pump. Either wetwell or pump can be out of service without losing system capacity, and the backwashing of two filters using this stored volume will allow those filters to begin producing filtered effluent that would begin replenishing the wetwells. In addition, the existing filtered water conduits will be re-configured under this alternative so that half of the filters can be taken off-line while the other half remains in service.

The three alternatives that include the New WRI Tank Alternative, the At-Grade Tank Alternative and the Extended Clearwell Alternative, have more reliability than the current backwash system because the tanks store two backwash volumes. All three of these alternatives feature supply pumps that take suction from the same point as the existing backwash pumps, so they have the same reliability concerns related to the existing filtered water conduit/wetwell. The At-Grade Tank Alternative could be modified to include a split wetwell to improve reliability, but that cost is not included in the costs presented in this TM3. All three of these alternatives include a single tank to supply backwash water, and when this tank has to be taken off-line for maintenance or cleaning, the filters can operate only until they require backwashing. This lack of reliability for the New WRI Tank Alternative could be overcome by constructing a second tank in the space currently occupied by the existing WRI tank, but the costs for a second tank are not included in the costs presented in this TM3.

The At-Grade Tank Alternative could be made more reliable by installing a second tank, or the high pressure side of the WRI system could be used as an alternate supply of backwash water for this alternative. A supply pipeline and flow control station would have to be connected to the discharge of the high service WRI pumps and routed to the filter supply conduit to provide this level of reliability. This backup system would operate off of the 51st Street Tank hydraulic gradient, which is between elevation 726 and 766. However, that tank is somewhat remote from the WCWWTP and much of the system is 24-inch diameter pipeline. At a design flow of 30 mgd for the peak backwash water rate, the velocity in the 24-inch conduits approach 15 fps. There is not adequate head to push this volume of flow through the system; a peak flow of 25 mgd is the practical limit of this alternative supply. As a backup system, this is probably adequate as it would allow a peak backwash rate of 16 gpm/sf. It would be expensive and more difficult to add reliability to the extended clearwell alternative, although this alternative does provide the opportunity to remove the existing outlet weir and construct a less restrictive one which would help with filter hydraulics. Generally, the At-Grade Tank Alternative is more reliable than the New WRI Tank Alternative but less reliable than the New Clearwell Alternative.

5.0 FILTER COMPLEX CONTROL SYSTEM

The Filter Complex is currently operated in manual utilizing local panels or portions of the existing control panels that carry the label “Turbitrol”. This system is beyond its useful life and the operation of the system using this existing system is inefficient. This control system will be replaced with a new process control system designed for more efficient operation using a Programmable Logic Controller (PLC) based distributed control system (DCS) with remote monitoring and control.

5.1 Description of Control System Improvements

One local control panel (LCP) will be provided for each filter to contain I&C equipment dedicated to that filter. Each filter LCP will be located indoors on the control room level of the filter building adjacent to the respective filter viewing window. One PLC will be allocated per filter and the PLC will be used to monitor and control the entire filter, including filter motorized valves, filter level monitoring, flow, differential head and other process variables. An overall PLC for the Filter Process will be provided to coordinate activity among the individual filter dedicated PLCs. A dual-channel Ethernet copper network with star topology will be installed to facilitate communication between the individual filter PLCs and the main filter system PLC.

Operator interface units (OIUs) will be provided to allow operations staff to access the control system. An OIU provides a graphical presentation of the process with a touch-screen interface. One OIU will be provided in a central location in the control room level of each filter complex for control and indication of selected points within the system in lieu of using discrete operators and indicators or additional OIUs located at each filter LCP.

In the event of a PLC failure, provisions will be made to allow operation of any or all segments of the process in hand mode. The control switches located adjacent to each piece of process equipment would enable the operator to run the equipment with close observation of field instrument monitors and would require fully attended operation.

It is anticipated that all filter process instruments will be replaced. It is anticipated that all existing filter control consoles and associated SY/MAX PLCs will be demolished. Proposed conduit/wire will be installed inside the Filter Building to maintain the integrity of the existing SY/MAX communication link associated with other process areas that are routed through the Filter Building.

5.2 Capital Cost of Control System Improvements

The opinion of probable construction cost for the control system improvements includes the material and installation costs for work described in this section of TM3 directly related to the control of individual filters. Control of backwash water and backwash air systems are included with the respective alternatives. These costs only include a portion of the total work required at the plant and are intended to be used so that the granular filter alternative can be compared to the alternative technologies presented in TM2. Attachment TM3-B includes a copy of the Engineer's Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-20 lists the capital cost for the control system improvements.

Table TM3-20
Capital Costs for the Control System Improvements

Description	Capital Cost
Division 13 – Special Construction	$2,141,000
General Conditions, Overhead and Profit	$428,200
Contingencies	$1,027,700
Total Capital Cost	**$3,596,900**

6.0 REPLACE/RENOVATE ASSETS NEAR THE END OF THEIR USEFUL LIFE

Certain assets which must operate in order to make any granular filter alternative function are close to the end of their remaining useful life as described in TM1 – Condition Assessment. In order to ensure that the capital costs necessary to replace or renovate these assets are captured as part of the overall evaluation of filter technologies, this section describes the preliminary scope of this replacement and or renovation. These assets will be replaced to ensure that the granular filter alternative will have 20 years of remaining useful life regardless of the granular filter alternatives outlined in this technical memorandum.

6.1 Description of Assets to be Replaced

Each of the 10 filters has the following appurtenances that will be replaced: effluent valve, effluent flow meter, influent valve, backwash supply valve and filter backwash drain valve.

- The new effluent valves on all 10 filters will be 20-inch diameter full-body butterfly valves with electronic actuators specifically designed for modulating service.
- The new effluent flow meters for each filter will be electromagnetic flow meters, also 20-inch diameter, installed upstream of the new effluent valves. The existing effluent piping from each filter will be modified to accommodate the new valves and flow meters.
- All of the existing 36” filter influent valves will be replaced with new 36” full-body butterfly valves with open-close actuators. A new platform with access ladder, tie-off points and hoisting provisions will be constructed to improve access to these valves and actuators. Each valve stem will be rotated and include extended shafts as required to improve access to the actuator. The access platform will straddle the existing backwash piping in filters 1 through 4 and the platform and ladder will straddle the existing backwash waste piping for filters 5 through 10. New local-

remote open-close control stations will be mounted to the access platform supports so the valve can be manipulated from the gallery floor. The existing 30” backwash supply valves will be replaced with new 30” full-body butterfly valves with open-close actuators. Piping modifications will be made to improve access to the actuators from the gallery floor using a scissors lift. New local-remote open-close control stations will be installed adjacent to each valve so that they can be positioned from the gallery floor.

- The 36” backwash drain valves will be replaced with new full-body butterfly valves with open-close actuators. The corroded pipe harness mechanisms below these valves will be replaced, as well. New local-remote open-close control stations will be installed adjacent to each valve so that they can be positioned from the gallery floor.
- All existing and new piping, valves and appurtenances will be recoated as part of these improvements.

6.2 Capital Cost for Replacement of Assets

The opinion of probable construction cost for the replacement of assets that are near the end of their useful life includes the material and installation costs for work described in this section of TM3 directly related to individual filters. Assets related to backwash water and backwash air systems are replaced or renovated as part of the respective alternatives for these systems. These costs only include a portion of the total work required at the plant and are intended to be used so that the granular filter alternative can be compared to the alternative technologies presented in TM2. Attachment TM3-B includes a copy of the Engineer’s Opinion of Probable Construction Cost for this alternative including a listing of the assumptions used to develop the capital costs. Table TM3-21 lists the capital cost for the replacement of assets that are near the end of their useful life.

Table TM3-21
Capital Costs for the Replacement of Assets Near the End of Their Useful Life

Description	Capital Cost
Division 2 – Sitework and Demolition	$6,700
Division 5 – Metals	$100,000
Division 9 – Finishes	$85,000
Division 13 – Special Construction	$353,900
Division 15 – Mechanical	$651,000
Division 16 – Electrical	$10,000
General Conditions, Overhead and Profit	$241,300
Contingencies	$579,200
Total Capital Cost	**$2,027,100**

7.0 CONCLUSION AND RECOMMENDATIONS

The project goals can be met by combining several of the alternatives that are described within TM3. The preliminary recommendations focused solely on improvements utilizing granular media technology are summarized below.

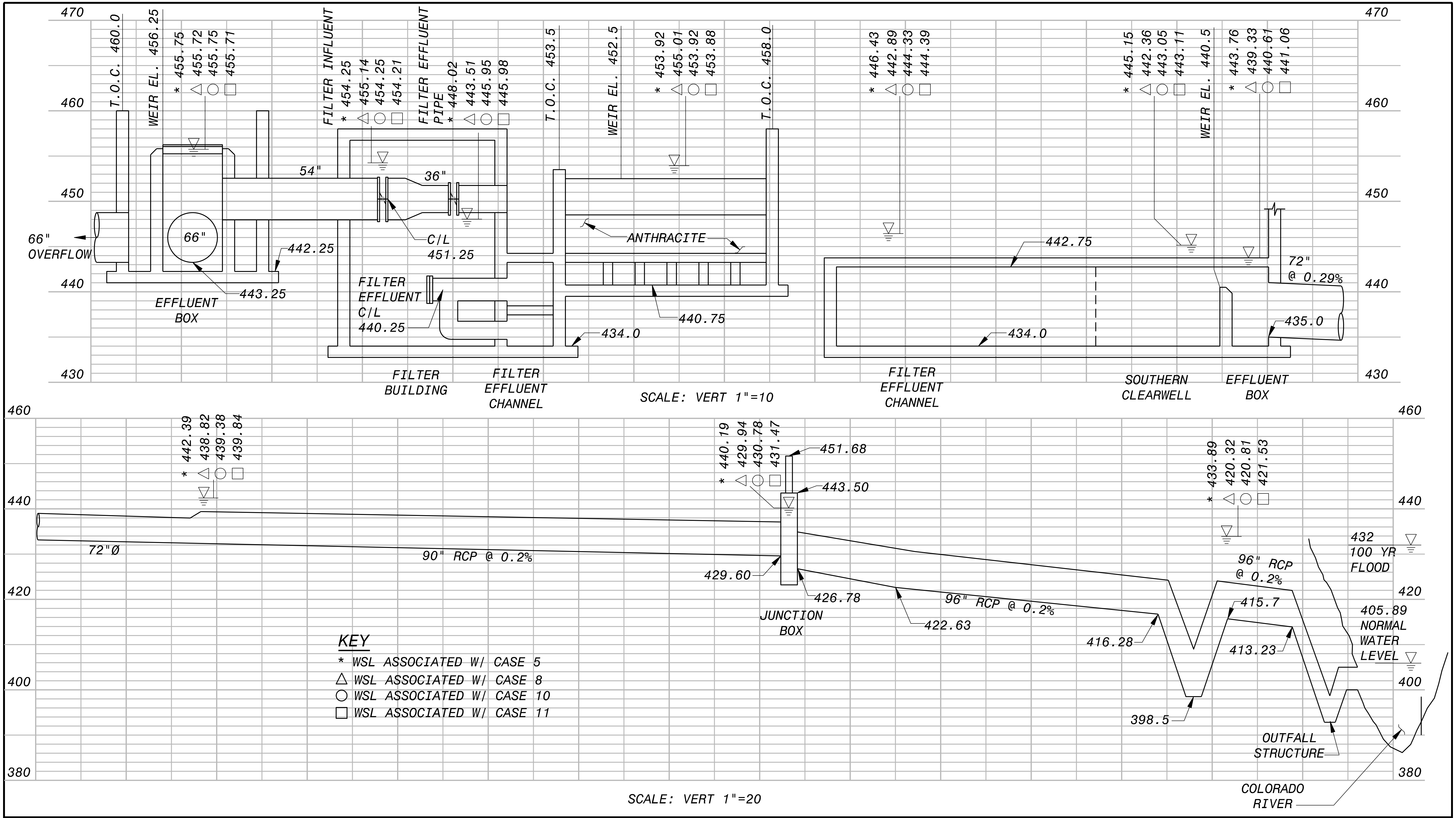
- The most effective use of the existing assets and the most flexibility in meeting future permit limits can be achieved by implementing the Nozzle Underdrain and Mono-Media Alternative. This will result in all ten filters equipped with four feet of anthracite and designed for combined air-water backwash.
- To supply the air for the combined air-water backwash, the Centrifugal Blower within an Existing Structure Alternative is recommended. This alternative provides the most cost-effective method for supplying low pressure air to the filter complex, once the existing backwash pumps have been removed.
- To replace the existing backwash pumps, the Backwash Supply from a new At-Grade Tank is recommended. This alternative will ensure a reliable and efficient supply of backwash water to the complex at the least cost.
- The filter control system improvements must also be implemented as part of this work in order to ensure the continued efficient operation of the filter complex.
- The replacement of assets that are near the end of their useful life is recommended to ensure that the facility operates continuously at its rated capacity.

Table TM3-22 summarizes the capital and operating costs for the recommended granular filter media alternative.

Table TM3-22
Capital and Operating Costs for the Recommended Granular Filter Alternative

Capital Costs	
Description	**Capital Cost**
Nozzle Underdrains in Filters 1 – 4 with Mono-Media	$1,274,300
Additional Anthracite in Filters 5 - 10	$180,800
Air Supply Within Existing Structure	$410,600
Backwash Supply Using At-Grade Alternative (costs related to backwash only)	$894,800
Replace/Renovate Assets Near the End of their useful life	$1,206,600
Control System Upgrade	$2,141,000
General Conditions, Overhead and Profit	$1,221,181,600
Contingencies	$2,931,900
Total Capital Cost	**$10,261,600**
Annual O&M Costs	
Item	**Annual Cost**
Cost to Supply and Treat Backwash Air and Water	$15,800
Labor Cost	$50,900
Replacement Parts and Materials	$15,500
Total Annual Cost	**$82,200**

These recommendations and costs will be compared to those developed in TM2 for alternative filtration technologies and the City will then determine which improvements will move forward into design. The selection process will be documented in TM 4.



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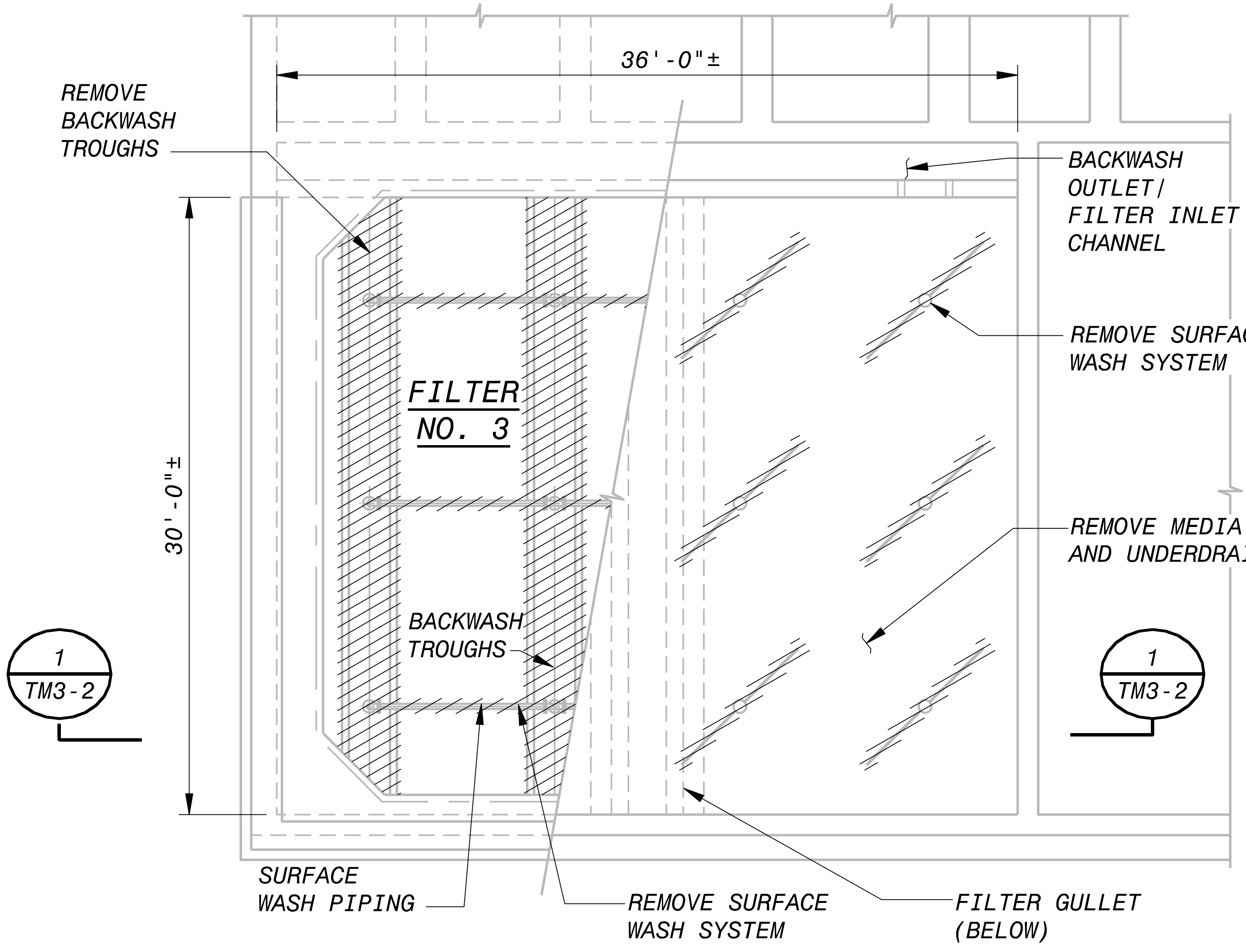
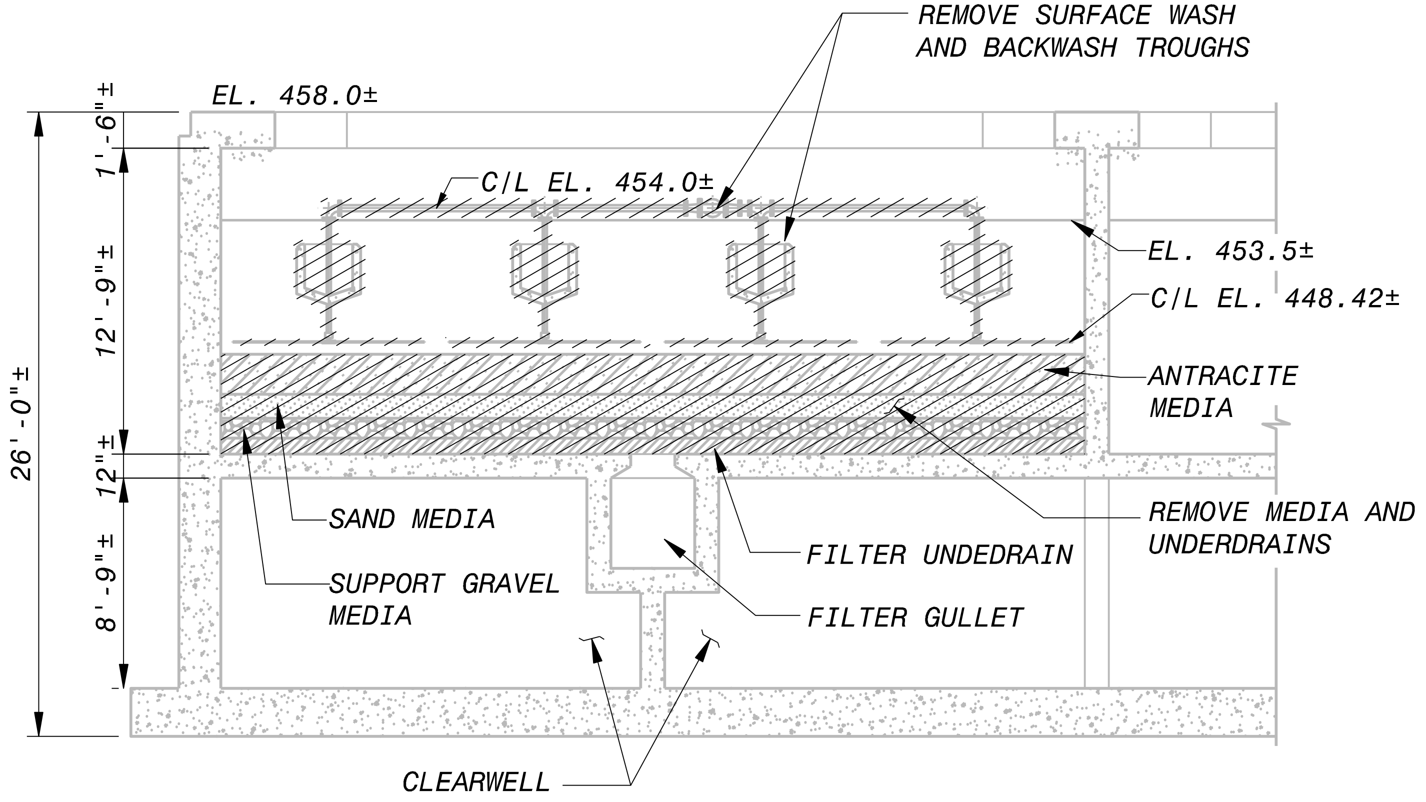
PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

HYDRAULIC PROFILE

Figure
TM3 - 1



PLAN/SECTIONAL PLAN
1/8" = 1'-0"



SECTION 1/-
1/8" = 1'-0"

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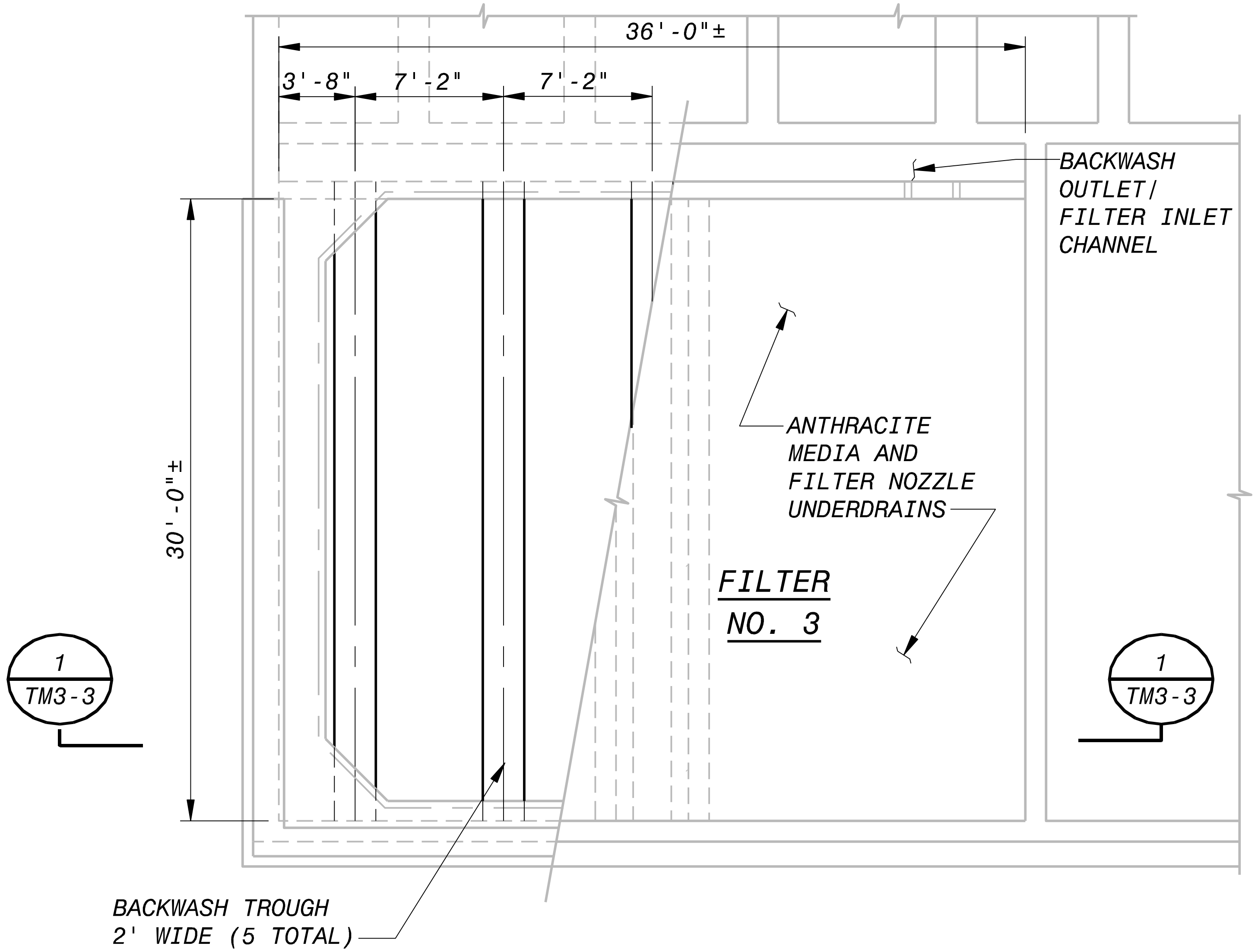
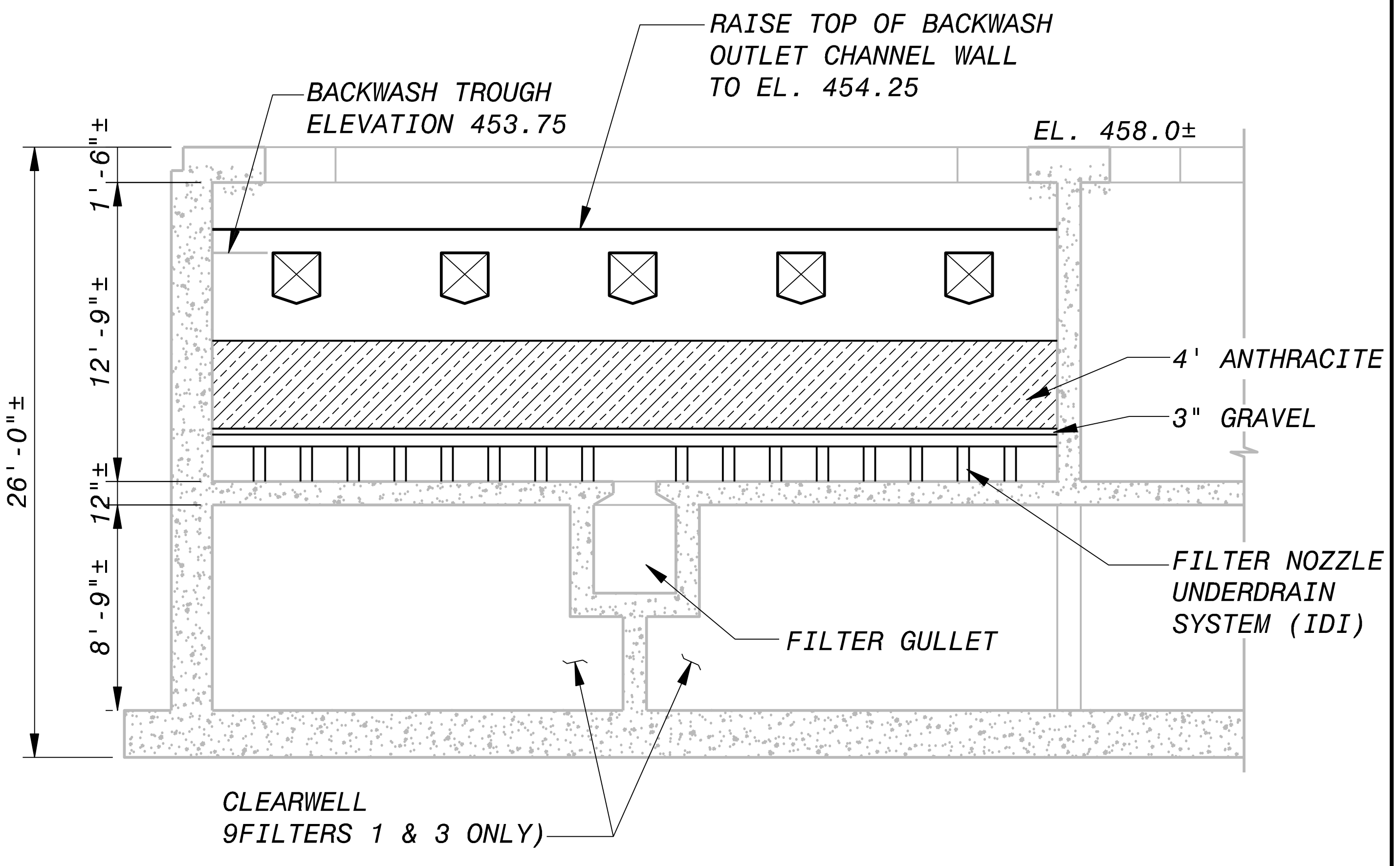
PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

FILTER NO. 3 DEMOLITION PLAN AND SECTION

Figure
TM3-2



PLAN/SECTIONAL PLAN
1/8" = 1'-0"

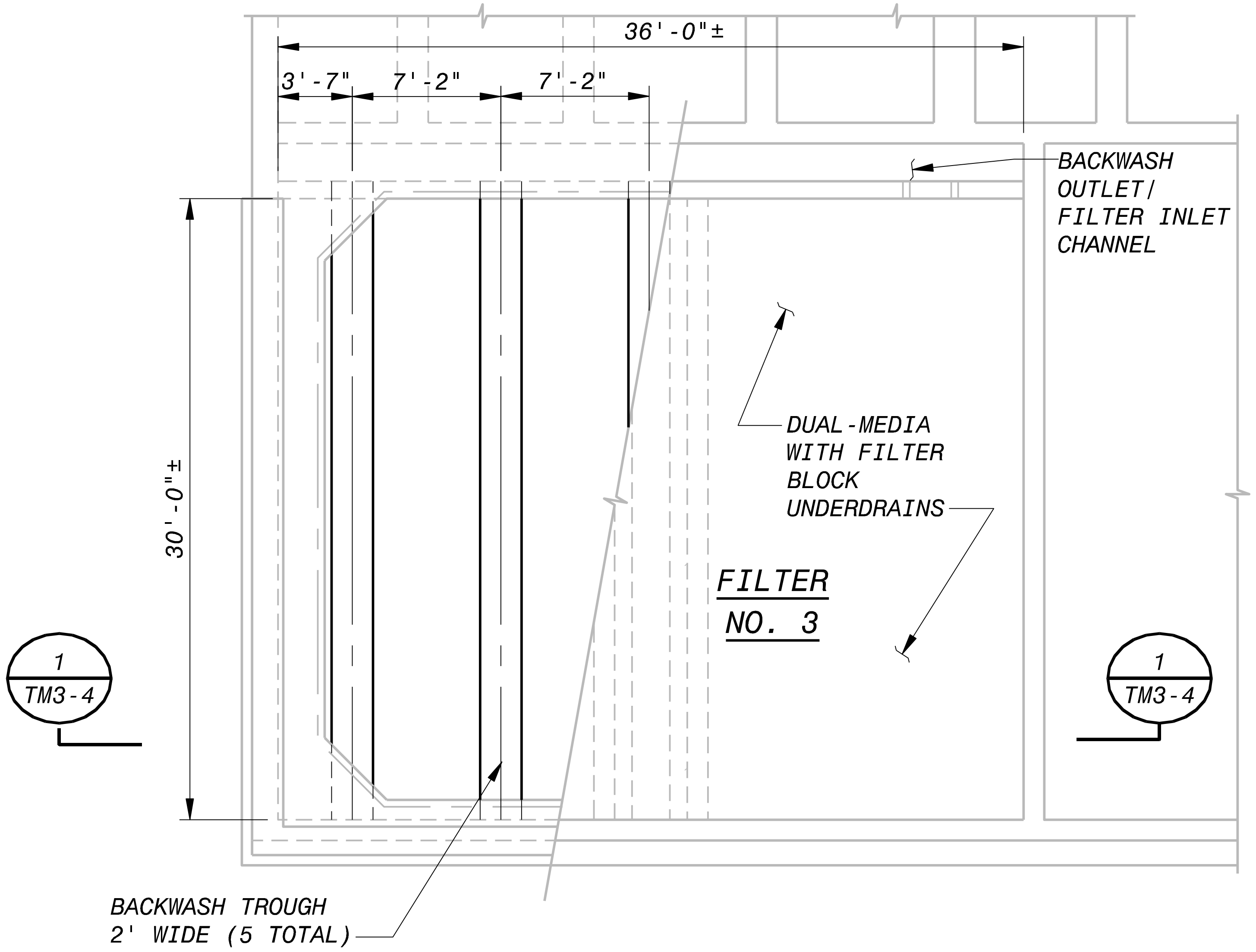


SECTION 1 -
1/8" = 1'-0"

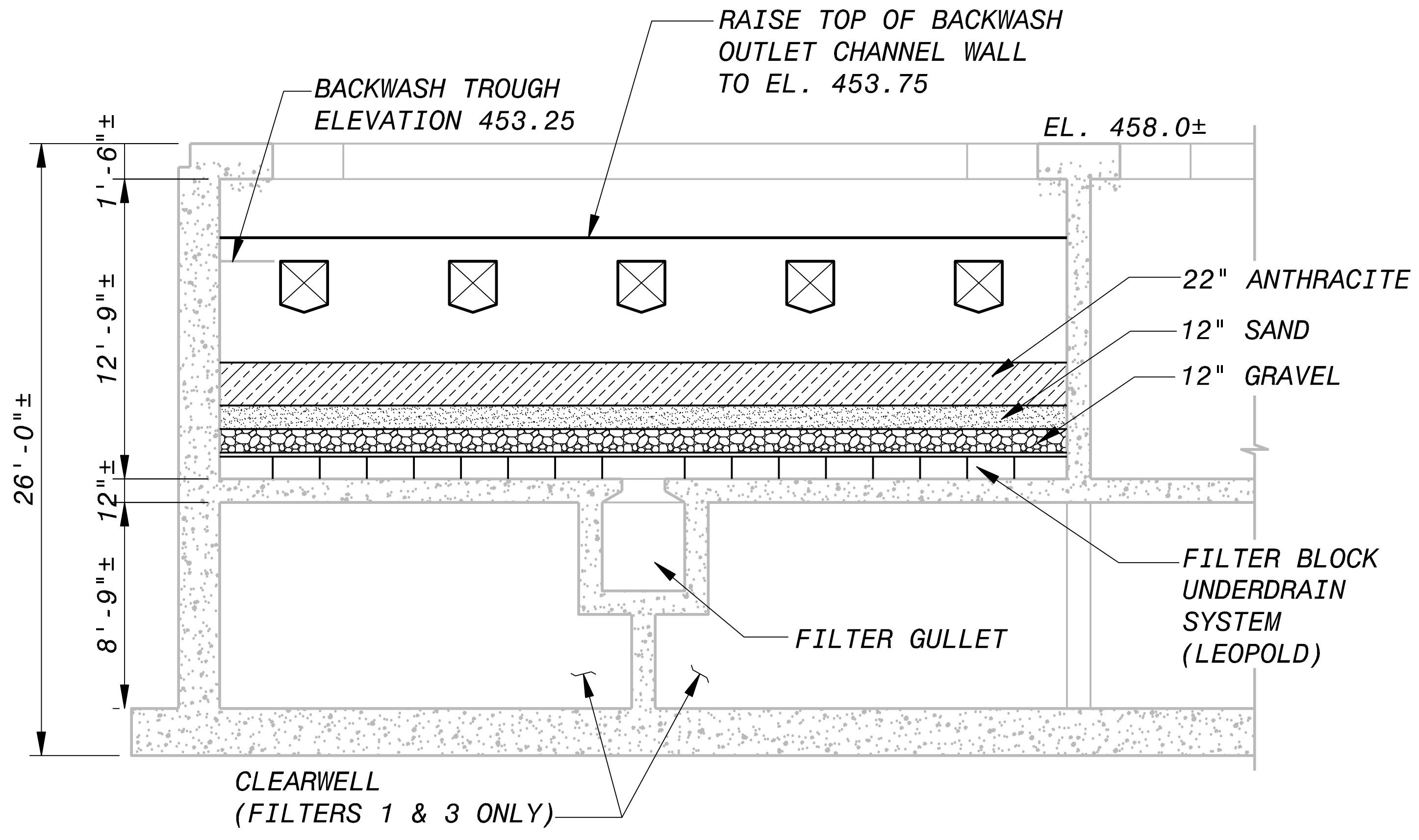
PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

NOZZLE UNDERDRAIN AND MONOMEDIA FILTER ALTERNATIVE

Figure
TM3-3



PLAN/SECTIONAL PLAN
1/8" = 1'-0"



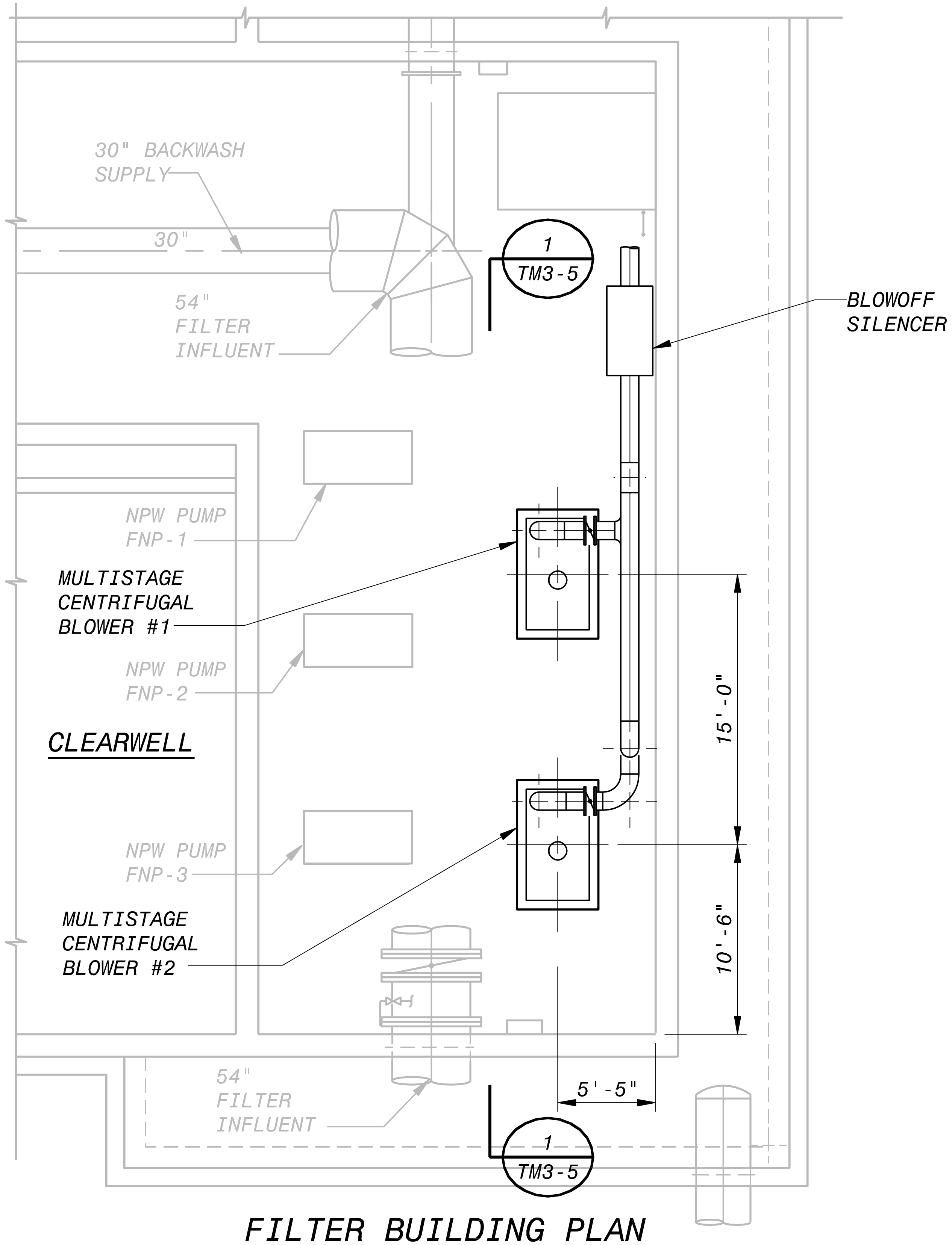
SECTION 1 -
1/8" = 1'-0"

PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

FILTER BLOCK UNDERDRAINS AND DUAL-MEDIA FILTER ALTERNATIVE

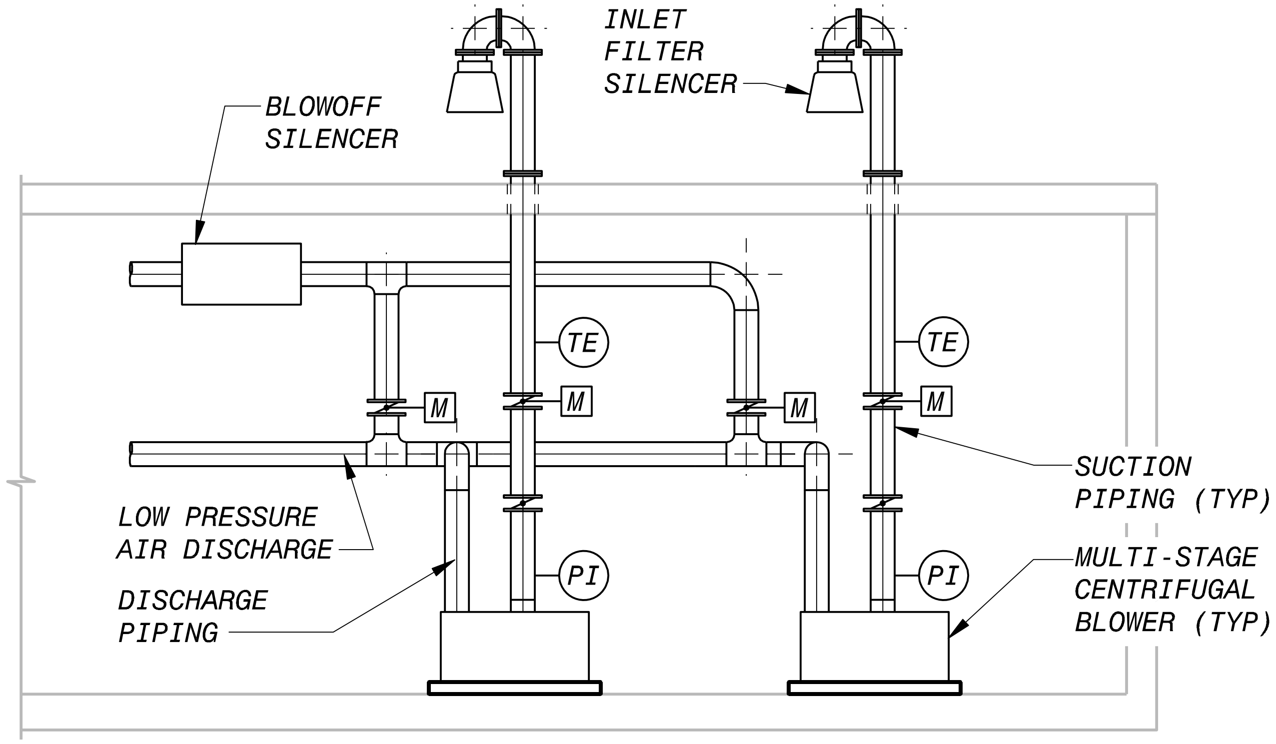
Figure
TM3-4

Austin WATER
BLACK & VEATCH
Building a world of difference.



FILTER BUILDING PLAN

1/8" = 1'-0"



SECTION 1 -

1/8" = 1'-0"

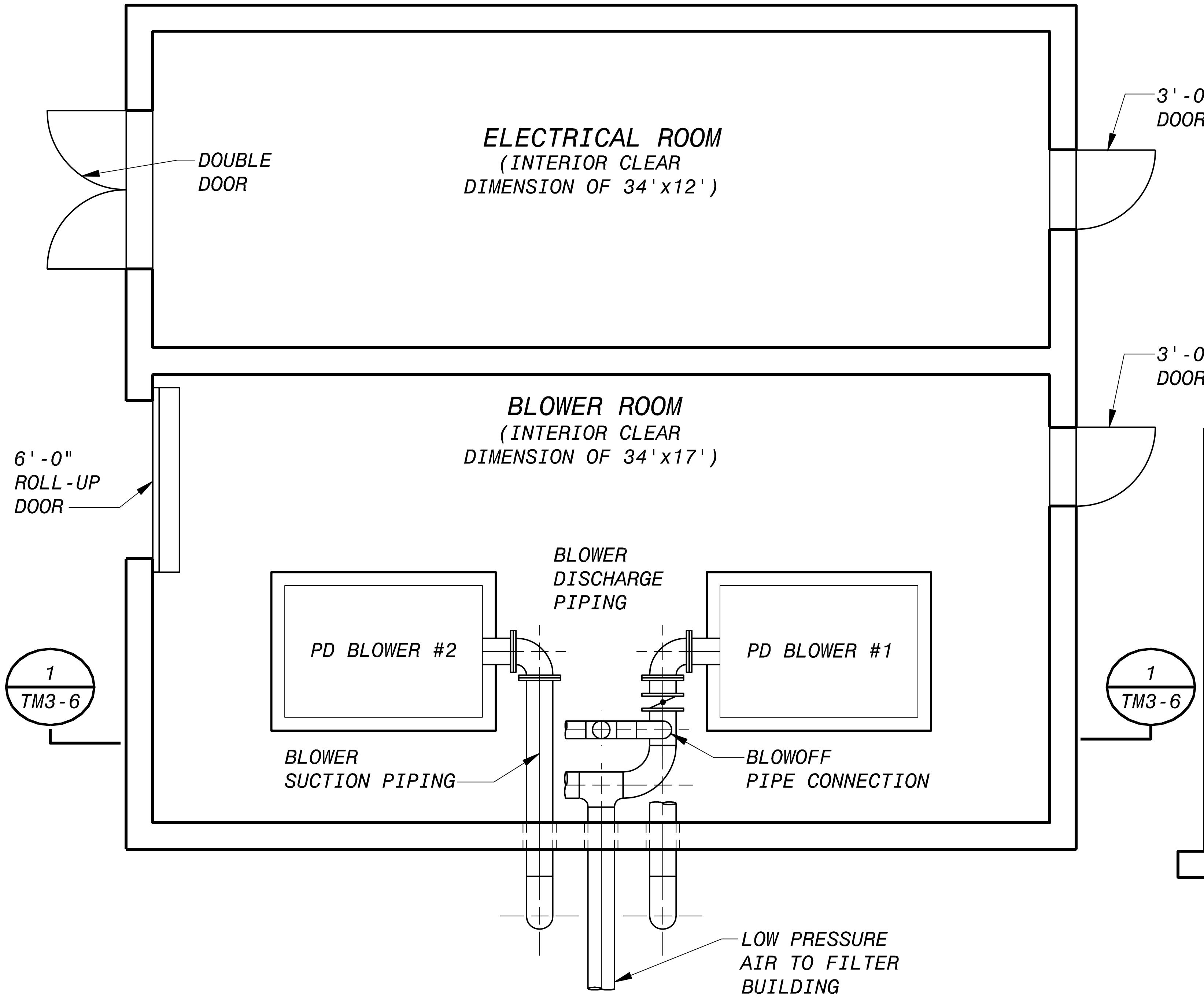
Austin Water

BLACK & VEATCH
Building a world of difference

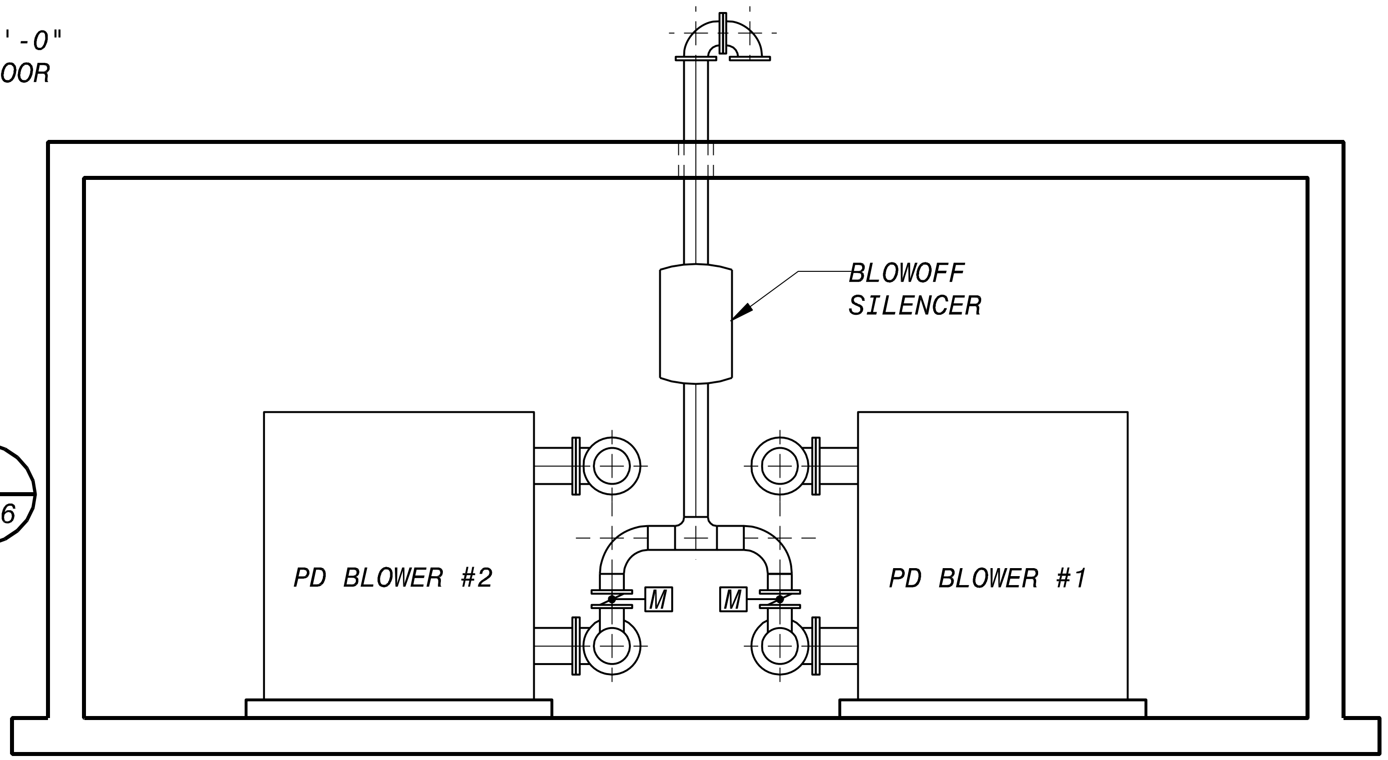
PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

CENTRIFUGAL BLOWERS WITHIN EXISTING STRUCTURE

Figure
TM3 - 5



BLOWER BUILDING PLAN
3/16" = 1'-0"



SECTION 1 / -
3/16" = 1'-0"

PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

POSITIVE DISPLACEMENT BLOWERS IN NEW STRUCTURE

Figure
TM3-6

Austin WATER

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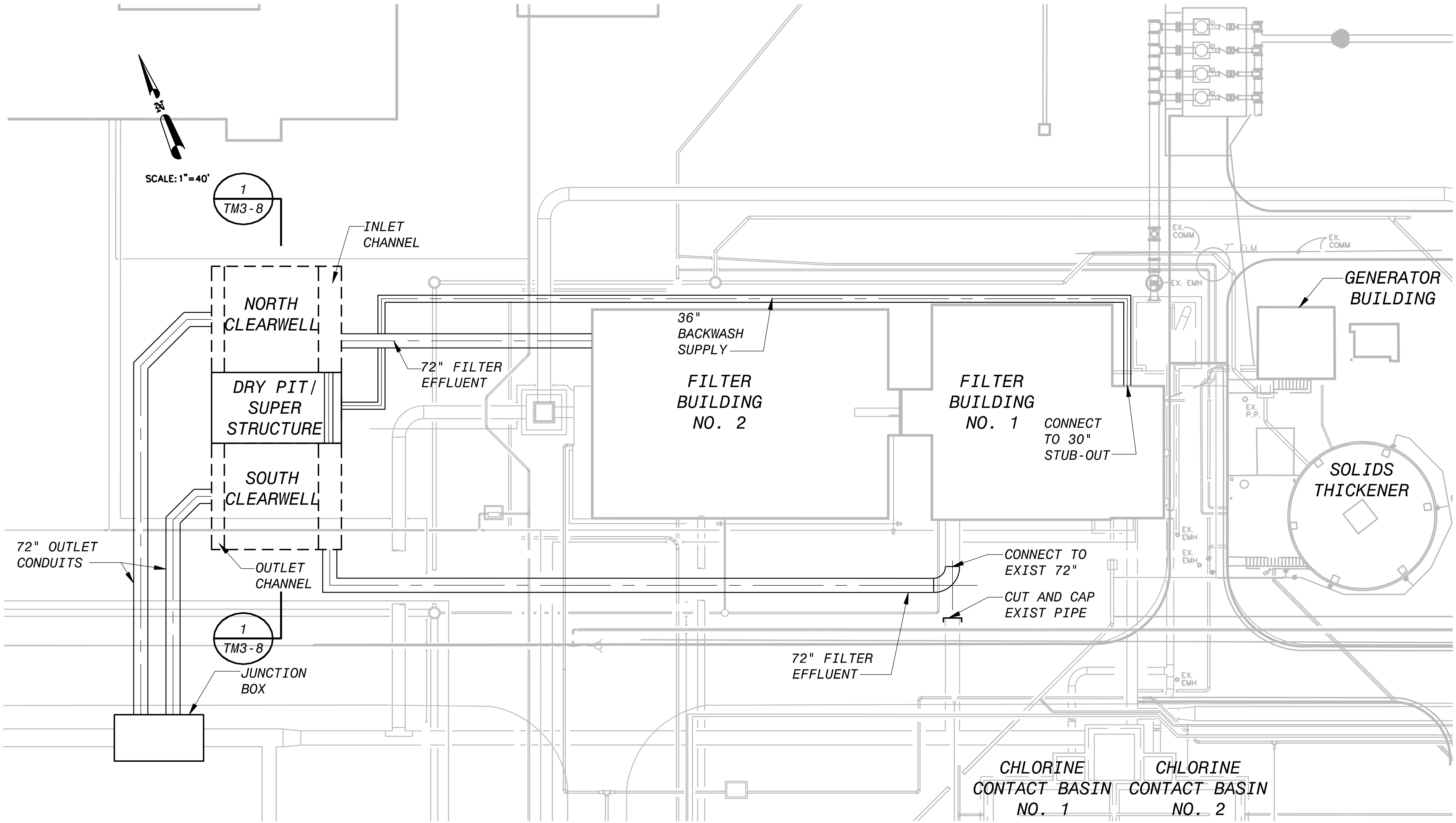
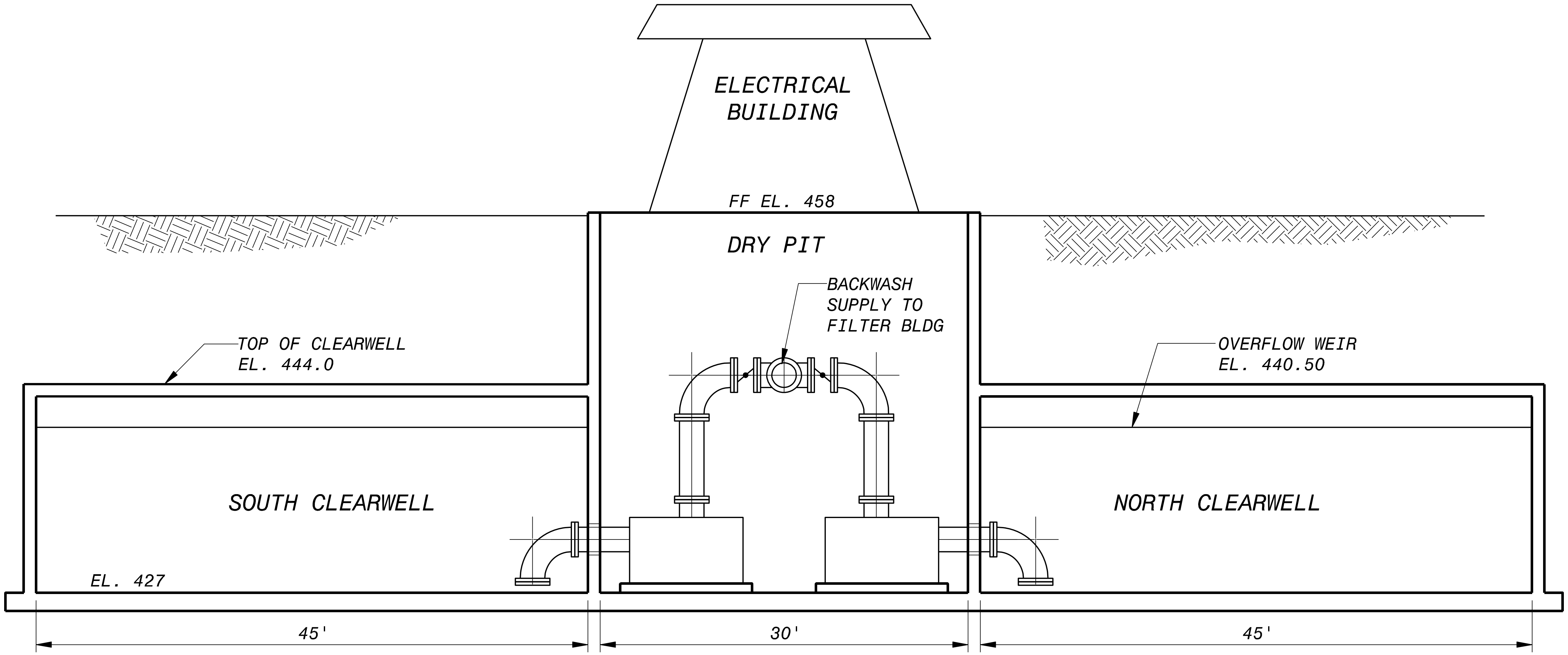


PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

BACKWASH STORAGE IN A NEW CLEARWELL ALTERNATIVE

Figure TM3 - 7

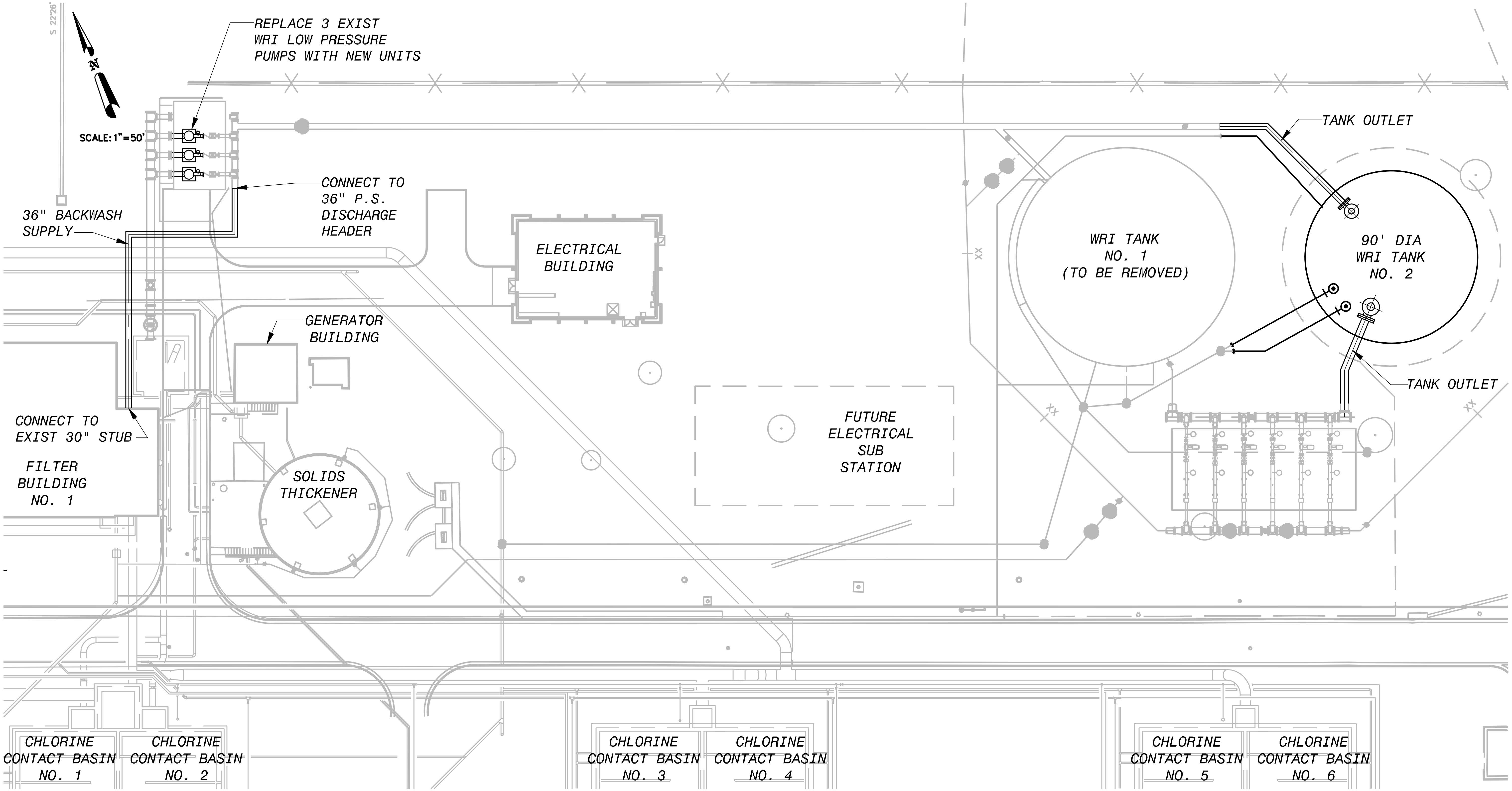


SECTION 1/TM3-7
1" = 10'-0"

PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

BACKWASH STORAGE SECTION

Figure
TM3 - 8



Austin WATER

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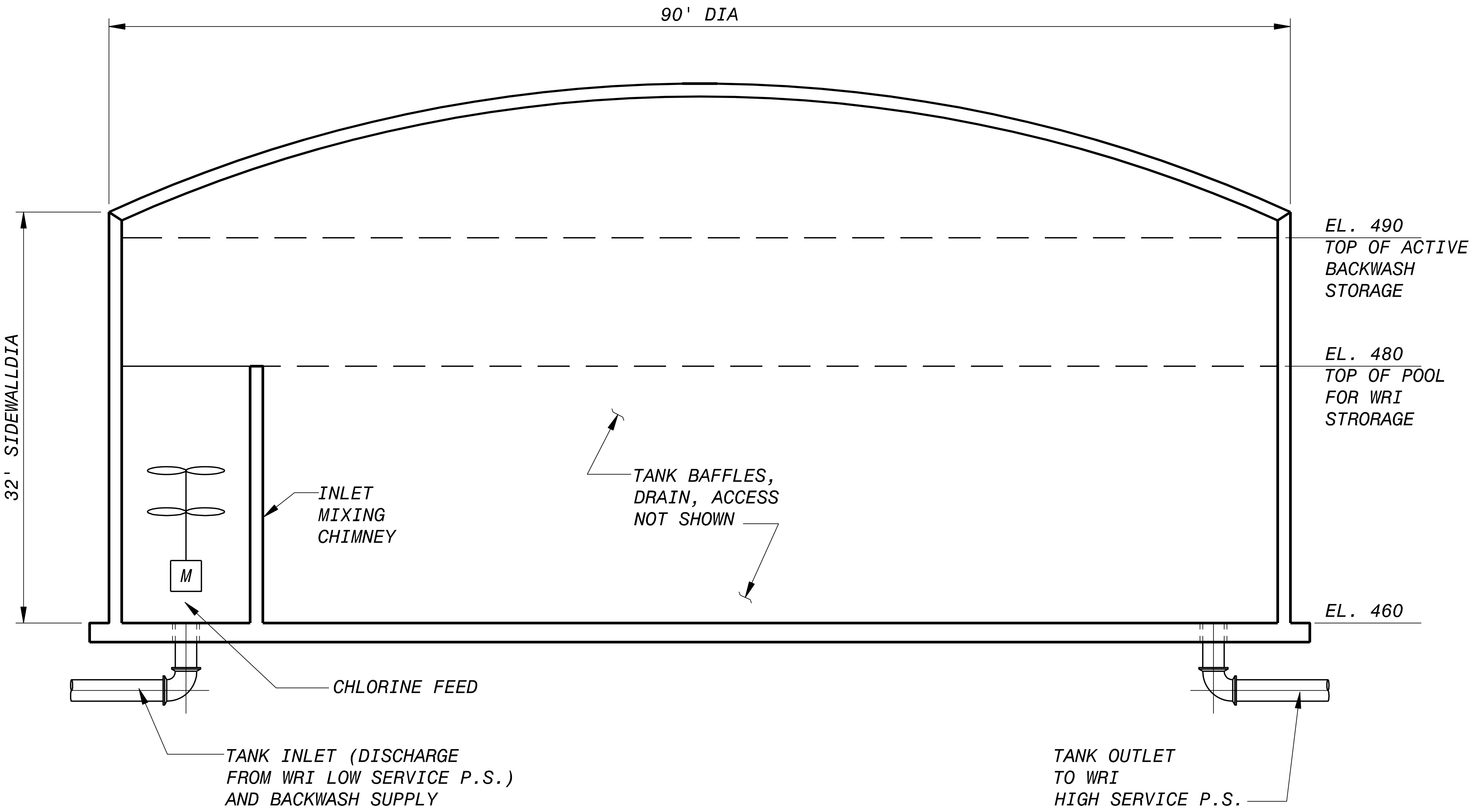
PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

EXISTING SITE PLAN

Figure TM3 - 9



Austin WATER
BLACK & VEATCH
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PRELIMINARY ENGINEERING REPORT
WALNUT CREEK WWTP FILTER IMPROVEMENTS

TANK SECTION

Figure
TM3 - 10

ATTACHMENT TM3-A

FILTER COMPLEX HYDRAULIC ANALYSES

Model Input	Case 1	Case 2
Colorado River Flood Stage (feet)	432	432
Flow to outfall (mgd)	60	75
Flow to filters (mgd)	60	75
Filter bypass flow (mgd)	0	0

Model Output	Water Surface Elevation (ft)	
Water Surface Elevation Location	Case 1	Case 2
Outfall to the Colorado River	432.00	432.00
Node ID - DOWNSTREAM CONTROL WATER SURFACE ELEVATION		
96" Outfall conduit just downstream of railroad/stream crossing	432.25	432.38
Node ID - CIRCULAR PIPE - Sta 4+80 to Sta 17+35 (96")		
96" Outfall conduit siphon at railroad/stream crossing	432.28	432.42
Node ID - CIRCULAR PIPE - Sta 17+35 to Sta 17+65 (96")		
96" Outfall conduit siphon at railroad/stream crossing	432.31	432.47
Node ID - CIRCULAR PIPE - Sta 17+65 to Sta 19+60 (96")		
96" Outfall conduit just upstream from railroad/stream crossing	432.34	432.52
Node ID - CIRCULAR PIPE - Sta 19+60 to Sta 20+23 (96")		
96" Outfall conduit at MH connection to old 90" outfall	433.22	433.86
Node ID - CIRCULAR PIPE - Sta 20+23 to Sta 72+75 (96")		
90" old outfall at 72" plant effluent pipe connection	438.59	438.82
Node ID - CIRCULAR PIPE - 90" Old Plant outfall up to excess flow MH (missing profile)		
72" plant effluent pipeat Filter Building	438.88	439.30
Node ID - CIRCULAR PIPE - Filter Effluent Pipe (72")		
Outlet Box downstream of Effluent Weir	438.91	439.33
Node ID - RECTANGULAR CHANNEL- OPEN TOP - Clearwell Outlet Box		
Water surface elevation at effluent weir (weir at 440.5)	442.10	442.36
Node ID - RECTANGULAR WEIR - Effluent Weir		
Clearwell at effluent channel connection in the southeast corner	442.10	442.37
Node ID - RECTANGULAR CHANNEL - Closed - Southern Clearwell		
Effluent channel at 90 degree turn (southeast corner)	442.18	442.49
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 7		
Effluent channel at 90 degree turn (northeast corner)	442.22	442.55
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 6		
Effluent channel at Filter 2 effluent pipe entrance	442.25	442.59
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 5		
Effluent channel at Filter 4 effluent pipe entrance	442.36	442.75
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 4		
Effluent channel at Filter 6 effluent pipe entrance	442.42	442.84
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 3		
Effluent channel at Filter 8 effluent pipe entrance	442.45	442.88
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 2		
Effluent channel at Filter 10 effluent pipe entrance	442.46	442.89
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 1		
Filter effluent pipe at elevation 440.25	442.86	443.51
Node ID - CIRCULAR PIPE - Filter 10 Effluent Pipe		
Water surface elevation in Filter 2	455.26	455.01
Node ID - CONVENTIONAL FILTERS - Filter 2		
Filter 2 influent pipe at 54" connection	455.33	455.13
Node ID - CIRCULAR PIPE - Filter 2 influent Pipe		
Main 54" filter influent line at Filters 3&4 connection	455.34	455.14
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 3&4 to Filters 1&2		
Main 54" filter influent line at Filters 5&6 connection	455.36	455.18
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 5&6 to Filters 3&4		
Main 54" filter influent line at Filters 7&8 connection	455.38	455.21
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 7&8 to Filters 5&6		
Main 54" filter influent line at Filters 9&10 connection	455.42	455.26
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 9&10 to Filters 7&8		
Main 54" filter influent line just outside of the Filter Building	455.71	455.71
Node ID - CIRCULAR PIPE - Junction Box to Main 54" Filter Influent		
Water surface elevation in the Junction Box on the west side of the filter building	455.72	455.72
Node ID - RECTANGULAR CHANNEL - OPEN TOP - Junction Box		

Model Input	**Case 3**	**Case 4**
Colorado River Flood Stage (feet)	432	432
Flow to outfall (mgd)	120	120
Flow to filters (mgd)	75	120
Filter bypass flow (mgd)	45	0

Model Output	**Water Surface Elevation (ft)**	
Water Surface Elevation Location	**Case 3**	**Case 4**
Outfall to the Colorado River	432.00	432.00
Node ID - DOWNSTREAM CONTROL WATER SURFACE ELEVATION		
96" Outfall conduit just downstream of railroad/stream crossing	432.92	432.92
Node ID - CIRCULAR PIPE - Sta 4+80 to Sta 17+35 (96")		
96" Outfall conduit siphon at railroad/stream crossing	433.02	433.02
Node ID - CIRCULAR PIPE - Sta 17+35 to Sta 17+65 (96")		
96" Outfall conduit siphon at railroad/stream crossing	433.14	433.14
Node ID - CIRCULAR PIPE - Sta 17+65 to Sta 19+60 (96")		
96" Outfall conduit just upstream from railroad/stream crossing	433.26	433.26
Node ID - CIRCULAR PIPE - Sta 19+60 to Sta 20+23 (96")		
96" Outfall conduit at MH connection to old 90" outfall	436.49	436.49
Node ID - CIRCULAR PIPE - Sta 20+23 to Sta 72+75 (96")		
90" old outfall at 72" plant effluent pipe connection	439.38	439.38
Node ID - CIRCULAR PIPE - 90" Old Plant outfall up to excess flow MH (missing profile)		
72" plant effluent pipeat Filter Building	439.84	440.55
Node ID - CIRCULAR PIPE - Filter Effluent Pipe (72")		
Outlet Box downstream of Effluent Weir	439.87	440.61
Node ID - RECTANGULAR CHANNEL- OPEN TOP - Clearwell Outlet Box		
Water surface elevation at effluent weir (weir at 440.5)	442.36	443.05
Node ID - RECTANGULAR WEIR - Effluent Weir		
Clearwell at effluent channel connection in the southeast corner	442.37	443.07
Node ID - RECTANGULAR CHANNEL - Closed - Southern Clearwell		
Effluent channel at 90 degree turn (southeast corner)	442.49	443.35
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 7		
Effluent channel at 90 degree turn (northeast corner)	442.55	443.49
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 6		
Effluent channel at Filter 2 effluent pipe entrance	442.59	443.60
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 5		
Effluent channel at Filter 4 effluent pipe entrance	442.75	443.99
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 4		
Effluent channel at Filter 6 effluent pipe entrance	442.84	444.21
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 3		
Effluent channel at Filter 8 effluent pipe entrance	442.88	444.31
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 2		
Effluent channel at Filter 10 effluent pipe entrance	442.89	444.33
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 1		
Filter effluent pipe at elevation 440.25	443.51	445.92
Node ID - CIRCULAR PIPE - Filter 10 Effluent Pipe		
Water surface elevation in Filter 2	455.01	453.92
Node ID - CONVENTIONAL FILTERS - Filter 2		
Filter 2 influent pipe at 54" connection	455.13	454.22
Node ID - CIRCULAR PIPE - Filter 2 influent Pipe		
Main 54" filter influent line at Filters 3&4 connection	455.14	454.25
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 3&4 to Filters 1&2		
Main 54" filter influent line at Filters 5&6 connection	455.18	454.34
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 5&6 to Filters 3&4		
Main 54" filter influent line at Filters 7&8 connection	455.21	454.42
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 7&8 to Filters 5&6		
Main 54" filter influent line at Filters 9&10 connection	455.26	454.55
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 9&10 to Filters 7&8		
Main 54" filter influent line just outside of the Filter Building	455.71	455.71
Node ID - CIRCULAR PIPE - Junction Box to Main 54" Filter Influent		
Water surface elevation in the Junction Box on the west side of the filter building	455.72	455.75
Node ID - RECTANGULAR CHANNEL - OPEN TOP - Junction Box		

Model Input	Case 5	Case 6
Colorado River Flood Stage (feet)	432	432
Flow to outfall (mgd)	165	200
Flow to filters (mgd)	120	120
Filter bypass flow (mgd)	45	80

Model Output	Water Surface Elevation (ft)	
Water Surface Elevation Location	**Case 5**	**Case 6**
Outfall to the Colorado River	432.00	432.00
Node ID - DOWNSTREAM CONTROL WATER SURFACE ELEVATION		
96" Outfall conduit just downstream of railroad/stream crossing	433.69	434.43
Node ID - CIRCULAR PIPE - Sta 4+80 to Sta 17+35 (96")		
96" Outfall conduit siphon at railroad/stream crossing	433.88	434.71
Node ID - CIRCULAR PIPE - Sta 17+35 to Sta 17+65 (96")		
96" Outfall conduit siphon at railroad/stream crossing	434.09	435.01
Node ID - CIRCULAR PIPE - Sta 17+65 to Sta 19+60 (96")		
96" Outfall conduit just upstream from railroad/stream crossing	434.32	435.34
Node ID - CIRCULAR PIPE - Sta 19+60 to Sta 20+23 (96")		
96" Outfall conduit at MH connection to old 90" outfall	440.19	443.77
Node ID - CIRCULAR PIPE - Sta 20+23 to Sta 72+75 (96")		
90" old outfall at 72" plant effluent pipe connection	442.39	446.97
Node ID - CIRCULAR PIPE - 90" Old Plant outfall up to excess flow MH (missing profile)		
72" plant effluent pipeat Filter Building	443.73	448.31
Node ID - CIRCULAR PIPE - Filter Effluent Pipe (72")		
Outlet Box downstream of Effluent Weir	443.76	448.32
Node ID - RECTANGULAR CHANNEL- OPEN TOP - Clearwell Outlet Box		
Water surface elevation at effluent weir (weir at 440.5)	445.15	449.71
Node ID - RECTANGULAR WEIR - Effluent Weir		
Clearwell at effluent channel connection in the southeast corner	445.17	449.73
Node ID - RECTANGULAR CHANNEL - Closed - Southern Clearwell		
Effluent channel at 90 degree turn (southeast corner)	445.45	450.01
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 7		
Effluent channel at 90 degree turn (northeast corner)	445.59	450.15
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 6		
Effluent channel at Filter 2 effluent pipe entrance	445.70	450.26
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 5		
Effluent channel at Filter 4 effluent pipe entrance	446.09	450.65
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 4		
Effluent channel at Filter 6 effluent pipe entrance	446.31	450.87
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 3		
Effluent channel at Filter 8 effluent pipe entrance	446.41	450.97
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 2		
Effluent channel at Filter 10 effluent pipe entrance	446.43	450.99
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 1		
Filter effluent pipe at elevation 440.25	448.02	452.58
Node ID - CIRCULAR PIPE - Filter 10 Effluent Pipe		
Water surface elevation in Filter 2	453.92	453.88
Node ID - CONVENTIONAL FILTERS - Filter 2		
Filter 2 influent pipe at 54" connection	454.22	454.18
Node ID - CIRCULAR PIPE - Filter 2 influent Pipe		
Main 54" filter influent line at Filters 3&4 connection	454.25	454.21
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 3&4 to Filters 1&2		
Main 54" filter influent line at Filters 5&6 connection	454.34	454.30
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 5&6 to Filters 3&4		
Main 54" filter influent line at Filters 7&8 connection	454.42	454.38
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 7&8 to Filters 5&6		
Main 54" filter influent line at Filters 9&10 connection	454.55	454.51
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 9&10 to Filters 7&8		
Main 54" filter influent line just outside of the Filter Building	455.71	455.67
Node ID - CIRCULAR PIPE - Junction Box to Main 54" Filter Influent		
Water surface elevation in the Junction Box on the west side of the filter building	455.75	455.71
Node ID - RECTANGULAR CHANNEL - OPEN TOP - Junction Box		

Model Input	Case 7	Case 8
Colorado River Flood Stage (feet)	420	420
Flow to outfall (mgd)	60	75
Flow to filters (mgd)	60	75
Filter bypass flow (mgd)	0	0

Model Output	Water Surface Elevation (ft)	
Water Surface Elevation Location	**Case 7**	**Case 8**
Outfall to the Colorado River	420.00	420.00
Node ID - DOWNSTREAM CONTROL WATER SURFACE ELEVATION		
96" Outfall conduit just downstream of railroad/stream crossing	420.20	420.32
Node ID - CIRCULAR PIPE - Sta 4+80 to Sta 17+35 (96")		
96" Outfall conduit siphon at railroad/stream crossing	420.23	420.36
Node ID - CIRCULAR PIPE - Sta 17+35 to Sta 17+65 (96")		
96" Outfall conduit siphon at railroad/stream crossing	420.26	420.41
Node ID - CIRCULAR PIPE - Sta 17+65 to Sta 19+60 (96")		
96" Outfall conduit just upstream from railroad/stream crossing	420.29	420.46
Node ID - CIRCULAR PIPE - Sta 19+60 to Sta 20+23 (96")		
96" Outfall conduit at MH connection to old 90" outfall	429.60	429.94
Node ID - CIRCULAR PIPE - Sta 20+23 to Sta 72+75 (96")		
90" old outfall at 72" plant effluent pipe connection	438.59	438.82
Node ID - CIRCULAR PIPE - 90" Old Plant outfall up to excess flow MH (missing profile)		
72" plant effluent pipeat Filter Building	438.88	439.30
Node ID - CIRCULAR PIPE - Filter Effluent Pipe (72")		
Outlet Box downstream of Effluent Weir	438.91	439.33
Node ID - RECTANGULAR CHANNEL- OPEN TOP - Clearwell Outlet Box		
Water surface elevation at effluent weir (weir at 440.5)	442.10	442.36
Node ID - RECTANGULAR WEIR - Effluent Weir		
Clearwell at effluent channel connection in the southeast corner	442.10	442.37
Node ID - RECTANGULAR CHANNEL - Closed - Southern Clearwell		
Effluent channel at 90 degree turn (southeast corner)	442.18	442.49
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 7		
Effluent channel at 90 degree turn (northeast corner)	442.22	442.55
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 6		
Effluent channel at Filter 2 effluent pipe entrance	442.25	442.59
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 5		
Effluent channel at Filter 4 effluent pipe entrance	442.36	442.75
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 4		
Effluent channel at Filter 6 effluent pipe entrance	442.42	442.84
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 3		
Effluent channel at Filter 8 effluent pipe entrance	442.45	442.88
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 2		
Effluent channel at Filter 10 effluent pipe entrance	442.46	442.89
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 1		
Filter effluent pipe at elevation 440.25	442.86	443.51
Node ID - CIRCULAR PIPE - Filter 10 Effluent Pipe		
Water surface elevation in Filter 2	455.26	455.01
Node ID - CONVENTIONAL FILTERS - Filter 2		
Filter 2 influent pipe at 54" connection	455.33	455.13
Node ID - CIRCULAR PIPE - Filter 2 influent Pipe		
Main 54" filter influent line at Filters 3&4 connection	455.34	455.14
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 3&4 to Filters 1&2		
Main 54" filter influent line at Filters 5&6 connection	455.36	455.18
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 5&6 to Filters 3&4		
Main 54" filter influent line at Filters 7&8 connection	455.38	455.21
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 7&8 to Filters 5&6		
Main 54" filter influent line at Filters 9&10 connection	455.42	455.26
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 9&10 to Filters 7&8		
Main 54" filter influent line just outside of the Filter Building	455.71	455.71
Node ID - CIRCULAR PIPE - Junction Box to Main 54" Filter Influent		
Water surface elevation in the Junction Box on the west side of the filter building	455.72	455.72
Node ID - RECTANGULAR CHANNEL - OPEN TOP - Junction Box		

Model Input	**Case 9**	**Case 10**
Colorado River Flood Stage (feet)	420	420
Flow to outfall (mgd)	120	120
Flow to filters (mgd)	75	120
Filter bypass flow (mgd)	45	0

Model Output	**Water Surface Elevation (ft)**	
Water Surface Elevation Location	**Case 9**	**Case 10**
Outfall to the Colorado River	420.00	420.00
Node ID - DOWNSTREAM CONTROL WATER SURFACE ELEVATION		
96" Outfall conduit just downstream of railroad/stream crossing	420.81	420.81
Node ID - CIRCULAR PIPE - Sta 4+80 to Sta 17+35 (96")		
96" Outfall conduit siphon at railroad/stream crossing	420.91	420.91
Node ID - CIRCULAR PIPE - Sta 17+35 to Sta 17+65 (96")		
96" Outfall conduit siphon at railroad/stream crossing	421.03	421.03
Node ID - CIRCULAR PIPE - Sta 17+65 to Sta 19+60 (96")		
96" Outfall conduit just upstream from railroad/stream crossing	421.15	421.15
Node ID - CIRCULAR PIPE - Sta 19+60 to Sta 20+23 (96")		
96" Outfall conduit at MH connection to old 90" outfall	430.78	430.78
Node ID - CIRCULAR PIPE - Sta 20+23 to Sta 72+75 (96")		
90" old outfall at 72" plant effluent pipe connection	439.38	439.38
Node ID - CIRCULAR PIPE - 90" Old Plant outfall up to excess flow MH (missing profile)		
72" plant effluent pipeat Filter Building	439.84	440.55
Node ID - CIRCULAR PIPE - Filter Effluent Pipe (72")		
Outlet Box downstream of Effluent Weir	439.87	440.61
Node ID - RECTANGULAR CHANNEL- OPEN TOP - Clearwell Outlet Box		
Water surface elevation at effluent weir (weir at 440.5)	442.36	443.05
Node ID - RECTANGULAR WEIR - Effluent Weir		
Clearwell at effluent channel connection in the southeast corner	442.37	443.07
Node ID - RECTANGULAR CHANNEL - Closed - Southern Clearwell		
Effluent channel at 90 degree turn (southeast corner)	442.49	443.35
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 7		
Effluent channel at 90 degree turn (northeast corner)	442.55	443.49
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 6		
Effluent channel at Filter 2 effluent pipe entrance	442.59	443.60
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 5		
Effluent channel at Filter 4 effluent pipe entrance	442.75	443.99
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 4		
Effluent channel at Filter 6 effluent pipe entrance	442.84	444.21
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 3		
Effluent channel at Filter 8 effluent pipe entrance	442.88	444.31
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 2		
Effluent channel at Filter 10 effluent pipe entrance	442.89	444.33
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 1		
Filter effluent pipe at elevation 440.25	443.51	445.92
Node ID - CIRCULAR PIPE - Filter 10 Effluent Pipe		
Water surface elevation in Filter 2	455.01	453.92
Node ID - CONVENTIONAL FILTERS - Filter 2		
Filter 2 influent pipe at 54" connection	455.13	454.22
Node ID - CIRCULAR PIPE - Filter 2 influent Pipe		
Main 54" filter influent line at Filters 3&4 connection	455.14	454.25
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 3&4 to Filters 1&2		
Main 54" filter influent line at Filters 5&6 connection	455.18	454.34
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 5&6 to Filters 3&4		
Main 54" filter influent line at Filters 7&8 connection	455.21	454.42
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 7&8 to Filters 5&6		
Main 54" filter influent line at Filters 9&10 connection	455.26	454.55
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 9&10 to Filters 7&8		
Main 54" filter influent line just outside of the Filter Building	455.71	455.71
Node ID - CIRCULAR PIPE - Junction Box to Main 54" Filter Influent		
Water surface elevation in the Junction Box on the west side of the filter building	455.72	455.75
Node ID - RECTANGULAR CHANNEL - OPEN TOP - Junction Box		

Model Input	**Case 11**	**Case 12**
Colorado River Flood Stage (feet)	420	420
Flow to outfall (mgd)	165	200
Flow to filters (mgd)	120	120
Filter bypass flow (mgd)	45	80

Model Output	**Water Surface Elevation (ft)**	
Water Surface Elevation Location	**Case 11**	**Case 12**
Outfall to the Colorado River	420.00	420.00
Node ID - DOWNSTREAM CONTROL WATER SURFACE ELEVATION		
96" Outfall conduit just downstream of railroad/stream crossing	421.53	422.25
Node ID - CIRCULAR PIPE - Sta 4+80 to Sta 17+35 (96")		
96" Outfall conduit siphon at railroad/stream crossing	421.72	422.53
Node ID - CIRCULAR PIPE - Sta 17+35 to Sta 17+65 (96")		
96" Outfall conduit siphon at railroad/stream crossing	421.93	422.83
Node ID - CIRCULAR PIPE - Sta 17+65 to Sta 19+60 (96")		
96" Outfall conduit just upstream from railroad/stream crossing	422.16	423.16
Node ID - CIRCULAR PIPE - Sta 19+60 to Sta 20+23 (96")		
96" Outfall conduit at MH connection to old 90" outfall	431.47	431.95
Node ID - CIRCULAR PIPE - Sta 20+23 to Sta 72+75 (96")		
90" old outfall at 72" plant effluent pipe connection	439.84	440.16
Node ID - CIRCULAR PIPE - 90" Old Plant outfall up to excess flow MH (missing profile)		
72" plant effluent pipeat Filter Building	441.01	441.33
Node ID - CIRCULAR PIPE - Filter Effluent Pipe (72")		
Outlet Box downstream of Effluent Weir	441.06	441.38
Node ID - RECTANGULAR CHANNEL- OPEN TOP - Clearwell Outlet Box		
Water surface elevation at effluent weir (weir at 440.5)	443.11	443.18
Node ID - RECTANGULAR WEIR - Effluent Weir		
Clearwell at effluent channel connection in the southeast corner	443.13	443.20
Node ID - RECTANGULAR CHANNEL - Closed - Southern Clearwell		
Effluent channel at 90 degree turn (southeast corner)	443.41	443.48
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 7		
Effluent channel at 90 degree turn (northeast corner)	443.55	443.62
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 6		
Effluent channel at Filter 2 effluent pipe entrance	443.66	443.73
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 5		
Effluent channel at Filter 4 effluent pipe entrance	444.05	444.12
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 4		
Effluent channel at Filter 6 effluent pipe entrance	444.27	444.34
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 3		
Effluent channel at Filter 8 effluent pipe entrance	444.37	444.44
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 2		
Effluent channel at Filter 10 effluent pipe entrance	444.39	444.46
Node ID - RECTANGULAR CHANNEL - Closed - Filter Effluent Section 1		
Filter effluent pipe at elevation 440.25	445.98	446.05
Node ID - CIRCULAR PIPE - Filter 10 Effluent Pipe		
Water surface elevation in Filter 2	453.88	453.85
Node ID - CONVENTIONAL FILTERS - Filter 2		
Filter 2 influent pipe at 54" connection	454.18	454.15
Node ID - CIRCULAR PIPE - Filter 2 influent Pipe		
Main 54" filter influent line at Filters 3&4 connection	454.21	454.18
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 3&4 to Filters 1&2		
Main 54" filter influent line at Filters 5&6 connection	454.30	454.27
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 5&6 to Filters 3&4		
Main 54" filter influent line at Filters 7&8 connection	454.38	454.35
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 7&8 to Filters 5&6		
Main 54" filter influent line at Filters 9&10 connection	454.51	454.48
Node ID - CIRCULAR PIPE - Main 54" filter influent from Filters 9&10 to Filters 7&8		
Main 54" filter influent line just outside of the Filter Building	455.67	455.64
Node ID - CIRCULAR PIPE - Junction Box to Main 54" Filter Influent		
Water surface elevation in the Junction Box on the west side of the filter building	455.71	455.68
Node ID - RECTANGULAR CHANNEL - OPEN TOP - Junction Box		

ATTACHMENT TM3-B

ENGINEER’S OPINION OF PROBABLE CONSTRUCTION COST

1.0 Overview

Engineer's Opinions of Probable Construction Cost (EOPC's) have been developed individually for all improvements described within TM3 Alternative Granular Filter Improvements (TM3). The various improvements include both those improvements for which there are no alternatives and those that do include alternatives that will be compared to each other on the basis of both economic and non-economic criteria.

2.0 EOPC Methodology

The project improvements discussed in TM3 are at the conceptual level of development and as such, do not provide the level of design detail required for estimating on the basis of detailed quantities and unit pricing. However, where certain items of materials and equipment were identified for replacement or rehabilitation, vendors were contacted and were able to provide budget pricing. As a result, the estimates have been developed from a combination of the following estimating resources and references and adjusted, as appropriate, to provide results that represent a conservative level of cost relative to current pricing in the construction industry.

- Current budget price quotations from vendors for individual items of equipment. In addition to the cost of equipment, the cost of equipment installation is accounted for based on a percentage of the equipment cost. In general, for all equipment except electrical equipment, the installation percentage used is 40 percent. This amount is adjusted up or down as appropriate for the amount of labor, materials and equipment anticipated for the installation.

- In the absence of more detailed information, the installation percentage for electrical equipment is 35 percent of the equipment and materials listed in Divisions 11 and 15. For the two alternatives that include new structures with electrical rooms, electrical costs were estimated at the same conceptual level as the costs for other components of the work. Electrical equipment cost represents an approximation of miscellaneous items electrical equipment and materials as well as the labor required to connect and start-up the equipment.

- Cost references for materials and commodities available from cost estimates for other water and wastewater related projects that have been prepared within the last several months.

- Cost references for labor and materials, equipment rental, construction aids, etc. available from building and heavy construction cost data published annually by RS Means.

- Where other references where not available, certain costs have been estimated based on previous experience and engineering judgment.

3.0 Estimate Components

The individual EOPCs have been organized and costs have been listed in accordance with the standard Construction Specification Institute (CSI) specification divisions. In addition to the base cost of equipment, labor and materials, contractors direct and indirect costs associated with contract and general requirements as well as overhead and profit have been accounted for as a single line item estimated at 20% of the base cost. Finally, given that the design is still in the conceptual stages of development, an overall project contingency of 40 percent has been applied to each of the cost estimates to conservatively account for the many unknowns inherent in a project in the early stages of development. The effective estimate date is July 2011.

Estimates for Operation and Maintenance Costs associated with the various alternatives have been prepared based on the assumptions given in TM3 and the anticipated operation of equipment when the facility is operating at capacity.

4.0 Attachments

The EOPCs for the various alternatives and a summary of the total EOPC for all of the recommended alternatives are attached as four pages that carry the designation "Summary" in the footer. The Operation and Maintenance Costs for the various alternatives are attached as nine pages following the EOPCs.

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CITY OF AUSTIN
WALNUT CREEK WWTP FILTER IMPROVEMENTS
ALTERNATIVE GRANULAR FILTER IMPROVEMENTS

APPENDIX TM3-B PROBABLE CONSTRUCTION COST
February 24, 2012

SUMMARY OF ALTERNATIVE COSTS

Description	$
Nozzle Underdrain with Mono-Media Filter Alternative	
Filters 1-4	
Division 2 - Sitework	119,600
Division 3 - Concrete	90,700
Division 13 - Special Construction	1,064,000
Filters 1-4 Subtotal	1,274,300
Filters 5-10	
Division 13 - Special Construction	180,800
Filters 5-10 Subtotal	180,800
Subtotal	**1,455,100**
General Conditions/Overhead and Profit (20%)	291,000
Contingency (40%)	698,400
Total Construction Cost	**2,444,500**
Filter Block Underdrain with Dual-Media Filter Alternative	
Filters 1-4	
Division 2 - Sitework	119,600
Division 3 - Concrete	69,100
Division 13 - Special Construction	1,010,800
Filters 1-4 Subtotal	1,199,500
Filters 5-10	
Division 2 - Sitework	71,900
Division 13 - Special Construction	448,000
Filters 5-10 Subtotal	519,900
Subtotal	**1,719,400**
General Conditions/Overhead and Profit (20%)	343,900
Contingency (40%)	825,300
Total Construction Cost	**2,888,600**
Centrifugal Blowers Within an Existing Structure Alternative	
Division 2 - Sitework	20,400
Division 3 - Concrete	700
Division 9 - Finishes	3,000
Division 11 - Equipment	138,600
Division 15 - Mechanical	147,700
Division 16 - Electrical	100,200
Subtotal	**410,600**
General Conditions/Overhead and Profit (20%)	82,100
Contingency (40%)	197,100
Total Construction Cost	**689,900**

CITY OF AUSTIN
WALNUT CREEK WWTP FILTER IMPROVEMENTS
ALTERNATIVE GRANULAR FILTER IMPROVEMENTS

APPENDIX TM3-B PROBABLE CONSTRUCTION COST
February 24, 2012

SUMMARY OF ALTERNATIVE COSTS

Description	$
Positive Displacement Blowers within a New Structure Alternative	
Division 2 - Sitework	26,700
Division 3 - Concrete	15,700
Divisions 4 - 9 - Superstructure	167,600
Division 11 - Equipment	123,200
Division 15 - Mechanical	243,200
Division 16 - Electrical	375,000
Subtotal	**951,300**
General Conditions/Overhead and Profit (20%)	190,300
Contingency (40%)	456,600
Total Construction Cost	**1,598,200**
Backwash Storage in a New Clearwell Alternative	
Division 2 - Sitework	428,400
Division 3 - Concrete	845,500
Divisions 4 - 9 - Superstructure	280,500
Division 5 - Metals	55,000
Division 7 - Thermal and Moisture Protection	16,100
Division 9 - Finishes	7,500
Division 11 - Equipment	700,000
Division 13 - Special Construction	20,000
Division 15 - Mechanical	1,129,300
Division 16 - Electrical	1,084,000
Subtotal	**4,566,300**
General Conditions/Overhead and Profit (20%)	913,300
Contingency (40%)	2,191,800
Total Construction Cost	**7,671,400**
Backwash From a New WRI Tank Alternative	
Division 2 - Sitework	45,400
Division 5 - Metals	2,500
Division 9 - Finishes	3,000
Division 11 - Equipment	628,900
Division 13 - Special Construction	258,000
Division 15 - Mechanical	84,800
Division 16 - Electrical	249,800
Subtotal	**1,272,300**
General Conditions/Overhead and Profit (20%)	254,500
Contingency (40%)	610,700
Total Construction Cost	**2,137,500**

CITY OF AUSTIN
WALNUT CREEK WWTP FILTER IMPROVEMENTS
ALTERNATIVE GRANULAR FILTER IMPROVEMENTS

APPENDIX TM3-B PROBABLE CONSTRUCTION COST
February 24, 2012

SUMMARY OF ALTERNATIVE COSTS

Description	$
Backwash From a New At-Grade Tank Alternative	
Division 2 - Sitework	45,400
Division 5 - Metals	2,500
Division 9 - Finishes	3,000
Division 11 - Equipment	86,800
Division 13 - Special Construction	570,000
Division 15 - Mechanical	116,100
Division 16 - Electrical	71,000
Subtotal	**894,800**
General Conditions/Overhead and Profit (20%)	179,000
Contingency (40%)	429,500
Total Construction Cost	**1,503,300**
Backwash Storage in Expanded Clearwell Alternative	
Division 2 - Sitework	263,800
Division 3 - Concrete	210,900
Divisions 4 - 9 - Superstructure	170,000
Division 5 - Metals	5,000
Division 7 - Thermal and Moisture Protection	4,200
Division 9 - Finishes	7,500
Division 11 - Equipment	700,000
Division 13 - Special Construction	20,000
Division 16 - Electrical	71,000
Subtotal	**1,452,400**
General Conditions/Overhead and Profit (20%)	290,500
Contingency (40%)	697,200
Total Construction Cost	**2,440,100**
Replace/Renovate Assets Near the End of Their Useful Life	
Division 2 - Sitework	6,700
Division 5 - Metals	100,000
Division 9 - Finishes	85,000
Division 13 - Special Construction	353,900
Division 15 - Mechanical	651,000
Division 16 - Electrical	10,000
Subtotal	**1,206,600**
General Conditions/Overhead and Profit (20%)	241,300
Contingency (40%)	579,200
Total Construction Cost	**2,027,100**
Control System Improvements	
Division 13 - Special Construction	2,141,000
General Conditions/Overhead and Profit (20%)	428,200
Contingency (40%)	1,027,700
Total Construction Cost	**3,596,900**

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CITY OF AUSTIN
WALNUT CREEK WWTP FILTER IMPROVEMENTS
ALTERNATIVE GRANULAR FILTER IMPROVEMENTS

APPENDIX TM3-B PROBABLE CONSTRUCTION COST
February 24, 2012

SUMMARY OF RECOMMENDED GRANULAR FILTER MEDIA IMPROVEMENTS

Description	$
Nozzle Underdrain with Mono-Media Filter	
Filters 1-4	
Division 2 - Sitework	119,600
Division 3 - Concrete	90,700
Division 13 - Special Construction	1,064,000
Filters 1-4 Subtotal	**1,274,300**
Filters 5-10	
Division 13 - Special Construction	180,800
Filters 5-10 Subtotal	**180,800**
Subtotal	**1,455,100**
Centrifugal Blowers Within an Existing Structure	
Division 2 - Sitework	20,400
Division 3 - Concrete	700
Division 9 - Finishes	3,000
Division 11 - Equipment	138,600
Division 15 - Mechanical	147,700
Division 16 - Electrical	100,200
Subtotal	**410,600**
Backwash From a New At-Grade Tank Alternative	
Division 2 - Sitework	45,400
Division 5 - Metals	2,500
Division 9 - Finishes	3,000
Division 11 - Equipment	86,800
Division 13 - Special Construction	570,000
Division 15 - Mechanical	116,100
Division 16 - Electrical	71,000
Subtotal	**894,800**
Replace/Renovate Assets Near the End of Their Useful Life	
Division 2 - Sitework	6,700
Division 5 - Metals	100,000
Division 9 - Finishes	85,000
Division 13 - Special Construction	353,900
Division 15 - Mechanical	651,000
Division 16 - Electrical	10,000
Subtotal	**1,206,600**
Control System Improvements	
Division 13 - Special Construction	2,141,000
Subtotal	**6,108,100**
General Conditions/Overhead and Profit (20%)	1,221,600
Contingency (40%)	2,931,900
Total Construction Cost for Recommended Alternatives	**10,261,600**

Filter Media and Underdrain "Do Nothing" Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	0		mgd	Duration	0	min	
Average Backwash flow, peak	22		mgd	Duration	18	min	
Average Backwash flow, low	0		mgd	Duration	0	min	
Total Volume per Backwash	0.275		mgd				
Average Filter Run Time	36		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	6.67		each				
Total Volume of Backwash water	1.833		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	0	mgd	0.0%	0	$0	N/A
Backwash Pumping, peak	1	22	mgd	8.3%	20	$18,300	325 bhp from exist pump curve
Backwash Pumping, low flow	1	0	mgd	0.0%	0	$0	N/A
Backwash Blower	1	2200	scfm	0.0%		$0	N/A
Settled Water Pumping	1	1.833	mgd	100.0%	9	$8,200	Assumed head = 30 ft, Eff = 80%
Subtotal					47	$26,500	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	38	lb/day	$0.23	$3,200	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$29,700**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff	1825	$27.11	$49,500	5 hours per day split between shifts
Maintenance Staff	1248	$27.11	$33,800	8 hours per day, 3 days per week
Annual Labor Cost			**$83,300**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Anthracite	71	ton	$225.00	$16,000	18" added to one filter each year
Filter Influent Valves	10%	percent	$155,000.00	$15,500	10% of new valve cost cost each year
Filter Effluent Valves	10%	percent	$230,000.00	$23,000	10% of new valve & meter cost each year
Annual Replacement Parts and Materials				**$54,500**	
Total Annual Operation and Maintenance Costs				**$167,500**	

Annual Operation and Maintenance Costs
Nozzle Underdrain with Mono-media Filter Alternative or Filter Block Underdrain with Dual-Media Filter Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs							
Commodity	**Cost**	**Unit**	**Comments**				
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%				
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218				
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11				
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11				
Cost to Supply and Treat Backwash Air and Water							
Volume Calculation							
Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				
Electrical Costs							
Item	**Quantity**	**Size**	**Units**	**Demand Factor**	**Ave kW-hr**	**Annual Cost**	**Comments**
Backwash Pumping, air/water	1	10	mgd	2.1%	4.4	$3,900	280 bhp from exist pump curve
Backwash Pumping, peak	1	28	mgd	2.1%	5.1	$4,600	325 bhp from exist pump curve
Backwash Pumping, low flow	1	10	mgd	2.1%	4.4	$3,900	280 bhp from exist pump curve
Backwash Blower	1	2200	scfm	2.1%	1.3	$1,200	83 bhp from Manf Information
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					38	$18,000	
Chemical Costs							
Item		**Quantity**		**Unit**	**Unit Cost**	**Annual Cost**	**Comments**
Chlorine fed to secondary effluent		21		lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water						**$19,800**	
Labor Costs							
Personnel Description				**Hours per Year**	**Ave Salary**	**Annual Cost**	**Comments**
Operations Staff				1460	$27.11	$39,600	4 hours per day split between shifts
Maintenance Staff				416	$27.11	$11,300	8 hours per day, 1 day per week
Annual Labor Cost						**$50,900**	
Replacement Parts and Materials							
Item		**Quantity**		**Unit**	**Unit Cost**	**Annual Cost**	**Comments**
Anthracite		47		ton	$225.00	$10,600	12" added to one filter each year
Filter Influent Valves		1%		percent	$233,000.00	$2,300	1% of new equipment cost each year
Filter Effluent Valves		1%		percent	$119,000.00	$1,200	1% of new equipment cost each year
Annual Replacement Parts and Materials						**$14,100**	
Total Annual Operation and Maintenance Costs						**$84,800**	

Annual Operation and Maintenance Costs
Low Pressure Air "Do Nothing" Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	0		mgd	Duration	0	min	
Average Backwash flow, peak	22		mgd	Duration	18	min	
Average Backwash flow, low	0		mgd	Duration	0	min	
Total Volume per Backwash	0.275		mgd				
Average Filter Run Time	36		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	6.67		each				
Total Volume of Backwash water	1.833		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	0	mgd	0.0%	0.0	$0	280 bhp from exist pump curve
Backwash Pumping, peak	1	22	mgd	8.3%	20.2	$18,300	325 bhp from exist pump curve
Backwash Pumping, low flow	1	0	mgd	0.0%	0.0	$0	280 bhp from exist pump curve
Backwash Blower	1	2200	scfm	0.0%	0.0	$0	83 bhp from Manf Information
Settled Water Pumping	1	1.833	mgd	100.0%	9.0	$8,200	Assumed head = 30 ft, Eff = 80%
Subtotal					47	$26,500	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	38	lb/day	$0.23	$3,200	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$29,700**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff for extended backwash cleaning	160	$27.11	$4,300	8 hours per day, twice each year per filter
Maintenance Staff for extended backwash cleaning	160	$27.11	$4,300	8 hours per day, twice each year per filter
Annual Labor Cost			**$8,600**	
Total Annual Operation and Maintenance Costs			**$38,300**	

Annual Operation and Maintenance Costs
Centrifugal Blowers Within an Existing Structure Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	10	mgd	2.1%	4.4	$3,900	280 bhp from exist pump curve
Backwash Pumping, peak	1	28	mgd	2.1%	5.1	$4,600	325 bhp from exist pump curve
Backwash Pumping, low flow	1	10	mgd	2.1%	4.4	$3,900	280 bhp from exist pump curve
Backwash Blower	1	2200	scfm	2.1%	1.4	$1,200	87 bhp from G/D Sizing Criteria
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					38	$18,000	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$19,800**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Blower Replacement Parts and Materials	1.0%	percentage	$107,000.00	$1,100	One percent of G/D Equipment Quote
Total Annual Operation and Maintenance Costs				**$20,900**	

Annual Operation and Maintenance Costs
Positive Displacement Blowers Within a New Structure Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	10	mgd	2.1%	4.4	$3,900	280 bhp from exist pump curve
Backwash Pumping, peak	1	28	mgd	2.1%	5.1	$4,600	325 bhp from exist pump curve
Backwash Pumping, low flow	1	10	mgd	2.1%	4.4	$3,900	280 bhp from exist pump curve
Backwash Blower	1	2200	scfm	2.1%	1.5	$1,300	96 bhp from Sutorbuilt Sizing Criteria
Lights and HVAC for Blower Bldg	1	14	kw	30.0%	4.2	$3,800	Primarily Ventilation of New Space
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					42	$21,900	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$23,700**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Blower Replacement Parts and Materials	1.0%	percentage	$70,000.00	$700	One percent of Sutorbuilt Equipment Quote
Total Annual Operation and Maintenance Costs				**$24,400**	

Annual Operation and Maintenance Costs
Backwash Supply "Do Nothing" Alternative
Calculated at 75 mgd Maximum Month Flow

Unit Costs							
Commodity	**Cost**	**Unit**	**Comments**				
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%				
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218				
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11				
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11				
Cost to Supply and Treat Backwash Air and Water							
Volume Calculation							
Average Backwash flow, air/water	0		mgd	Duration	0	min	
Average Backwash flow, peak	22		mgd	Duration	18	min	
Average Backwash flow, low	0		mgd	Duration	0	min	
Total Volume per Backwash	0.275		mgd				
Average Filter Run Time	36		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	6.67		each				
Total Volume of Backwash water	1.833		mgd				
Electrical Costs							
Item	**Quantity**	**Size**	**Units**	**Demand Factor**	**Ave kW-hr**	**Annual Cost**	**Comments**
Backwash Pumping, air/water	1	0	mgd	0.0%	0.0	$0	280 bhp from exist pump curve
Backwash Pumping, peak	1	22	mgd	8.3%	20.2	$18,300	325 bhp from exist pump curve
Backwash Pumping, low flow	1	0	mgd	0.0%	0.0	$0	280 bhp from exist pump curve
Backwash Blower	1	2200	scfm	0.0%	0.0	$0	N/A
Settled Water Pumping	1	1.833	mgd	100.0%	9.0	$8,200	Assumed head = 30 ft, Eff = 80%
Subtotal					47	$26,500	
Chemical Costs							
Item		**Quantity**		**Unit**	**Unit Cost**	**Annual Cost**	**Comments**
Chlorine fed to secondary effluent		38		lb/day	$0.23	$3,200	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water						**$29,700**	
Replacement Parts and Materials							
Item		**Quantity**		**Unit**	**Unit Cost**	**Annual Cost**	**Comments**
Backwash Pump Replacement Parts		10.0%		percentage	$500,000.00	$50,000	10% of New Equipment Quote
Total Annual Operation and Maintenance Costs						**$79,700**	

Annual Operation and Maintenance Costs
Backwash Storage in a New Clearwell
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	10	mgd	2.1%	0.6	$600	Calculated head = 20 ft, Eff = 85%
Backwash Pumping, peak	1	28	mgd	2.1%	2.7	$2,400	Calculated head = 30 ft, Eff = 85%
Backwash Pumping, low flow	1	10	mgd	2.1%	0.6	$600	Calculated head = 20 ft, Eff = 85%
Backwash Blower	1	2200	scfm	2.1%	1.4	$1,200	87 bhp from G/D Sizing Criteria
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					28	$9,200	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$11,000**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Backwash Pump Replacement Parts	1.0%	percentage	$500,000.00	$5,000	1% of New Equipment Quote
Total Annual Operation and Maintenance Costs				**$16,000**	

Annual Operation and Maintenance Costs
Backwash from a New WRI Tank
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	1.000	mgd	100.0%	9.3	$8,400	Calculated head = 60 ft, Eff = 85%
Backwash Blower	1	2200	scfm	2.1%	1.4	$1,200	87 bhp from G/D Sizing Criteria
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					34	$14,000	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to WRI Tank	17	lb/day	$0.23	$1,400	2.0 mg/L boost for reclaimed water
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$17,200**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
WRI Pump Replacement Parts	1.0%	percentage	$255,500.00	$2,600	1% of New Equipment Quote
Total Annual Operation and Maintenance Costs				**$19,800**	

Annual Operation and Maintenance Costs
Backwash from a New At-Grade Tank
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	1.000	mgd	100.0%	9.3	$8,400	Calculated head = 60 ft, Eff = 85%
Backwash Blower	1	2200	scfm	2.1%	1.4	$1,200	87 bhp from G/D Sizing Criteria
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					34	$14,000	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$15,800**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
At-Grade Tank Pump Replacement Parts	1.0%	percentage	$31,000.00	$300	1% of New Equipment Quote
Total Annual Operation and Maintenance Costs				**$16,100**	

Annual Operation and Maintenance Costs
Backwash Storage in Expanded Clearwell
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping, air/water	1	10	mgd	2.1%	0.6	$600	Calculated head = 20 ft, Eff = 85%
Backwash Pumping, peak	1	28	mgd	2.1%	2.7	$2,400	Calculated head = 30 ft, Eff = 85%
Backwash Pumping, low flow	1	10	mgd	2.1%	0.6	$600	Calculated head = 20 ft, Eff = 85%
Backwash Blower	1	2200	scfm	2.1%	1.4	$1,200	87 bhp from G/D Sizing Criteria
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					28	$9,200	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$11,000**	

Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Backwash Pump Replacement Parts	1.0%	percentage	$500,000.00	$5,000	1% of New Equipment Quote
Total Annual Operation and Maintenance Costs				**$16,000**	

Annual Operation and Maintenance Costs
Total Project O&M Costs
Calculated at 75 mgd Maximum Month Flow

Unit Costs

Commodity	Cost	Unit	Comments
Labor	$27.11	/hr	Mike Welch E-mail 6-23-11, salary plus 20%
Electricity	$0.10	/kW-hr	Mike Welch E-mail 6-23-11, average of 6 months at $0.0847 and 6 months at $0.1218
Chlorine	$0.23	/lb	Mike Welch E-mail 6-23-11
Sulfur Dioxide	$0.30	/lb	Mike Welch E-mail 6-23-11

Cost to Supply and Treat Backwash Air and Water

Volume Calculation

Average Backwash flow, air/water	10		mgd	Duration	6	min	
Average Backwash flow, peak	28		mgd	Duration	6	min	
Average Backwash flow, low	10		mgd	Duration	6	min	
Total Volume per Backwash	0.200		mgd				
Average Filter Run Time	48		hrs				Based on a plant flow of 75 mgd
Number of Backwashes per day	5.00		each				
Total Volume of Backwash water	1.000		mgd				

Electrical Costs

Item	Quantity	Size	Units	Demand Factor	Ave kW-hr	Annual Cost	Comments
Backwash Pumping	1	1	mgd	100.0%	9.3	$8,400	280 bhp from exist pump curve
Backwash Blower	1	2200	scfm	2.1%	1.3	$1,200	83 bhp from Manf Information
Settled Water Pumping	1	1.000	mgd	100.0%	4.9	$4,400	Assumed head = 30 ft, Eff = 80%
Subtotal					33	$14,000	

Chemical Costs

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Chlorine fed to WRI System	0	lb/day	$0.23	$0	2.0 mg/L dose
Chlorine fed to secondary effluent	21	lb/day	$0.23	$1,800	2.5 mg/L dose
Annual Cost to Supply and Treat Backwash Water				**$15,800**	

Labor Costs

Personnel Description	Hours per Year	Ave Salary	Annual Cost	Comments
Operations Staff	1460	$27.11	$39,600	4 hours per day split between shifts
Maintenance Staff	416	$27.11	$11,300	8 hours per day, 1 day per week
Annual Labor Cost			**$50,900**	

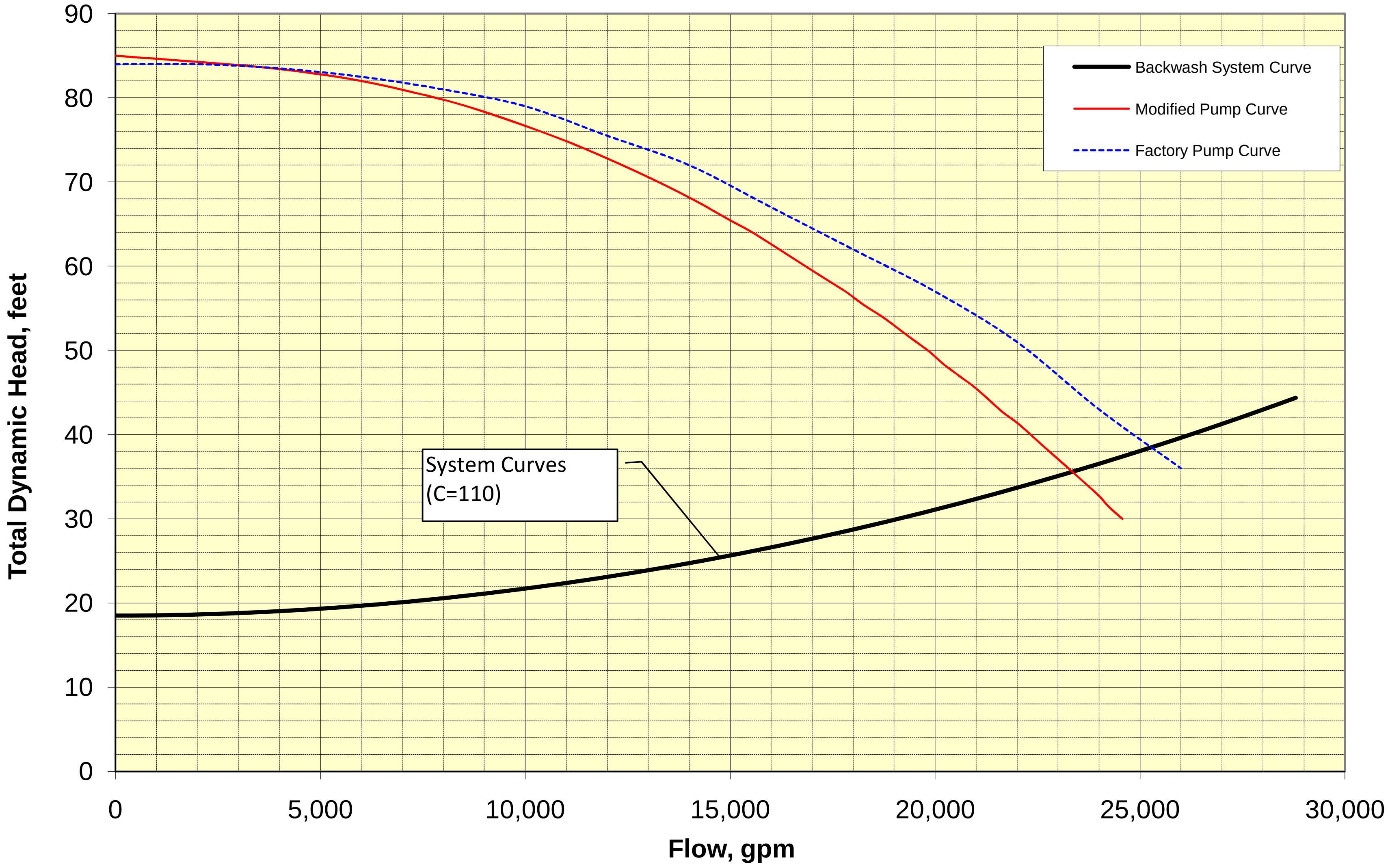
Replacement Parts and Materials

Item	Quantity	Unit	Unit Cost	Annual Cost	Comments
Anthracite	47	ton	$225.00	$10,600	12" added to one filter each year
Filter Influent Valves	1%	percent	$233,000.00	$2,300	1% of new equipment cost each year
Filter Effluent Valves	1%	percent	$119,000.00	$1,200	1% of new equipment cost each year
At-Grade Pumps	1%	percent	$31,000.00	$300	1% of new equipment cost each year
Low Pressure Blowers	1%	percent	$107,000.00	$1,100	1% of new equipment cost each year
Annual Replacement Parts and Materials				**$15,500**	
Total Annual Operation and Maintenance Costs				**$82,200**	

ATTACHMENT TM3-C

BACKWASH SYSTEM CURVE

Walnut Creek WWTP Backwash System Curve



CITY OF AUSTIN WALNUT CREEK WWTP TERTIARY FILTER REHABILITATION PROJECT

TM4 SELECTION OF FILTRATION TECHNOLOGY

CITY OF AUSTIN CIP ID: 3023.025
B&V PROJECT NO. 168622

AUGUST 5, 2011

BLACK & VEATCH
Building a world of difference.

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1.0 INTRODUCTION

This Technical Memorandum Number 4 (TM4) presents the methodology used to evaluate alternative treatment technologies and the results of that evaluation, culminating with a recommended filtration technology for the Walnut Creek WWTP. Three alternative technologies were evaluated, Cloth Media Filters, Rotating Disk Filters and Granular Filters. TM2 describes the Cloth Media and Rotating Disk Filters, TM3 describes the Granular Filters. The purpose of those two documents and this one is to identify the differences between the various technologies. Evaluation of the non-potable system and the standby power are not covered within this portion of the scope, and, therefore, not included in any of the alternatives. The following sections summarize the scope of each filtration technology alternative as described within those documents.

2.0 SUMMARY OF TM2 – ALTERNATIVE FILTRATION TECHNOLOGIES

TM2 describes a wide range of alternative filtration technologies that have been successfully applied to secondary effluent from wastewater treatment facilities. Understanding that granular filtration is the base case for this plant, the project team narrowed the list of potential alternative technologies. The remaining alternative technologies were cloth media filters and rotating disk filters. The project team devised a conceptual plan for implementing each of these technologies within the footprint of the existing filter complex.

2.1 Cloth Media Filters

The conceptual plan for implementing the cloth media filter alternative is to install equipment within the existing filter boxes at Filter Building 2. The existing granular media, underdrains and backwash equipment will be removed from the boxes, and new concrete influent channels, effluent channels and equipment bases will be constructed. Secondary effluent will be admitted into these boxes where it will penetrate the cloth media and be withdrawn from inside the unit as filtered effluent. Within the existing piping gallery, all piping, valves and equipment related to backwash supply will be removed and replaced with the backwash pumps and valves needed to serve the new equipment. The flow control to the individual units will be moved from the filter effluent to the filter influent, which will require re-piping the majority of those systems. Because the footprint required for this technology is substantially less than the footprint for granular media, only 6 out of the 10 existing filter boxes will have to be renovated to maintain the 75 mgd Maximum Month capacity of the filter complex.

2.2 Rotating Disk Filters

The conceptual plan for implementing the rotating disk filter alternative is similar to the cloth media filter in that it uses the existing filter boxes within the filter complex to house the new equipment. Unlike the cloth media filter, the rotating disk units have stainless steel housings that contain the filter influent and effluent. Therefore, for this alternative the filter boxes are filled in to create an operating floor that is at the proper elevation to allow gravity flow through the units. The existing filter media, underdrain and washwater troughs will be removed and the filter bays will be provided with a sunshade to protect equipment and employees. Influent piping and effluent piping will be installed to each unit from the headers in the piping gallery, this will require removal and replacement of the majority of the existing piping in the gallery. Like the cloth media filters, flow control to each unit is provided on the inlet side. The existing backwash piping, valves and equipment will be removed, as these units feature wash water equipment mounted right on the skid. Because the footprint required for this equipment is substantially less than granular media filters, only 7 of the 10 filter boxes will need to be retrofitted to maintain the 75 mgd Maximum Month capacity of the filter complex.

3.0 SUMMARY OF TM3 – GRANULAR MEDIA FILTER IMPROVEMENTS

The improvements required to bring the existing granular media filters up to today’s standard for this technology include renovation of Filters 1 through 4, replacement of the existing backwash water and low pressure air supply, replacement or renovation of assets near the end of their useful life, and a new control system. After completion of these improvements, all ten filters will be mono-media deep bed filters with nozzle style underdrains that utilize a combined air-water backwash. Backwash water will be supplied from an at grade tank designed to hold two filter backwash volumes. This tank will be fed from backwash tank supply pumps located in the filter gallery taking suction from the existing clearwell. Low pressure air required for the combined air/water backwash cycle will be supplied from dedicated blowers located in the piping gallery. A new control system will be installed to provide automatic control of the filters. Existing assets that are at the end of their useful life will be renovated or replaced. Upon completion, this filter complex will have a firm capacity of 75 mgd with a remaining useful life of 20 years.

4.0 COMPARISON OF ALTERNATIVES

The three alternatives described in this TM4 have been compared based on economic and non-economic criteria in order to determine which alternative provides the best value for the City. The economic evaluation yields a present worth cost, a dollar value that includes both capital and operating costs. The lowest present worth is the most cost-effective solution, all other criteria being equal. However, all other criteria are not equal, therefore each alternative is evaluated based on a set of non-economic criteria. These criteria are weighted and each alternative is then scored against all of the criteria to develop a ranking that is representative of the value of each alternative. The following sections describe the economic evaluation, non-economic evaluation and the overall ranking of the alternatives.

4.1 Economic Evaluation

Conceptual designs for each alternative have been developed and utilized to estimate costs. These estimates have been used to establish the present worth of each alternative as described in this section.

4.1.1 Capital Cost

Engineer's Opinions of Probable Construction Cost (EOPC) have been developed individually for the three alternatives described within TM2 and TM3. These alternatives are at the conceptual level of development and as such, do not provide the level of design detail required for estimating on the basis of detailed quantities and unit pricing. However, where certain items of materials and equipment were identified for replacement or rehabilitation, vendors were contacted and were able to provide budget pricing. As a result, the estimates have been developed from a combination of estimating resources and adjusted, as appropriate, to provide results that represent a conservative level of cost relative to current pricing in the construction industry.

The individual EOPC have been organized and costs have been listed in accordance with the standard Construction Specification Institute (CSI) specification divisions. In addition to the base cost of equipment, labor and materials, contractors direct and indirect costs associated with contract and general requirements as well as overhead and profit have been accounted for as a single line item estimated at 20 percent of the base cost. Finally, given that the design is still in the conceptual stages of development, an overall project contingency of 40 percent has been applied to each of the cost estimates to conservatively account for the many unknowns inherent in a project in the early stages of development.

The effective estimate date is July 2011. Table TM4-1 lists the Capital Costs for each alternative.

Table TM4-1

Capital Costs for Alternative Filter Technologies

Description	Granular Media Filters	Cloth Media Filters	Rotating Disk Filters
Division 2 – Sitework and Demolition	192,100	361,000	361,000
Division 3 – Concrete	91,400	606,900	187,100
Divisions 4 through 9	193,500	1,065,500	1,431,300
Division 11 - Equipment	225,400	0	0
Division 13 – Special Construction	4,109,700	8,680,000	7,560,000
Division 15 – Mechanical	914,800	355,900	265,900
Division 16 – Electrical	181,200	159,900	123,800
General Conditions, OH&P	1,181,600	2,245,800	1,985,800
Contingencies	2,835,900	5,390,000	4,766,000
Total Capital Cost	**9,925,600**	**18,865,000**	**16,680,900**

Table TM4-1 clearly indicates that the least capital cost would be incurred by retaining the current granular filter technology. This is not an unexpected result.

4.1.2 Operating and Maintenance Costs

Operating and maintenance costs were developed for the granular media filter alternative based on historic operating and maintenance levels for the existing filter complex. Operating costs for the cloth media and rotating disk alternatives were based on information supplied by the manufacturer of those systems. The costs assume that the filters are operating at the design maximum month flow of 75 mgd. Operating and maintenance costs have been grouped into the following categories:

- Cost to Supply and Treat Backwash Water. This cost includes the operation of the backwash equipment required for each alternative. In all cases, the spent backwash is returned to the settled water pump station, and from there the spent backwash is pumped to the secondary process and returned to the filter complex. For the rotating disk alternative, the electrical cost for rotating the disks is included in the backwash water cost.
- Labor Costs. These costs include an estimate of the amount of effort required of the plant staff to operate and maintain each alternative.

- Replacement Parts and Materials. These costs include replacement of filter media and wearing parts for the alternatives.

The annual operating and maintenance costs estimated for each alternative are listed in Table TM4-2.

Table TM4-2

Annual Operating and Maintenance Costs for Alternative Filter Technologies

Description	Granular Media Filters	Cloth Media Filters	Rotating Disk Filters
Cost to Supply and Treat Backwash Air and Water	15,800	26,600	137,600
Labor Costs	50,900	52,900	62,600
Replacement Parts and Materials	15,500	73,700	86,900
Total Annual Cost	**82,200**	**153,200**	**287,100**

The granular media filters have the lowest annual O&M cost, primarily due to the higher cost of replacement parts and materials associated with the cloth media and rotating disk filter alternative. This cost is largely driven by the assumptions made for media replacement, namely that each cloth filter has to be replaced every seven years and each granular media filter looses one foot of anthracite media every ten years. The rotating disk filters have the highest O&M cost because of the electricity needed to spin the disks at all times, that cost is captured as part of the cost to supply and treat backwash since the spinning disks allow much less backwash water to be used.

4.1.3 Present Worth

In order to compare the various capital and operating costs, a present worth analysis was completed for all three alternatives. The present worth costs were analyzed over a twenty year period, during which the plant was assumed to be operating consistently at a maximum month flow rate of 75 mgd. This present worth analysis does not account for the costs, and potential savings, to upgrade the plant to 100 mgd capacity. The period is assumed to begin the year that the improvements are completed, so that capital cost equals present worth in this analysis. The annual O&M costs listed in Table TM4-2 apply to each year of the period analyzed and represent a uniform series of annual payments. The cost of money was assumed to be 6 percent, and the effect of inflation was neglected in this analysis. Table TM4-3 lists the capital, annual O&M and present worth costs for each alternative.

Table TM4-3

Present Worth Analysis for Alternative Filter Technologies

Description	**Granular Media Filters**	**Cloth Media Filters**	**Rotating Disk Filters**
Capital Cost	9,925,600	18,865,000	16,680,900
Annual O&M Cost	82,200	153,200	287,100
Present Worth of O&M Costs	943,000	1,757,000	3,293,000
Total Present Worth	**10,870,000**	**20,620,000**	**19,970,000**

As could be expected from the lower capital and operating costs, the Granular Media Filters have the lowest present worth and are therefore the most cost-effective solution based on this economic analysis.

4.2 Comparison of Non-Economic Factors

Although the Granular Media Filter Alternative is clearly the most cost effective solution, the other alternatives may provide benefits to the plant that offset the additional costs. For the filter complex, these benefits are described using the non-economic factors described in the following sections. Each factor is given a weighting that represents how important that factor is compared to the others, the total of all weighting factors equaling 100 percent. Each alternative is rated against each factor using a scale of 1 to 5, with 5 being the best.

4.2.1 Flexibility for Future Expansion

The City plans to expand the Walnut Creek plant from 75 mgd to 100 mgd within the time frame of the present worth analysis. Therefore, there will be additional future capital costs required for the filter complex when the plant is expanded. Flexibility for future expansion is defined as the relative difficulty involved with expanding the filter complex from 75 mgd to 100 mgd, a higher ranking reflecting an easier expansion.

For this factor, both the Cloth Media Filter Alternative and the Rotating Disk Alternative are ranked 5, as both technologies can be constructed to 100 mgd capacity within the existing concrete footprint of the filter boxes. The Granular Media Filter alternative is rated as a 2, since it will require the construction of four new concrete filter boxes, an extension of the piping gallery, and significant improvements to the site. The existing facilities recommended for backwash supply will be adequate to serve these new filters, so the rating was not lowered to one. This factor is so important to the selection of the best filter technology that it is given a 40% weighting factor. This weighting reflects the strong desire to not focus entirely on initial capital costs, because the City may end up spending much more during the next expansion then they will save with the selection of this technology.

4.2.2 Flexibility to Meet Future Regulations

The State of Texas is planning to issue nutrient limits for treatment plants like Walnut Creek in the near future. Although the precise nature of these regulations is not known, it is anticipated that phosphorus will be regulated to a level in the 0.5 to 1.5 mg-P/L range. This level of phosphorus in wastewater effluent can be accomplished through Bio-P treatment in the aeration basin and effluent filtration. During periods when Bio-P is not working well or when there is a high solids carry over from the clarifiers, metal salts such as alum or ferric chloride can be added to meet this level of effluent phosphorus. Flexibility to meet future regulations is defined as the ability to remove particulate phosphorus from a Bio-P plant effluent with or without the addition of metal salts to precipitate the phosphorus that remains in solution, a higher rating given for technologies that are better suited to remove this particulate matter.

The Granular Media Filter alternative is rated as a 5, as the deep bed of filter media has shown to be very effective at removal of the particulate phosphorus from secondary effluent. This type of filter also has a much higher capacity to absorb solids loading if a metal salt is added after the secondary clarifiers. The Cloth Media Filter alternative is rated as a 3, since this technology has demonstrated that it can successfully treat effluent phosphorus levels in the range anticipated. This technology does not have the same capacity to absorb high solids loading, so it has been rated lower than the Granular Media Filter Alternative. The Rotating Disk Filter alternative has been rated at 1, because there are not a significant number of successful applications of this technology for the removal of phosphorus. This factor is considered to be the second highest in importance, and is thus weighted at 30 percent. The logic for this weighting is similar to the weighting for Flexibility for Future Expansion, in that the City would not want to invest in technology that could not meet the upcoming regulations.

4.2.3 Reliability and Complexity of O&M

Because filtration of secondary effluent is the final unit process before plant effluent is routed to the Reclaimed Water System or discharged to the Colorado River, the reliability of the technology is quite important. This can be described in two different ways – the percentage of down time or the relative complexity of the equipment in terms of operations and maintenance. These two are closely related, as the higher the complexity the higher percentage of down time that would be expected. Reliability and Complexity of O&M is defined as the relative complexity of the components required to implement the filter technology and the resulting reliability of that technology to perform day in and day out. The less complex the technology is, or the more reliable the technology appears to be, the higher the rating.

The Granular Media Filter alternative is rated as a 5, it has the fewest moving parts of any of the alternatives. The maintenance of the pumps, blowers, valves and filter beds are relatively straight forward and are well understood by the City. The Cloth Media Filter alternative is rated as a 2, as it requires numerous backwash pumps and a very large number of valves to accomplish the backwash cycle. This alternative also features drive motors to turn the disks when backwashing, another point of failure. This alternative is rated higher than the Rotating Disk Filter primarily because there are a significant number of cloth filters in operation. The Rotating Disk Filter alternative is rated as a 1, primarily because a lack of successful operating plants. It has fewer parts than the Cloth Media Filter alternative, but the nozzles used for backwash and the main seals that run against the moving disks could be significant maintenance items. This factor is the third highest in terms of importance, and has been weighted at 20 percent. One reason for a lower weighting is that the annual operating costs capture labor and materials necessary to maintain each alternative, so to some degree this factor has already been accounted for in the economic evaluation.

4.2.4 Sustainability

Sustainability is required to be factored into analyses of this type by resolution of the City Council. The project team conducted a Sustainability Review of these alternatives to solicit input from City staff familiar with the Council resolution and how it might be applied to this project. Because the resolution is based on Leadership in Energy and Environmental Design (LEED) principals, this program does not translate well to an unoccupied process structure like the filter complex. The underlying principals of LEED can be applied to this type of project, and the Sustainability Review was an opportunity to discuss those principals. Sustainability is defined as how well each alternative supports the principals of the LEED program as codified by City Council resolution, more sustainable solutions are given a higher ranking.

The Granular Media Filter alternative is rated as a 5, it makes the most use of existing facilities, will generate the least construction waste, and is expected to be the most efficient overall as demonstrated by annual O&M cost. Both the Cloth Media Filter and Rotating Disk Filter alternatives are rated as 1. They will utilize only the concrete shell of the filter boxes, will generate significantly more construction waste, and are less efficient overall. This factor is given the lowest weighting in terms of importance, at 10 percent. One reason for this weighting is that the traditional LEED criteria cannot be applied to an unoccupied process structure; this is not the type of facility envisioned when those criteria were developed. Additionally, the annual operating costs capture the relative efficiency of each alternative, so to some degree this factor has already been accounted for in the economic evaluation.

4.3 Summary of Criteria and Rankings

The ratings for each alternative and each non-economic criteria are multiplied by the weighting factor for that criteria and then totaled together to obtain an overall numeric rating for each alternative. This numeric value can be thought of as the benefit side of a cost/benefit equation. To complete the math and determine the alternative with the lowest cost/benefit ratio, the highest rated alternative is given the benefit value of unity, so that its cost/benefit ratio is equal to the total present worth calculated in Table TM4-3. Lower ranking alternatives are given a benefit score less than one based on the total value of the ranking, that score is then divided into the total present worth for the alternative to arrive at the cost/benefit ratio for that alternative. The alternative with the lowest cost/benefit ratio is the most cost effective alternative. Table TM4-4 is a summary of the ratings, benefit scores and cost/benefit ratios for each alternative.

Table TM4-4

Non-Economic Criteria Rating and Cost/Benefit Analysis for Alternative Filter Technologies

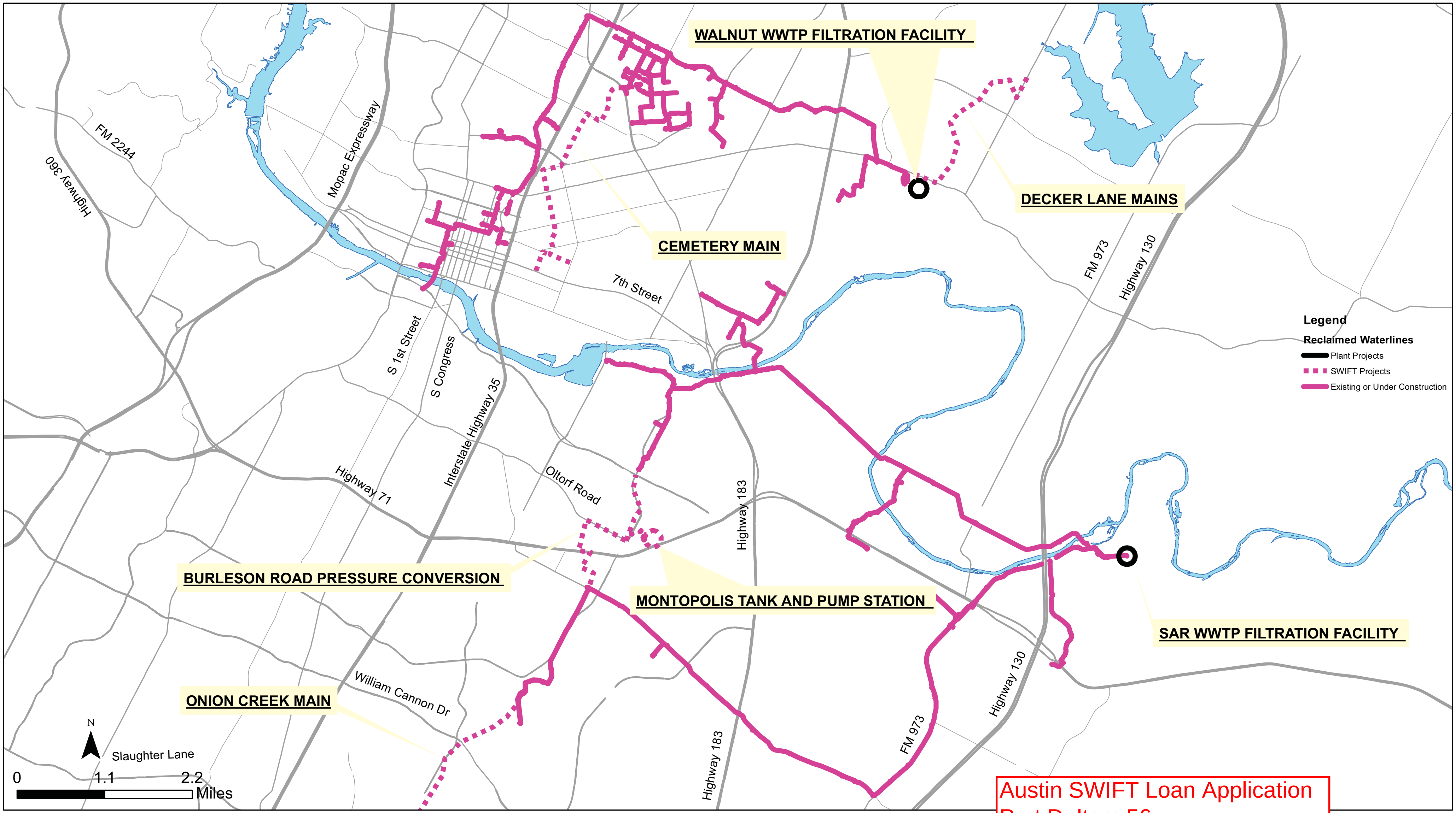
	Flexibility for Future Expansion	Flexibility to Meet Future Regulations	Reliability and Complexity of O&M	Sustainability	Total Weighted Rating	Benefit Score	Cost/Benefit Ratio (1,000,000's)
Weighting	40%	30%	20%	10%			
Granular Media Filter Alternative	2	5	5	5	3.80	1.00	11
Cloth Media Filter Alternative	5	3	2	1	3.40	0.89	23
Rotating Disk Filter Alternative	5	1	1	1	2.60	0.68	29

5.0 RECOMMENDATION AND SELECTION OF TECHNOLOGY

Based on the results of the effort that went into this technical memorandum, rehabilitating filters 1 through 4 and adding media to filters 5 through 10 is the recommended option for the City of Austin. As shown in Table TM4-4 the granular media alternative scores higher in all categories except flexibility for future expansion, resulting in the highest total weighted ranking. The cost/benefit ratio for the granular media alternative is half that of the cloth media and rotating disk alternatives.

TWDB SWIFT FUNDING APPLICATION RECLAIMED WATER PROJECTS KEY MAP

March 2016



"USING PURPLE TO KEEP AUSTIN GREEN"

Austin SWIFT Loan Application
Part D, Item 56
Map of All Reuse Projects
Included in SWIFT Application

Austin SWIFT Loan Application
Part D, Item 56
Burleson Pressure Zone Map

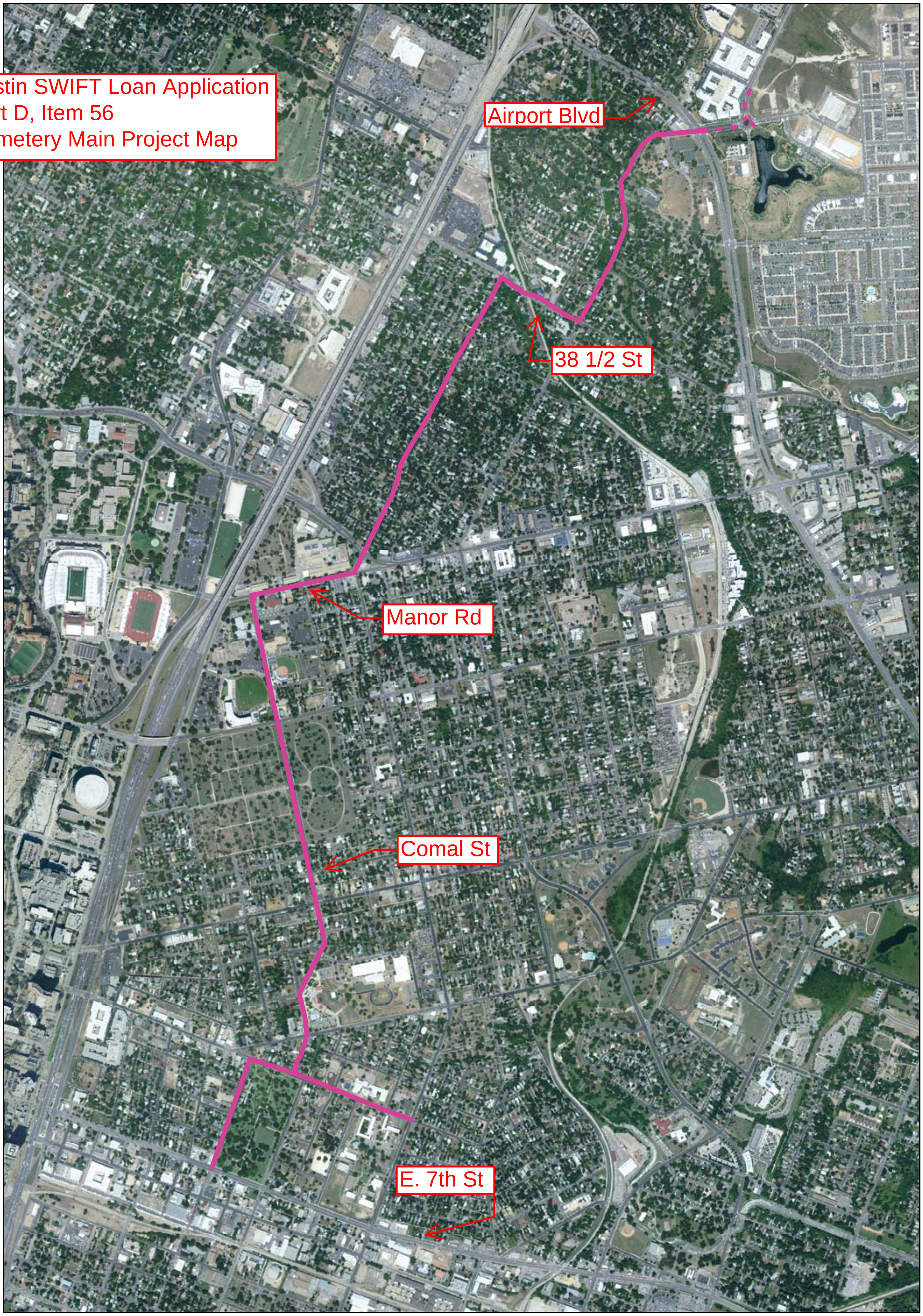
CITY OF AUSTIN
BURLESON WRI PRESSURE
CONVERSION

EXHIBIT 1:
ROUTE OPTION "A"

K•FRIESE
+ ASSOCIATES
PUBLIC PROJECT ENGINEERING

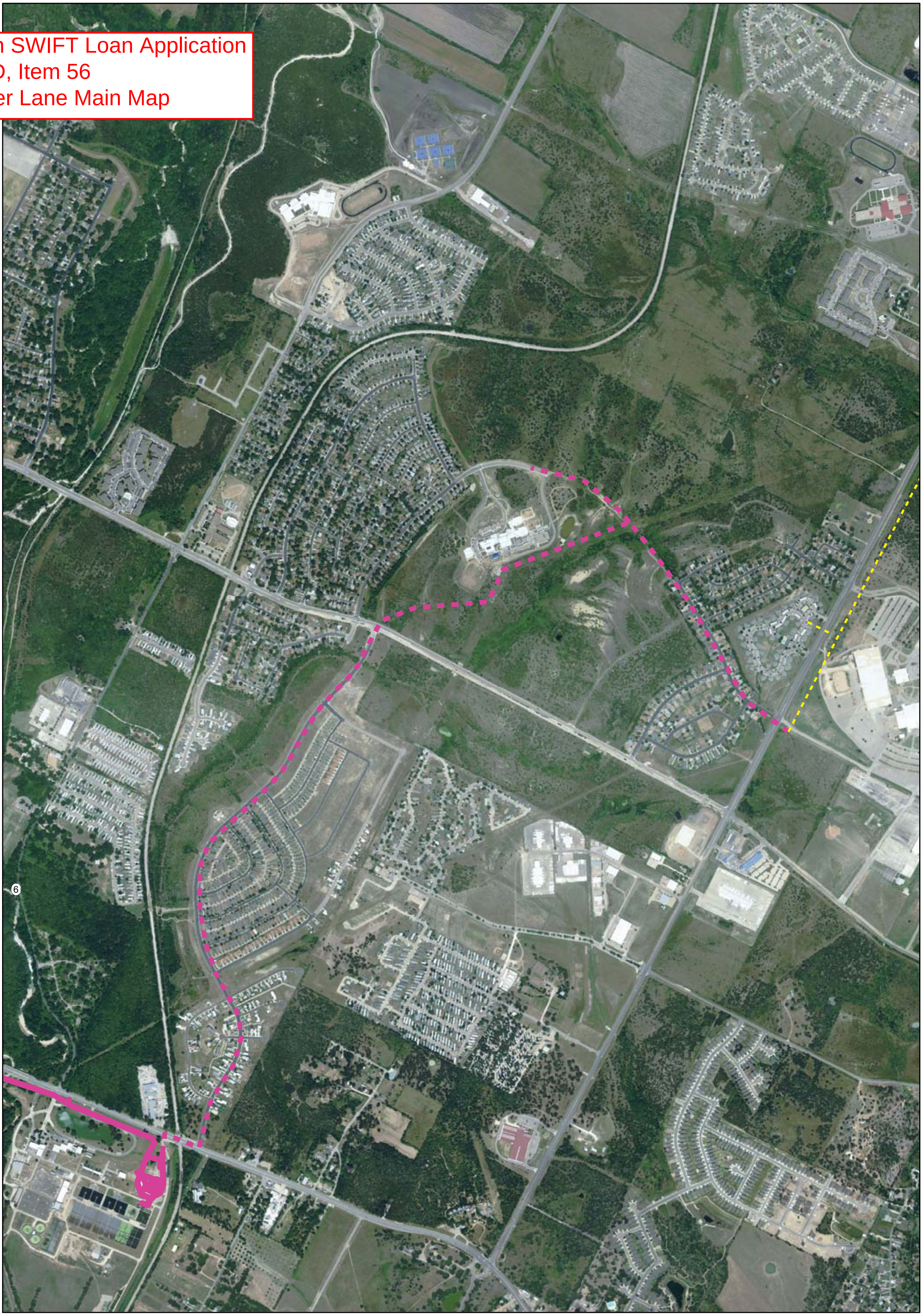
1120 S. Capital of Texas Highway
CityView 2, Suite 100
Austin, Texas 78746
P – 512.338.1704 F – 512.338.1784
TBPE Firm Number 6535
www.kfriese.com

Austin SWIFT Loan Application
Part D, Item 56
Cemetery Main Project Map



Proposed Alignment for Cemetery Main

Austin SWIFT Loan Application
Part D, Item 56
Decker Lane Main Map



Legend

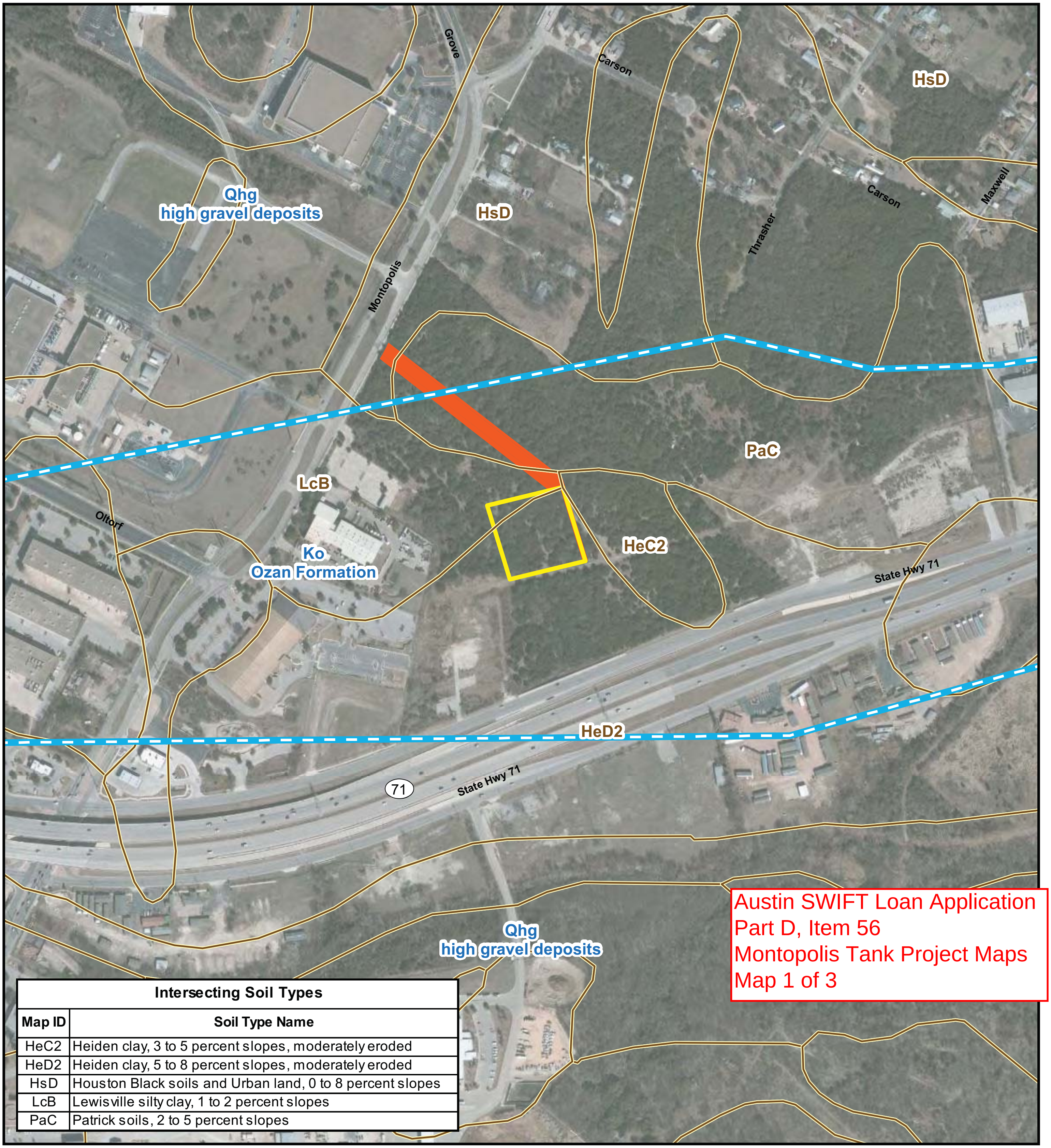
Proposed Reclaimed Main
Existing Reclaimed Main

"Using purple to keep Austin green"

N

0 500 1,000 2,000 Feet

Proposed Reclaimed Main to Decker Lane



Austin SWIFT Loan Application
Part D, Item 56
Montopolis Tank Project Maps
Map 1 of 3

Intersecting Soil Types

Map ID	Soil Type Name
HeC2	Heiden clay, 3 to 5 percent slopes, moderately eroded
HeD2	Heiden clay, 5 to 8 percent slopes, moderately eroded
HsD	Houston Black soils and Urban land, 0 to 8 percent slopes
LcB	Lewisville silty clay, 1 to 2 percent slopes
PaC	Patrick soils, 2 to 5 percent slopes

N

0 250 500

Feet

One inch equals 500 ft

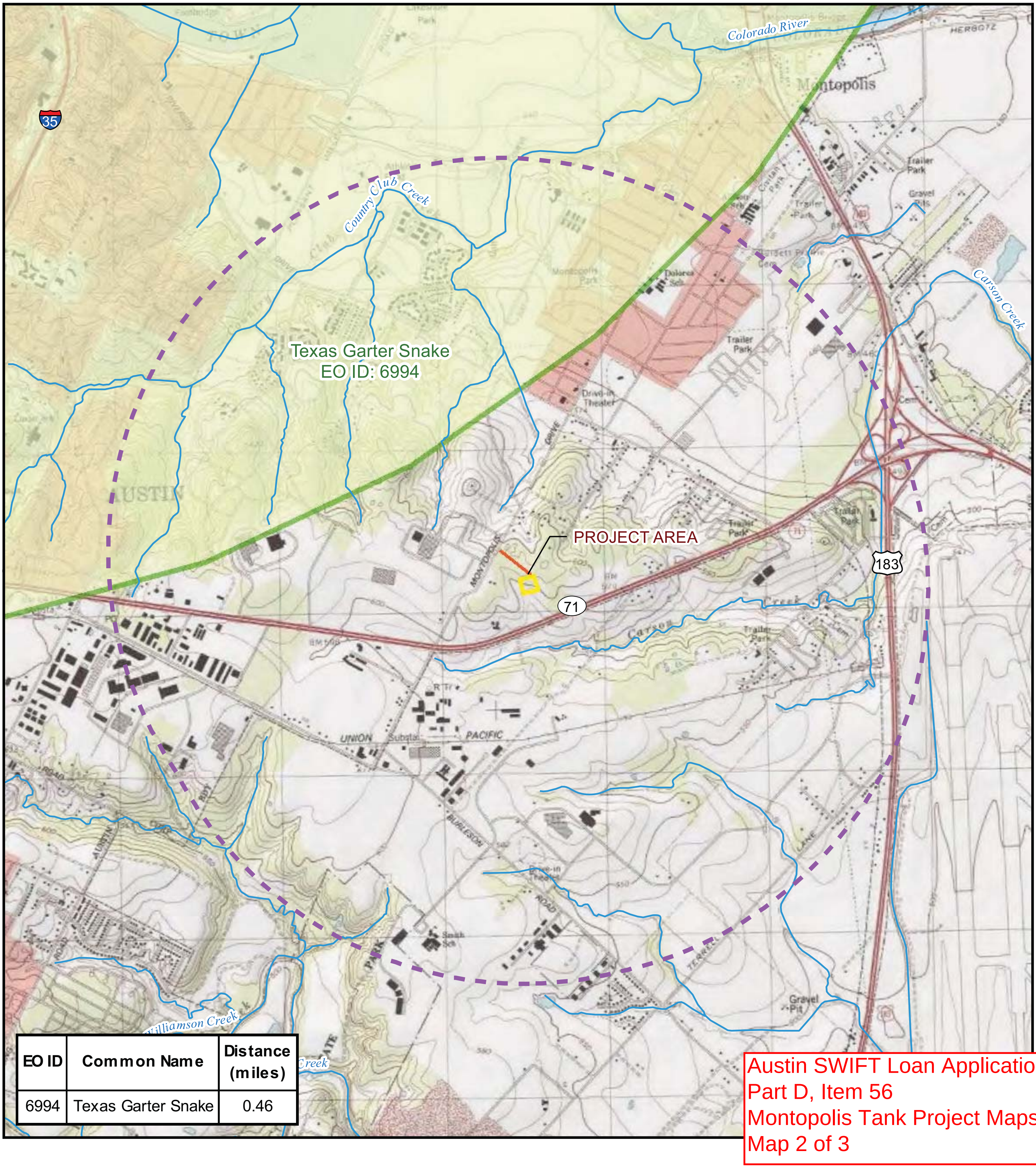
Figure 6

Geology and Soils

Montopolis Water Reuse Site

Key to Features

▭	Geology Boundaries
▭	Soil Type Boundaries
▭	Water Tank Site
🟥	Easements



EO ID	Common Name	Distance (miles)
6994	Texas Garter Snake	0.46

Austin SWIFT Loan Application
Part D, Item 56
Montopolis Tank Project Maps
Map 2 of 3

N

0 0.25 0.5
Miles
One inch equals .5 miles

Figure 7

TxNDD Occurrences

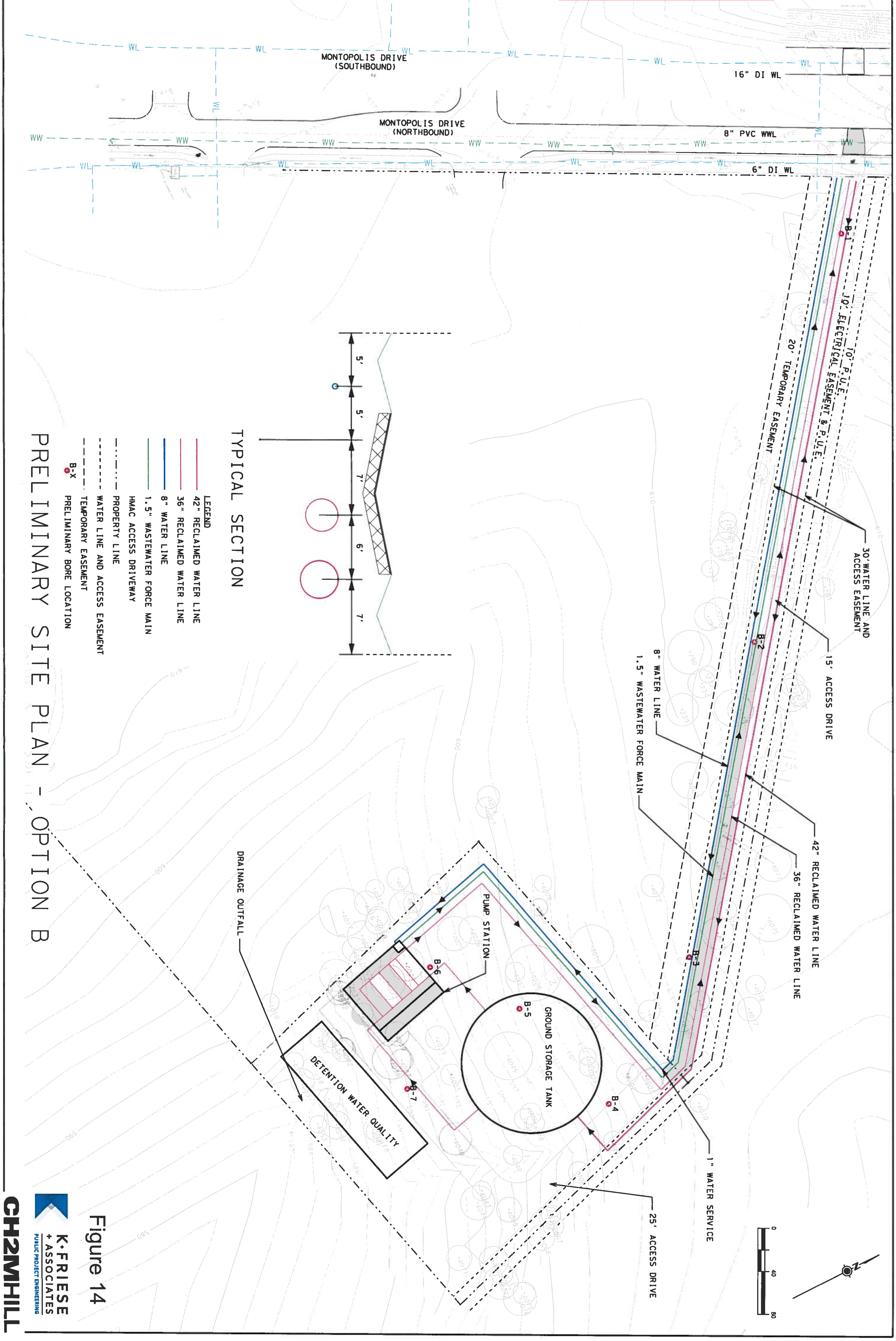
Montopolis Water Reuse Site

USGS 7.5-minute Topographic Quadrangle:
Montopolis, TX

Key to Features

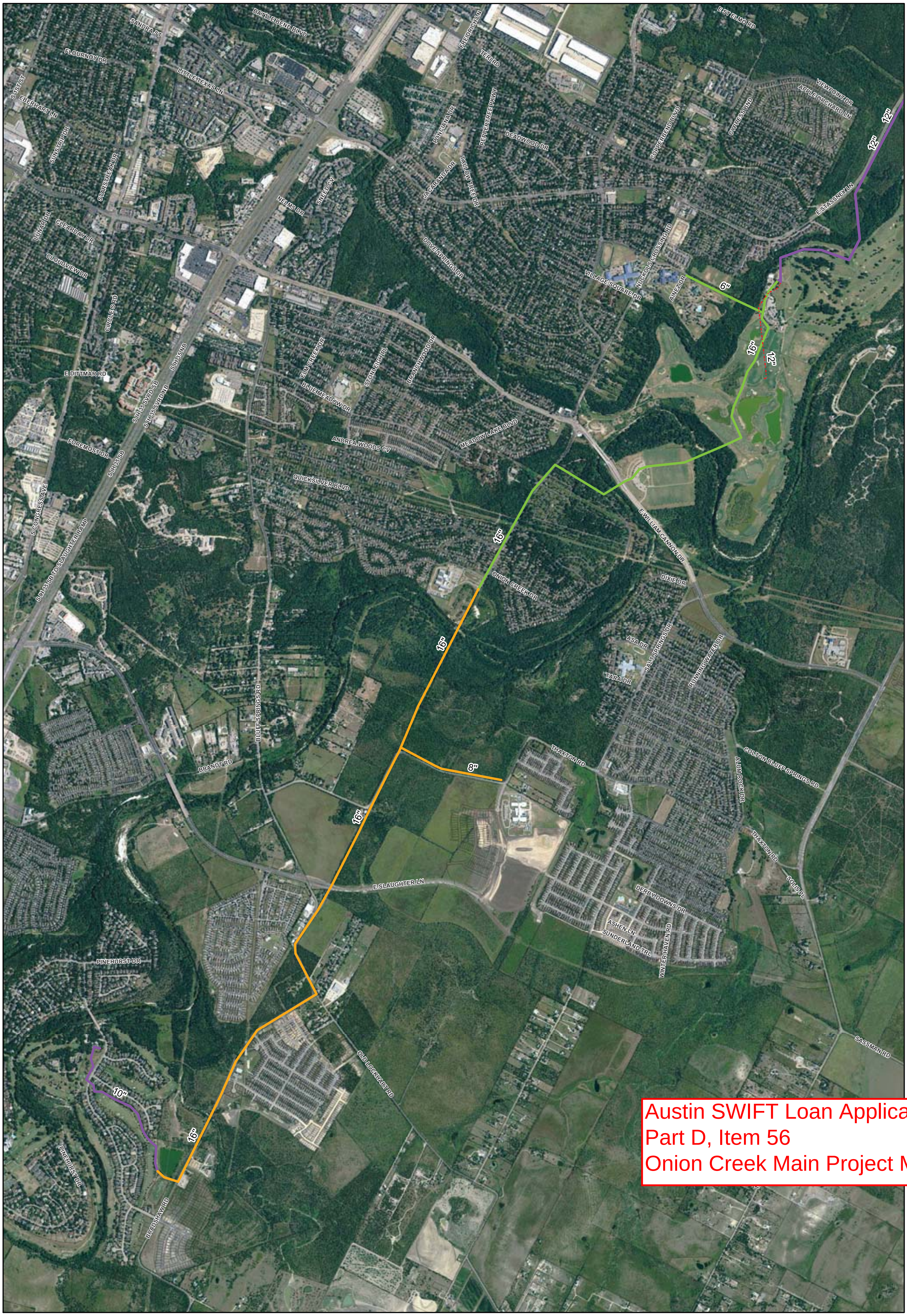
- ▭ 1.5 Mile Search Radius
- 🟩 TxNDD Occurrences
- 🟨 Water Tank Site
- 🟧 Easements

Austin SWIFT Loan Application
Part D, Item 56
Montopolis Tank Project Maps
Map 3 of 3



PRELIMINARY SITE PLAN - OPTION B

Figure 14



Austin SWIFT Loan Application
Part D, Item 56
Onion Creek Main Project Map

Reclaimed Water Mains

- Existing
- Phase 1
- Phase 2
- Private

City of Austin
Austin Water
Reclaimed Water Program

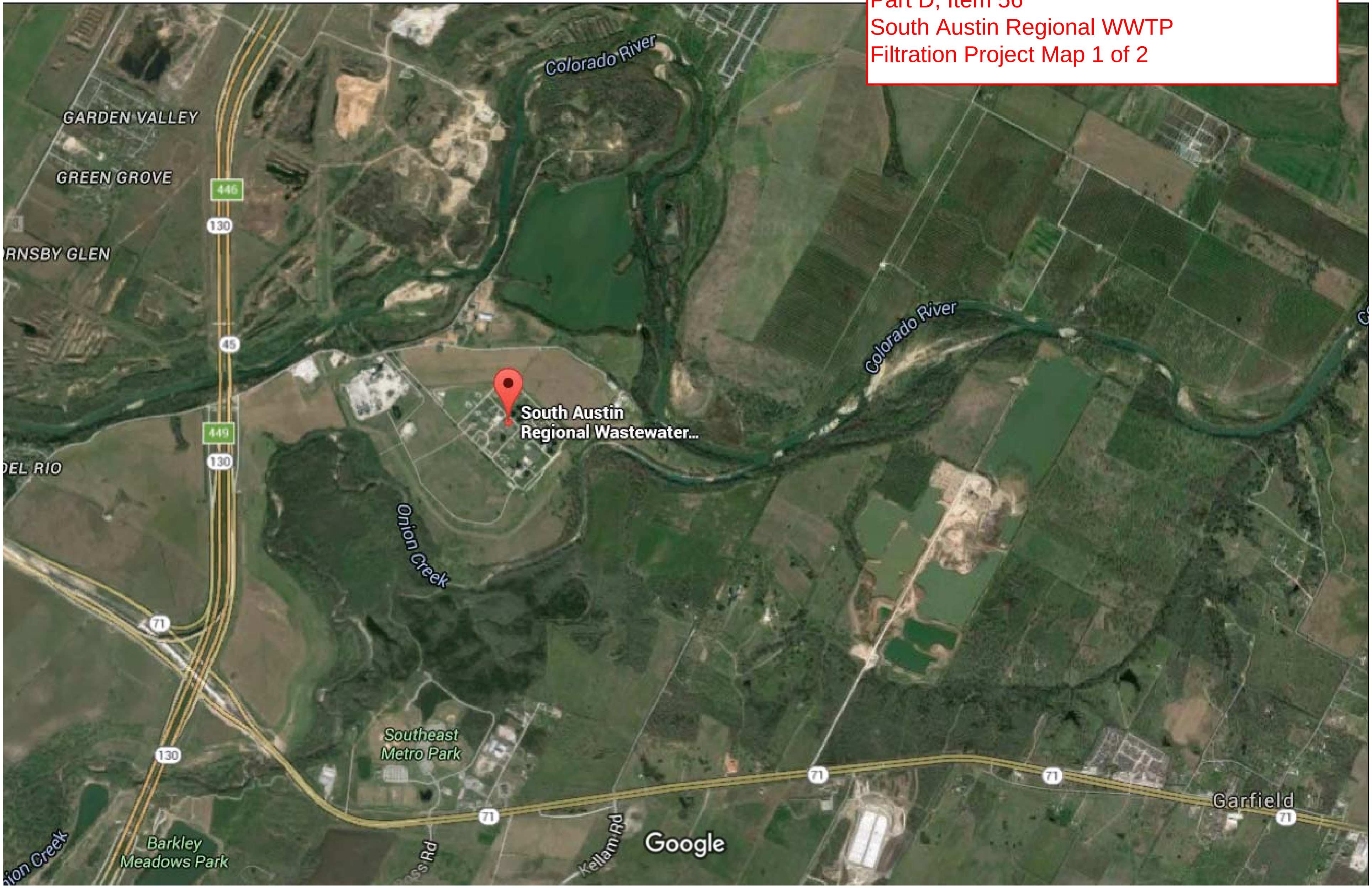
Onion Creek
Reclaimed Water Main

Produced by the Reclaimed Water Program
2/1/2016

City of Austin
Water Reclamation Program

Google Maps South Austin Regional Wastewater Treatment Plant

Austin SWIFT Loan Application
Part D, Item 56
South Austin Regional WWTP
Filtration Project Map 1 of 2



Imagery ©2016 Google, Map data ©2016 Google 2000 ft

SURVEY CONTROL POINTS:

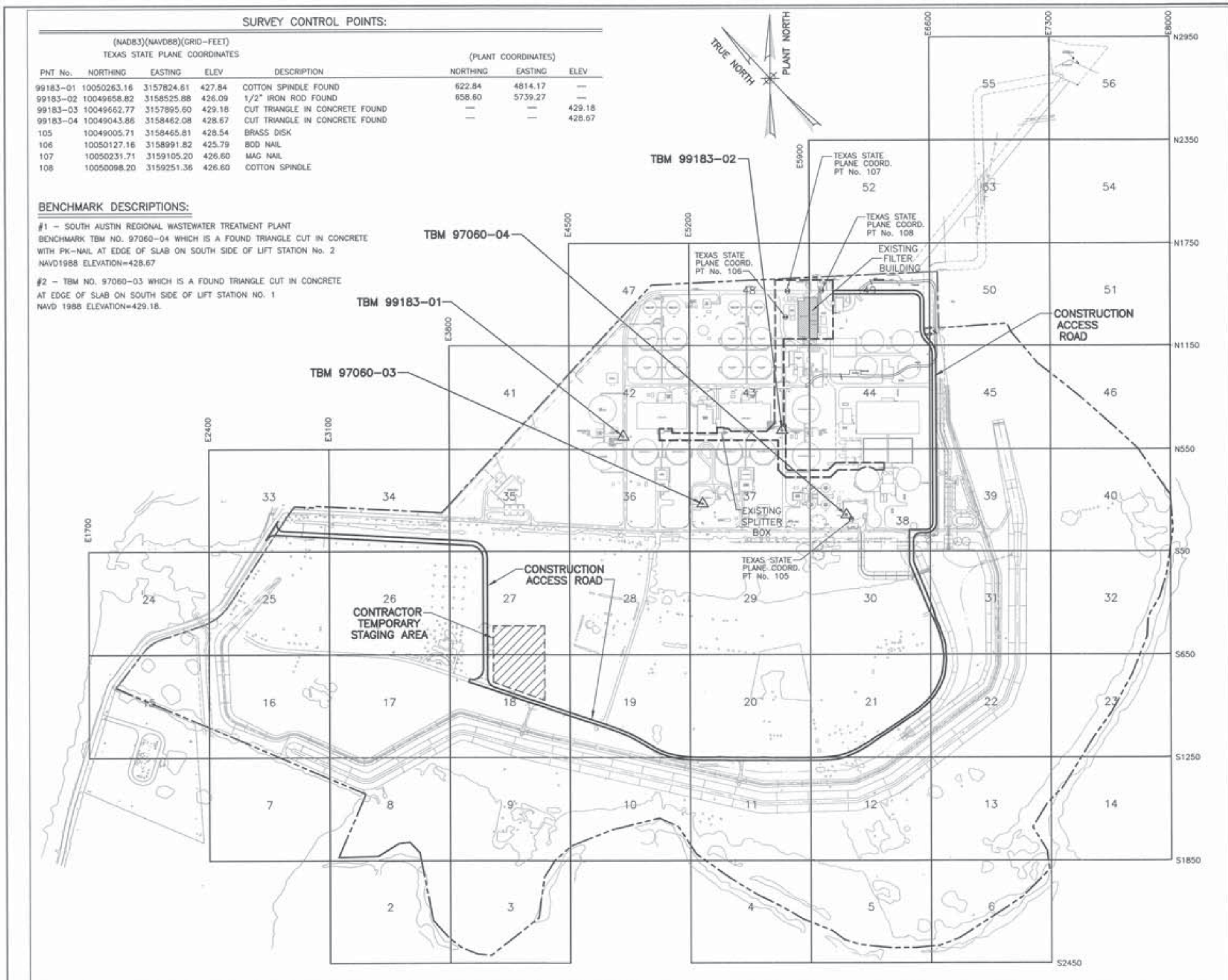
(NAD83)(NAVD88)(GRID–FEET)
TEXAS STATE PLANE COORDINATES

					(PLANT COORDINATES)		
PNT No.	NORTHING	EASTING	ELEV	DESCRIPTION	NORTHING	EASTING	ELEV
99183–01	10050263.16	3157824.61	427.84	COTTON SPINDLE FOUND	622.84	4814.17	—
99183–02	10049658.82	3158525.88	426.09	1/2" IRON ROD FOUND	658.60	5739.27	—
99183–03	10049662.77	3157895.60	429.18	CUT TRIANGLE IN CONCRETE FOUND	—	—	429.18
99183–04	10049043.86	3158462.08	428.67	CUT TRIANGLE IN CONCRETE FOUND	—	—	428.67
105	10049005.71	3158465.81	428.54	BRASS DISK			
106	10050127.16	3158991.82	425.79	80D NAIL			
107	10050231.71	3159105.20	426.60	MAG NAIL			
108	10050098.20	3159251.36	426.60	COTTON SPINDLE			

BENCHMARK DESCRIPTIONS:

#1 – SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT BENCHMARK TBM NO. 97060–04 WHICH IS A FOUND TRIANGLE CUT IN CONCRETE WITH PK–NAIL AT EDGE OF SLAB ON SOUTH SIDE OF LIFT STATION No. 2
NAVD1988 ELEVATION=428.67

#2 – TBM NO. 97060–03 WHICH IS A FOUND TRIANGLE CUT IN CONCRETE AT EDGE OF SLAB ON SOUTH SIDE OF LIFT STATION NO. 1
NAVD 1988 ELEVATION=429.18.



LEGEND

— — — ——— — — —	PROPERTY LIMITS
————————	PROJECT SHEET GRID
— — — — — — —	CONSTRUCTION LIMITS

CONSTRUCTION NOTES:

1. THE GRID SHOWN ON THIS DRAWING DIVIDES THE SAR WWTP SITE INTO GEOGRAPHIC AREAS. EACH GEOGRAPHIC AREA IS DEFINED ON A PLAN DRAWINGS. THE PLAN DRAWING NUMBER IS THE NUMBER SHOWN ON THIS DRAWING WITHIN EACH GEOGRAPHIC AREA. THE PLAN DRAWING NUMBERING CONCEPT WAS USED ON PREVIOUS PROJECT AT THE SAR WWTP AND IS CONTINUED ON THIS PROJECT.
2. PLAN DRAWINGS (RECORD DRAWINGS) OF GEOGRAPHIC AREAS ARE INCLUDED IN THIS SET OF CONSTRUCTION PLANS TO PROVIDE APPROPRIATE INFORMATION TO THE CONTRACTOR. NOTE THAT NOT ALL OF THE PLAN DRAWINGS, SHOWING THE ROUTE OF CONSTRUCTION ACCESS, ARE INCLUDED IN THIS PLAN SET.
3. CONTRACTOR SHALL USE THE CONSTRUCTION ACCESS ROUTE, SHOWN ON THIS DRAWING, TO ACCESS THE FILTER BUILDING SITE.

SURVEY NOTES:

1. ALL UNDERGROUND UTILITY LOCATIONS AS SHOWN ON THIS SURVEY PLAT ARE BASED ON FIELD INFORMATION AND ON THE MOST RECENT AND CURRENT INFORMATION PROVIDED BY THE UTILITY OWNER. THERE MAY BE OTHER PIPE LINES AND INSTALLATIONS IN THE AREA THAT ARE NOT SHOWN ON THIS PLAT. PRIOR TO ANY CONSTRUCTION OR EXCAVATION THE "ONE–CALL" SYSTEM SHOULD BE CONTACTED.
2. ALL COORDINATES AND BEARINGS REFER TO THE TEXAS STATE PLANE COORDINATE SYSTEM, CENTRAL ZONE, NORTH AMERICAN DATUM OF 1983. COMBINED SCALE FACTOR OF (0.9999600016)
3. ELEVATIONS AND CONTOURS ARE BASED ON SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT BENCHMARK TBM NO. 97060–04 WHICH IS A FOUND TRIANGLE CUT IN CONCRETE WITH PK–NAIL AT EDGE OF SLAB ON SOUTH SIDE OF LIFT STATION No. 2:
NAVD 1988 ELEVATION=428.67
AND TBM NO. 97060–03 WHICH IS A FOUND TRIANGLE CUT IN CONCRETE AT EDGE OF SLAB ON SOUTH SIDE OF LIFT STATION No. 1:
NAVD 1988 ELEVATION=429.18.

Austin SWIFT Loan Application
Part D, Item 56
SAR WWTP Filtration Project
Map 2 of 2

REV	DATE	DESCRIPTION	APPROVED

CITY OF AUSTIN

SOUTH AUSTIN REGIONAL WASTEWATER TREATMENT PLANT - FILTER IMPROVEMENTS
CIP PROJECT No. 3333.015

LOCATION KEY MAP
AND CONSTRUCTION ACCESS

AECOM
AECOM TECHNICAL SERVICES INC.
400 W 15th STREET SUITE 600
AUSTIN, TEXAS 78701
WWW.AECOM.COM
TBPE REG. NO. F-3580

JOHN N. BUSER
90881
7/31/15

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF THIS BAR DOES NOT MEASURE ONE INCH, DWG IS NOT TO SCALE

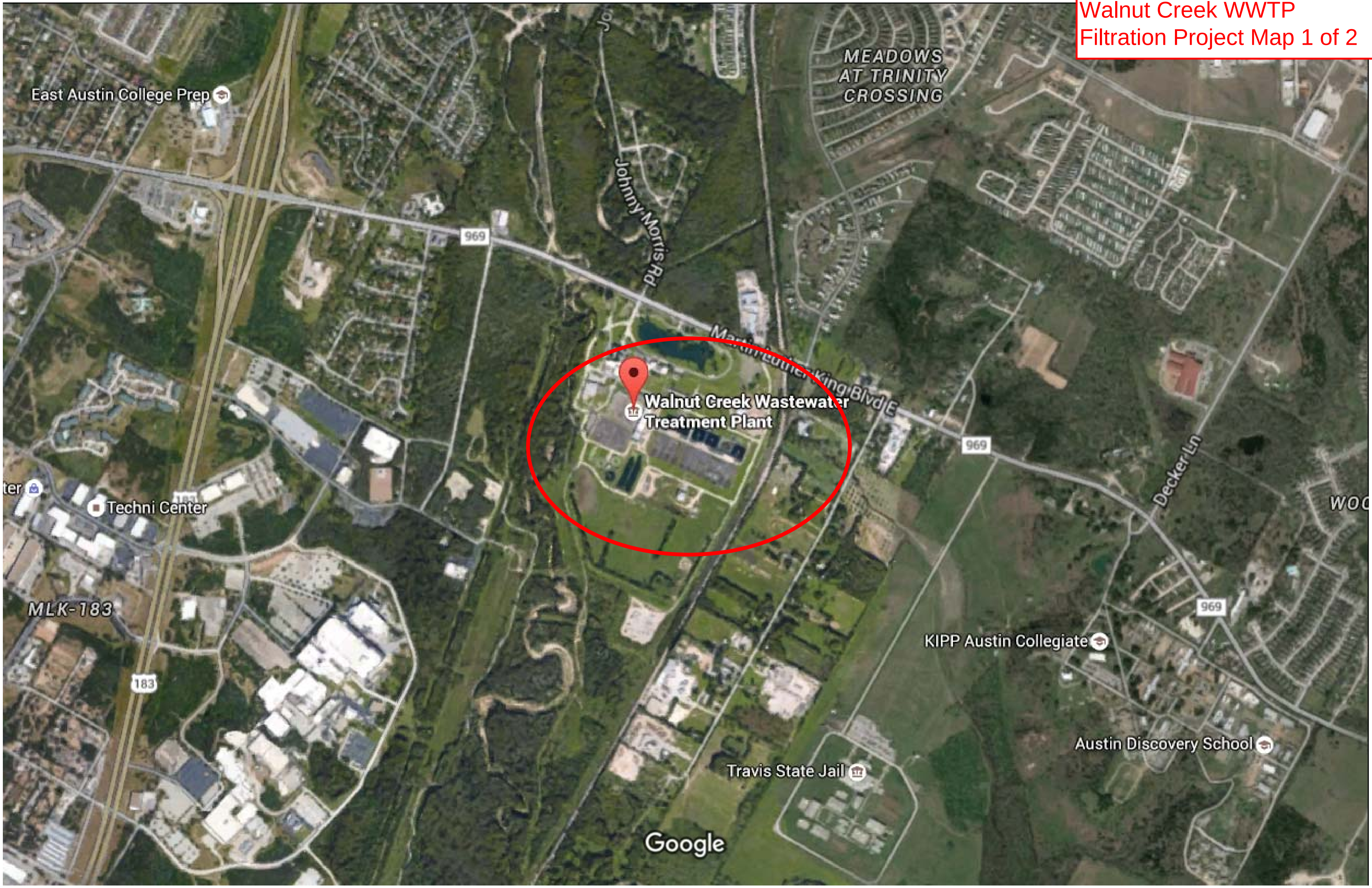
DESIGNED:	BY
DRAWN:	PW
CHECKED:	JNB
APPROVED:	SGE
SCALE:	NTS
DATE:	JULY 2015

PROJECT No. 60282054
DRAWING No. AG20
SHEET No. OF

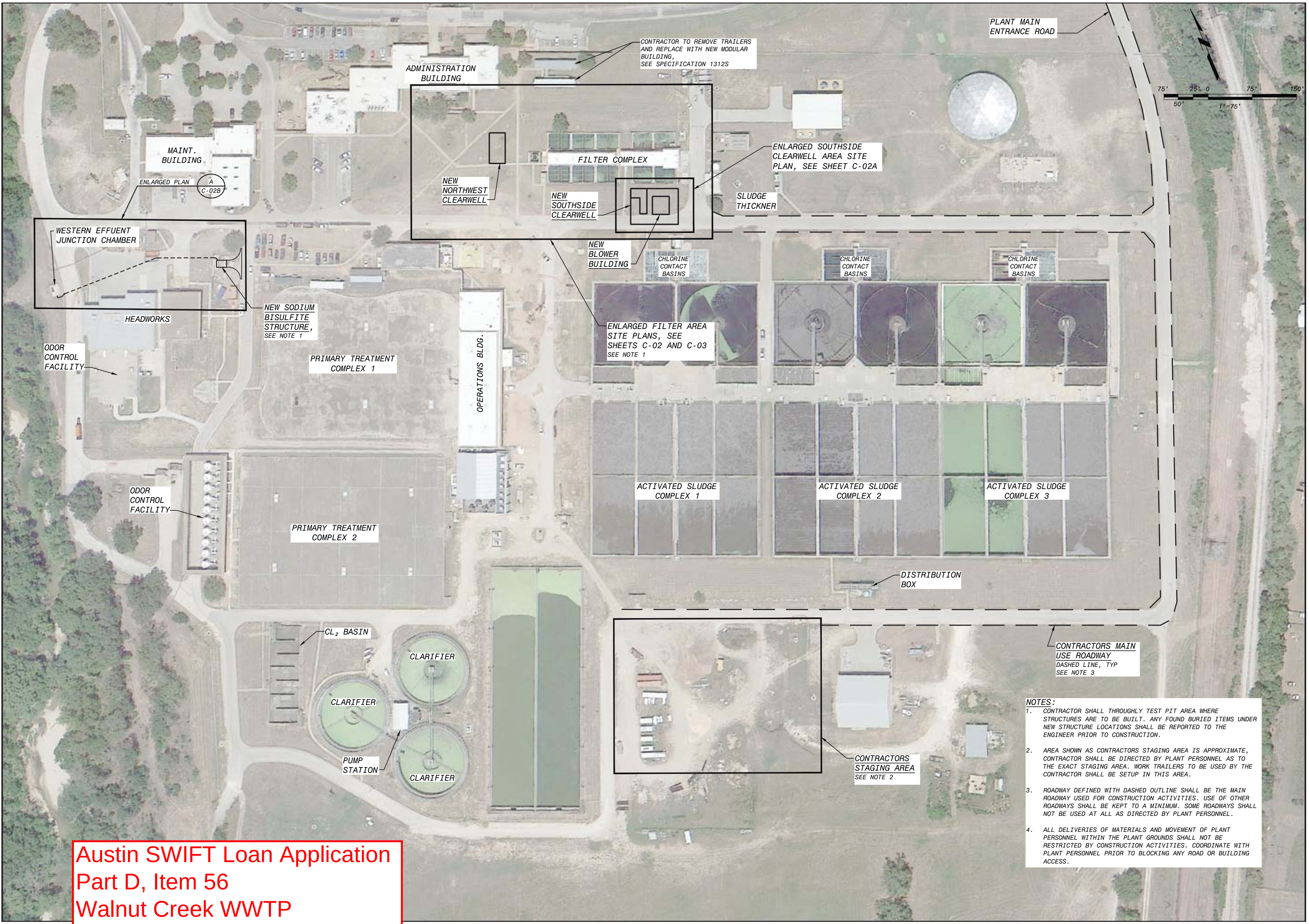
E:\60282054 SAR FILTER FINAL DESIGN & BID\400 TECHNICAL INFORMATION\423 CADD\AG20.DWG BY: NUNGARAYJ DATE: 7/28/2015 6:34 AM

Austin SWIFT Loan Application
Part D, Item 56
Walnut Creek WWTP
Filtration Project Map 1 of 2

Google Maps Walnut Creek Wastewater Treatment Plant



Imagery ©2016 Google, Map data ©2016 Google 1000 ft



NOTES:

1. CONTRACTOR SHALL THROUGHLY TEST PIT AREA WHERE STRUCTURES ARE TO BE BUILT. ANY FOUND BURIED ITEMS UNDER NEW STRUCTURE LOCATIONS SHALL BE REPORTED TO THE ENGINEER PRIOR TO CONSTRUCTION.

2. AREA SHOWN AS CONTRACTORS STAGING AREA IS APPROXIMATE, CONTRACTOR SHALL BE DIRECTED BY PLANT PERSONNEL AS TO THE EXACT STAGING AREA. WORK TRAILERS TO BE USED BY THE CONTRACTOR SHALL BE SETUP IN THIS AREA.

3. ROADWAY DEFINED WITH DASHED OUTLINE SHALL BE THE MAIN ROADWAY USED FOR CONSTRUCTION ACTIVITIES. USE OF OTHER ROADWAYS SHALL BE KEPT TO A MINIMUM. SOME ROADWAYS SHALL NOT BE USED AT ALL AS DIRECTED BY PLANT PERSONNEL.

4. ALL DELIVERIES OF MATERIALS AND MOVEMENT OF PLANT PERSONNEL WITHIN THE PLANT GROUNDS SHALL NOT BE RESTRICTED BY CONSTRUCTION ACTIVITIES. COORDINATE WITH PLANT PERSONNEL PRIOR TO BLOCKING ANY ROAD OR BUILDING ACCESS.

Austin SWIFT Loan Application
Part D, Item 56
Walnut Creek WWTP
Filtration Project Map 2 of 2

FD168622 SAVED: LER07108, 3/6/2014 6:57:13 AM
D168622 PW FOLDER ID:168622....\09.5025 - Civil Drawings
File: C:\pw_working\cngpw\d0671638\C-01.dwg Layout: Layout1 Plotted: 4/8/2014 8:13:55 AM

REVISIONS

NO.	DR	CK	DATE	DESCRIPTION

BLACK & VEATCH
Building a world of difference.
Black & Veatch Corporation
Registration No. F-258
Austin, Texas

TERESA L. SMITH-DeHESUS
111227
4/4/2014

Austin WATER
Walnut Creek WWTP - Tertiary
Filter Rehabilitation Project
CIP ID No. 3023.025

CIVIL
OVERALL SITE PLAN

DESIGNED BY:	AWL
DRAWN BY:	AWL
REVIEWED BY:	WLK
APPROVED BY:	TSD
PROJECT NO.:	168622
DATE:	4/4/2014
SCALE:	1"=75'

REVISION:

DISCIPLINE NO.
C-01

DWG. NO.
9 OF 273

Austin SWIFT Loan Application
Part D, 60 - Direct Reuse Project Budget - Revised June 1, 2016

PROJECT 51041 BUDGET - Austin Direct Reuse Projects						
Uses	**TWDB Funds Series 1**	**TWDB Funds Series 2**	**TWDB Funds Series 3**	**Total TWDB Cost**	**Other Funds**	**Total Cost**
Construction						
Construction	$66,740,577	$0	$0	$66,740,577	$0	$66,740,577
Subtotal Construction	**$66,740,577**	**$0**	**$0**	**$66,740,577**	**$0**	**$66,740,577**
Basic Engineering Fees						
Planning +	$783,390	$0	$0	$783,390	$0	$783,390
Design	$6,193,344	$0	$0	$6,193,344	$0	$6,193,344
Construction Engineering	$3,369,257	$0	$0	$3,369,257	$0	$3,369,257
Basic Engineering Other **_______________	$0	$0	$0	$0	$0	$0
Subtotal Basic Engineering Fees	**$10,345,991**	**$0**	**$0**	**$10,345,991**	**$0**	**$10,345,991**
Special Services						
Application	$0	$0	$0	$0	$0	$0
Environmental	$0	$0	$0	$0	$0	$0
Water Conservation Plan	$0	$0	$0	$0	$0	$0
I/I Studies/Sewer Evaluation	$0	$0	$0	$0	$0	$0
Surveying	$19,813	$0	$0	$19,813	$0	$19,813
Geotechnical	$329,064	$0	$0	$329,064	$0	$329,064
Testing	$455,000	$0	$0	$455,000	$0	$455,000
Permits	$30,539	$0	$0	$30,539	$0	$30,539
Inspection	$725,000	$0	$0	$725,000	$0	$725,000
O&M Manual	$50,000	$0	$0	$50,000	$0	$50,000
Project Management (by engineer)	$550,000	$0	$0	$550,000	$0	$550,000
Pilot Testing	$0	$0	$0	$0	$0	$0
Water Distribution Modeling	$0	$0	$0	$0	$0	$0
Special Services Other **___________	$15,000	$0	$0	$15,000	$0	$15,000
Subtotal Special Services	**$2,174,416**	**$0**	**$0**	**$2,174,416**	**$0**	**$2,174,416**
Other						
Administration	$0	$0	$0	$0	$0	$0
Land/Easements Acquisition	$0	$0	$0	$0	$0	$0
Water Rights Purchase (If Applicable)	$0	$0	$0	$0	$0	$0
Capacity Buy-In (If Applicable)	$0	$0	$0	$0	$0	$0
Project Legal Expenses	$0	$0	$0	$0	$0	$0
Other **	$0	$0	$0	$0	$0	$0
Subtotal Other Services	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**
Fiscal Services						
Financial Advisor	$103,581	$0	$0	$103,581	$0	$103,581
Bond Counsel	$86,980	$0	$0	$86,980	$0	$86,980
Issuance Cost	$9,500	$0	$0	$9,500	$0	$9,500
Bond Insurance/Surety	$0	$0	$0	$0	$0	$0
Fiscal/Legal	$0	$0	$0	$0	$0	$0
Capitalized Interest	$0	$0	$0	$0	$0	$0
Bond Reserve Fund	$5,250,000	$0	$0	$5,250,000	$0	$5,250,000
Loan Origination Fee	$0	$0	$0	$0	$0	$0
Other **	$0	$0	$0	$0	$0	$0
Subtotal Fiscal Services	**$5,450,061**	**$0**	**$0**	**$5,450,061**	**$0**	**$5,450,061**
Contingency						
Contingency	$2,268,955	$0	$0	$2,268,955	$0	$2,268,955
Subtotal Contingency	**$2,268,955**	**$0**	**$0**	**$2,268,955**	**$0**	**$2,268,955**
TOTAL COSTS	**$86,980,000**	**$0**	**$0**	**$86,980,000**	**$0**	**$86,980,000**

Austin SWIFT Loan Application
Part D, Item 61
Direct Reuse Projects

WRD-253d
05/18/2010

Texas Water Development Board
Water Project Information

A. Project Name Austin Direct Reuse	B. Project No.	C. County Travis	D. Regional Planning Group (A-P) K
E. Program(s) SWIFT	F. Loan ☒ / Grant ☐ Amount: $86,980,456	G. Loan Term: 20 years	

H. Water Project Description: (Multiphase project, new or expansion; plant, well, storage, pump station, distribution system, etc)

Expand and enhance Austin's reclaimed water system infrastructure through multiple projects

Attach map of service area affected by Project or other documentation.

I. Is an Inter Basin Transfer potentially involved?

Yes ☐ No ☒

J. Is project located in a Groundwater District (If yes, identify District by name)?

Yes ☒ Barton Springs Edwards Aquifer Conservation District No ☐

K. Projected Population from application for at least a 20 year period. Attach justification and list service area populations if different from Planning Area.	Year	Reference Year	2010	2020	2030	2040	
	Population Projection	retail customers only		980,787	1,158,346	1,334,861	

Project Design Year	2011 through 2018	Design Population	1,158,346

L. Is the proposed project included in a current Regional Water Plan? Yes ☒ No ☐ Don't Know ☐
(If Yes, please specify on what page in the Regional Water Plan - Regional Water Plan Page Number: 5-54 and 5-55

M. What type of water source is associated directly with the proposed project? Surface Water ☒ Groundwater ☐ Reuse ☒

N. Will the project increase the volume of water supply? Yes ☒ No ☐

O. What volume of water is the project anticipated to deliver/ treat per year? 38,429 Acre-Feet/Year

anticipated annual demand by 2070

P. Current Water Supply Information

Surface Water Supply Source / Provider Names	Certificate No.	Source County	Annual Volume and Unit
Lower Colorado River/LCRA	14-5471	Travis	137,000 acre feet
Groundwater Source Aquifer	**Well Field location**	**Source County**	**Annual Volume and Unit**
Not Applicable - surface water sources only	Not Applicable	Not Applicable	Not Applicable

Q. Proposed Water Supply Associated Directly with the Proposed Project

Surface Water Supply Source / Provider Names	Certificate No.	Source County	Annual Volume and Unit
Lower Colorado River/LCRA	14-5471	Travis	137,000 acre feet
Groundwater Source Aquifer	**Well Field location:**	**Source County**	**Annual Volume and Unit**
Not Applicable - surface water sources only	Not Applicable	Not Applicable	Not Applicable

R. Consulting Engineer Name Chris Chen, PE (Austin Water)	Telephone No. 512-972-0240	E-mail address chris.chen@austintexas.gov
S. Applicant Contact Name, Title Heather Cooke, Legislative Coordinator	Telephone No. 512-972-0083	E-mail address heather.cooke@austintexas.gov

Austin SWIFT Loan Application
Part D, Item 62
South Austin Regional WWTP TPDES Permit

TPDES PERMIT NO.
WQ0010543012
[For TCEQ office use only - EPA I.D. No. TX0071889]

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. Box 13087
Austin, Texas 78711-3087

This is a renewal that replaces TPDES Permit No. WQ0010543012 issued on April 1, 2010.

PERMIT TO DISCHARGE WASTES
under provisions of
Section 402 of the Clean Water Act
and Chapter 26 of the Texas Water Code

City of Austin

whose mailing address is

c/o Director
Austin Water Utility
P. O. Box 1088
Austin, Texas 78767

is authorized to treat and discharge wastes from the South Austin Regional Wastewater Treatment Facility, SIC Code 4952

located at 13009 Fallwell Lane, Del Valle, in Travis County, Texas 78617

directly to the Colorado River Below Lady Bird Lake (formerly Town Lake) in Segment No. 1428 of the Colorado River Basin

only according to effluent limitations, monitoring requirements, and other conditions set forth in this permit, as well as the rules of the Texas Commission on Environmental Quality (TCEQ), the laws of the State of Texas, and other orders of the TCEQ. The issuance of this permit does not grant to the permittee the right to use private or public property for conveyance of wastewater along the discharge route described in this permit. This includes, but is not limited to, property belonging to any individual, partnership, corporation, or other entity. Neither does this permit authorize any invasion of personal rights nor any violation of federal, state, or local laws or regulations. It is the responsibility of the permittee to acquire property rights as may be necessary to use the discharge route.

This permit shall expire at midnight, **September 1, 2019**.

ISSUED DATE: May 29, 2015

For the Commission

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning upon the date of issuance and lasting through date of expiration the permittee is authorized to discharge subject to the following effluent limitations:

   The annual average flow of effluent shall not exceed 75.0 million gallons per day (MGD), nor shall the average discharge during any two-hour period (2-hour peak) exceed 150,000 gallons per minute (gpm).

Effluent Characteristic	Discharge Limitations				Min. Self-Monitoring Requirements	
	Daily Avg mg/l (lbs/day)	7-day Avg mg/l	Daily Max mg/l	Single Grab mg/l	Report Daily Avg. & Daily Max. Measurement Frequency	Sample Type
Flow, MGD	Report	N/A	Report	N/A	Continuous	Totalizing Meter
Carbonaceous Biochemical Oxygen Demand (5-day)	10 (6,255)	15	25	35	One/day	Composite
Total Suspended Solids	15 (9,383)	25	40	60	One/day	Composite
Ammonia Nitrogen	2 (1,251)	5	10	15	One/day	Composite
E. coli, CFU or MPN/100 ml	126	N/A	399	N/A	Five/week	Grab

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l after a detention time of at least 20 minutes (based on peak flow) and shall be monitored daily by grab sample at each chlorination chamber. The permittee shall dechlorinate the chlorinated effluent to less than 0.1 mg/l chlorine residual and shall monitor chlorine residual daily by grab sample after the dechlorination process. An equivalent method of disinfection may be substituted only with prior approval of the Executive Director.

3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per day by grab sample.

4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.

5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit.

6. The effluent shall contain a minimum dissolved oxygen of 6.0 mg/l and shall be monitored once per day by grab sample.

7. The annual average flow and maximum 2-hour peak flow shall be reported monthly.

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 30 Texas Administrative Code (TAC) Chapter 305, certain regulations appear as standard conditions in waste discharge permits. 30 TAC § 305.121 - 305.129 (relating to Permit Characteristics and Conditions) as promulgated under the Texas Water Code (TWC) §§ 5.103 and 5.105, and the Texas Health and Safety Code (THSC) §§ 361.017 and 361.024(a), establish the characteristics and standards for waste discharge permits, including sewage sludge, and those sections of 40 Code of Federal Regulations (CFR) Part 122 adopted by reference by the Commission. The following text includes these conditions and incorporates them into this permit. All definitions in TWC § 26.001 and 30 TAC Chapter 305 shall apply to this permit and are incorporated by reference. Some specific definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

   a. Annual average flow - the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months. The annual average flow determination shall consist of daily flow volume determinations made by a totalizing meter, charted on a chart recorder and limited to major domestic wastewater discharge facilities with one million gallons per day or greater permitted flow.

   b. Daily average flow - the arithmetic average of all determinations of the daily flow within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily flow, the determination shall be the arithmetic average of all instantaneous measurements taken during that month. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

   c. Daily maximum flow - the highest total flow for any 24-hour period in a calendar month.

   d. Instantaneous flow - the measured flow during the minimum time required to interpret the flow measuring device.

   e. 2-hour peak flow (domestic wastewater treatment plants) - the maximum flow sustained for a two-hour period during the period of daily discharge. The average of multiple measurements of instantaneous maximum flow within a two-hour period may be used to calculate the 2-hour peak flow.

   f. Maximum 2-hour peak flow (domestic wastewater treatment plants) - the highest 2-hour peak flow for any 24-hour period in a calendar month.

2. Concentration Measurements

   a. Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar month, consisting of at least four separate representative measurements.

      i. For domestic wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values in the previous four consecutive month period consisting of at least four measurements shall be utilized as the daily average concentration.

    ii. For all other wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.

b. 7-day average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar week, Sunday through Saturday.

c. Daily maximum concentration - the maximum concentration measured on a single day, by the sample type specified in the permit, within a period of one calendar month.

d. Daily discharge - the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the sampling day.

   The daily discharge determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily discharge determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that day.

e. Bacteria concentration (*E. coli* or Enterococci) - Colony Forming Units (CFU) or Most Probable Number (MPN) of bacteria per 100 milliliters effluent. The daily average bacteria concentration is a geometric mean of the values for the effluent samples collected in a calendar month. The geometric mean shall be determined by calculating the nth root of the product of all measurements made in a calendar month, where n equals the number of measurements made; or, computed as the antilogarithm of the arithmetic mean of the logarithms of all measurements made in a calendar month. For any measurement of bacteria equaling zero, a substituted value of one shall be made for input into either computation method. If specified, the 7-day average for bacteria is the geometric mean of the values for all effluent samples collected during a calendar week.

f. Daily average loading (lbs/day) - the arithmetic average of all daily discharge loading calculations during a period of one calendar month. These calculations must be made for each day of the month that a parameter is analyzed. The daily discharge, in terms of mass (lbs/day), is calculated as (Flow, MGD x Concentration, mg/l x 8.34).

g. Daily maximum loading (lbs/day) - the highest daily discharge, in terms of mass (lbs/day), within a period of one calendar month.

3. Sample Type

a. Composite sample - For domestic wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (a). For industrial wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (b).

b. Grab sample - an individual sample collected in less than 15 minutes.

4. Treatment Facility (facility) - wastewater facilities used in the conveyance, storage, treatment, recycling, reclamation and/or disposal of domestic sewage, industrial wastes, agricultural wastes, recreational wastes, or other wastes including sludge handling or disposal facilities under the jurisdiction of the Commission.

5. The term "sewage sludge" is defined as solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in 30 TAC Chapter 312. This includes the solids that have not been classified as hazardous waste separated from wastewater by unit processes.

6. Bypass - the intentional diversion of a waste stream from any portion of a treatment facility.

MONITORING AND REPORTING REQUIREMENTS

1. Self-Reporting

   Monitoring results shall be provided at the intervals specified in the permit. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 30 TAC §§ 319.4 - 319.12. Unless otherwise specified, a monthly effluent report shall be submitted each month, to the Enforcement Division (MC 224), by the 20th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month. Monitoring results must be reported on an approved self-report form that is signed and certified as required by Monitoring and Reporting Requirements No. 10.

   As provided by state law, the permittee is subject to administrative, civil and criminal penalties, as applicable, for negligently or knowingly violating the Clean Water Act (CWA); TWC §§ 26, 27, and 28; and THSC § 361, including but not limited to knowingly making any false statement, representation, or certification on any report, record, or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, or falsifying, tampering with or knowingly rendering inaccurate any monitoring device or method required by this permit or violating any other requirement imposed by state or federal regulations.

2. Test Procedures

   a. Unless otherwise specified in this permit, test procedures for the analysis of pollutants shall comply with procedures specified in 30 TAC §§ 319.11 - 319.12. Measurements, tests, and calculations shall be accurately accomplished in a representative manner.

   b. All laboratory tests submitted to demonstrate compliance with this permit must meet the requirements of 30 TAC § 25, Environmental Testing Laboratory Accreditation and Certification.

3. Records of Results

   a. Monitoring samples and measurements shall be taken at times and in a manner so as to be representative of the monitored activity.

   b. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503), monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by this permit, records of all data used to complete the application for this permit, and the certification required by 40 CFR § 264.73(b)(9) shall be retained at the facility site, or shall be readily available for review by a TCEQ representative for a period of three years from the date of the record or sample, measurement, report, application or certification. This period shall be extended at the request of the Executive Director.

c. Records of monitoring activities shall include the following:

  i. date, time and place of sample or measurement;

  ii. identity of individual who collected the sample or made the measurement.

  iii. date and time of analysis;

  iv. identity of the individual and laboratory who performed the analysis;

  v. the technique or method of analysis; and

  vi. the results of the analysis or measurement and quality assurance/quality control records.

The period during which records are required to be kept shall be automatically extended to the date of the final disposition of any administrative or judicial enforcement action that may be instituted against the permittee.

4. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, all results of such monitoring shall be included in the calculation and reporting of the values submitted on the approved self-report form. Increased frequency of sampling shall be indicated on the self-report form.

5. Calibration of Instruments

All automatic flow measuring or recording devices and all totalizing meters for measuring flows shall be accurately calibrated by a trained person at plant start-up and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the Executive Director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be retained at the facility site and/or shall be readily available for review by a TCEQ representative for a period of three years.

6. Compliance Schedule Reports

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date to the Regional Office and the Enforcement Division (MC 224).

7. Noncompliance Notification

a. In accordance with 30 TAC § 305.125(9) any noncompliance which may endanger human health or safety, or the environment shall be reported by the permittee to the TCEQ. Report of such information shall be provided orally or by facsimile transmission (FAX) to the Regional Office within 24 hours of becoming aware of the noncompliance. A written submission of such information shall also be provided by the permittee to the Regional Office and the Enforcement Division (MC 224) within five working days of becoming aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

b. The following violations shall be reported under Monitoring and Reporting Requirement 7.a.:

   i. Unauthorized discharges as defined in Permit Condition 2(g).

   ii. Any unanticipated bypass that exceeds any effluent limitation in the permit.

   iii. Violation of a permitted maximum daily discharge limitation for pollutants listed specifically in the Other Requirements section of an Industrial TPDES permit.

c. In addition to the above, any effluent violation which deviates from the permitted effluent limitation by more than 40% shall be reported by the permittee in writing to the Regional Office and the Enforcement Division (MC 224) within 5 working days of becoming aware of the noncompliance.

d. Any noncompliance other than that specified in this section, or any required information not submitted or submitted incorrectly, shall be reported to the Enforcement Division (MC 224) as promptly as possible. For effluent limitation violations, noncompliances shall be reported on the approved self-report form.

8. In accordance with the procedures described in 30 TAC §§ 35.301 - 35.303 (relating to Water Quality Emergency and Temporary Orders) if the permittee knows in advance of the need for a bypass, it shall submit prior notice by applying for such authorization.

9. Changes in Discharges of Toxic Substances

All existing manufacturing, commercial, mining, and silvicultural permittees shall notify the Regional Office, orally or by facsimile transmission within 24 hours, and both the Regional Office and the Enforcement Division (MC 224) in writing within five (5) working days, after becoming aware of or having reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant listed at 40 CFR Part 122, Appendix D, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following “notification levels”:

  - i. One hundred micrograms per liter (100 µg/L);
  - ii. Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
  - iii. Five (5) times the maximum concentration value reported for that pollutant in the permit application; or
  - iv. The level established by the TCEQ.

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

  - i. Five hundred micrograms per liter (500 µg/L);
  - ii. One milligram per liter (1 mg/L) for antimony;
  - iii. Ten (10) times the maximum concentration value reported for that pollutant in the permit application; or
  - iv. The level established by the TCEQ. .

10. Signatories to Reports

All reports and other information requested by the Executive Director shall be signed by the person and in the manner required by 30 TAC § 305.128 (relating to Signatories to Reports).

11. All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Executive Director of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to CWA § 301 or § 306 if it were directly discharging those pollutants;

b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit; and

c. For the purpose of this paragraph, adequate notice shall include information on:

  - i. The quality and quantity of effluent introduced into the POTW; and
  - ii. Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

PERMIT CONDITIONS

1. General

a. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in an application or in any report to the Executive Director, it shall promptly submit such facts or information.

b. This permit is granted on the basis of the information supplied and representations made by the permittee during action on an application, and relying upon the accuracy and completeness of that information and those representations. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked, in whole or in part, in accordance with 30 TAC Chapter 305, Subchapter D, during its term for good cause including, but not limited to, the following:

   i. Violation of any terms or conditions of this permit;

   ii. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

   iii. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

c. The permittee shall furnish to the Executive Director, upon request and within a reasonable time, any information to determine whether cause exists for amending, revoking, suspending or terminating the permit. The permittee shall also furnish to the Executive Director, upon request, copies of records required to be kept by the permit.

2. Compliance

a. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment and agreement that such person will comply with all the terms and conditions embodied in the permit, and the rules and other orders of the Commission.

b. The permittee has a duty to comply with all conditions of the permit. Failure to comply with any permit condition constitutes a violation of the permit and the Texas Water Code or the Texas Health and Safety Code, and is grounds for enforcement action, for permit amendment, revocation, or suspension, or for denial of a permit renewal application or an application for a permit for another facility.

c. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

d. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal or other permit violation that has a reasonable likelihood of adversely affecting human health or the environment.

e. Authorization from the Commission is required before beginning any change in the permitted facility or activity that may result in noncompliance with any permit requirements.

f. A permit may be amended, suspended and reissued, or revoked for cause in accordance with 30 TAC §§ 305.62 and 305.66 and TWC§ 7.302. The filing of a request by the permittee for a permit amendment, suspension and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

g. There shall be no unauthorized discharge of wastewater or any other waste. For the purpose of this permit, an unauthorized discharge is considered to be any discharge of wastewater into or adjacent to water in the state at any location not permitted as an outfall or otherwise defined in the Other Requirements section of this permit.

h. In accordance with 30 TAC § 305.535(a), the permittee may allow any bypass to occur from a TPDES permitted facility which does not cause permitted effluent limitations to be exceeded or an unauthorized discharge to occur, but only if the bypass is also for essential maintenance to assure efficient operation.

i. The permittee is subject to administrative, civil, and criminal penalties, as applicable, under TWC §§ 7.051 - 7.075 (relating to Administrative Penalties), 7.101 - 7.111 (relating to Civil Penalties), and 7.141 - 7.202 (relating to Criminal Offenses and Penalties) for violations including, but not limited to, negligently or knowingly violating the federal CWA §§ 301, 302, 306, 307, 308, 318, or 405, or any condition or limitation implementing any sections in a permit issued under the CWA § 402, or any requirement imposed in a pretreatment program approved under the CWA §§ 402 (a)(3) or 402 (b)(8).

3. Inspections and Entry

a. Inspection and entry shall be allowed as prescribed in the TWC Chapters 26, 27, and 28, and THSC § 361.

b. The members of the Commission and employees and agents of the Commission are entitled to enter any public or private property at any reasonable time for the purpose of inspecting and investigating conditions relating to the quality of water in the state or the compliance with any rule, regulation, permit or other order of the Commission. Members, employees, or agents of the Commission and Commission contractors are entitled to enter public or private property at any reasonable time to investigate or monitor or, if the responsible party is not responsive or there is an immediate danger to public health or the environment, to remove or remediate a condition related to the quality of water in the state. Members, employees, Commission contractors, or agents acting under this authority who enter private property shall observe the establishment's rules and regulations concerning safety, internal security, and fire protection, and if the property has management in residence, shall notify management or the person then in charge of his presence and shall exhibit proper credentials. If any member, employee, Commission contractor, or agent is refused the right to enter in or on public or private property under this authority, the Executive Director may invoke the remedies authorized in TWC § 7.002. The statement above, that Commission entry shall occur in accordance with an establishment's rules and regulations concerning safety, internal security, and fire protection, is not grounds for denial or restriction of entry to any part of the facility, but merely describes the Commission's duty to observe appropriate rules and regulations during an inspection.

4. Permit Amendment and/or Renewal

a. The permittee shall give notice to the Executive Director as soon as possible of any planned physical alterations or additions to the permitted facility if such alterations or additions would require a permit amendment or result in a violation of permit requirements. Notice shall also be required under this paragraph when:

i. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in accordance with 30 TAC § 305.534 (relating to New Sources and New Dischargers); or

ii. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are subject neither to effluent limitations in the permit, nor to notification requirements in Monitoring and Reporting Requirements No. 9;

iii. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

b. Prior to any facility modifications, additions, or expansions that will increase the plant capacity beyond the permitted flow, the permittee must apply for and obtain proper authorization from the Commission before commencing construction.

c. The permittee must apply for an amendment or renewal at least 180 days prior to expiration of the existing permit in order to continue a permitted activity after the expiration date of the permit. If an application is submitted prior to the expiration date of the permit, the existing permit shall remain in effect until the application is approved, denied, or returned. If the application is returned or denied, authorization to continue such activity shall terminate upon the effective date of the action. If an application is not submitted prior to the expiration date of the permit, the permit shall expire and authorization to continue such activity shall terminate.

d. Prior to accepting or generating wastes which are not described in the permit application or which would result in a significant change in the quantity or quality of the existing discharge, the permittee must report the proposed changes to the Commission. The permittee must apply for a permit amendment reflecting any necessary changes in permit conditions, including effluent limitations for pollutants not identified and limited by this permit.

e. In accordance with the TWC § 26.029(b), after a public hearing, notice of which shall be given to the permittee, the Commission may require the permittee, from time to time, for good cause, in accordance with applicable laws, to conform to new or additional conditions.

f. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under CWA § 307(a) for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition. The permittee shall comply with effluent standards or prohibitions established under CWA § 307(a) for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Permit Transfer

a. Prior to any transfer of this permit, Commission approval must be obtained. The Commission shall be notified in writing of any change in control or ownership of facilities authorized by this permit. Such notification should be sent to the Applications Review and Processing Team (MC 148) of the Water Quality Division.

b. A permit may be transferred only according to the provisions of 30 TAC § 305.64 (relating to Transfer of Permits) and 30 TAC § 50.133 (relating to Executive Director Action on Application or WQMP update).

6. Relationship to Hazardous Waste Activities

This permit does not authorize any activity of hazardous waste storage, processing, or disposal that requires a permit or other authorization pursuant to the Texas Health and Safety Code.

7. Relationship to Water Rights

Disposal of treated effluent by any means other than discharge directly to water in the state must be specifically authorized in this permit and may require a permit pursuant to TWC Chapter 11.

8. Property Rights

A permit does not convey any property rights of any sort, or any exclusive privilege.

9. Permit Enforceability

The conditions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Relationship to Permit Application

The application pursuant to which the permit has been issued is incorporated herein; provided, however, that in the event of a conflict between the provisions of this permit and the application, the provisions of the permit shall control.

11. Notice of Bankruptcy

a. Each permittee shall notify the Executive Director, in writing, immediately following the filing of a voluntary or involuntary petition for bankruptcy under any chapter of Title 11 (Bankruptcy) of the United States Code (11 USC) by or against:

   i. the permittee;

   ii. an entity (as that term is defined in 11 USC, § 101(14)) controlling the permittee or listing the permit or permittee as property of the estate; or

   iii. an affiliate (as that term is defined in 11 USC, § 101(2)) of the permittee.

b. This notification must indicate:

   i. the name of the permittee and the permit number(s);

   ii. the bankruptcy court in which the petition for bankruptcy was filed; and

   iii. the date of filing of the petition.

OPERATIONAL REQUIREMENTS

1. The permittee shall at all times ensure that the facility and all of its systems of collection, treatment, and disposal are properly operated and maintained. This includes, but is not limited to, the regular, periodic examination of wastewater solids within the treatment plant by the operator in order to maintain an appropriate quantity and quality of solids inventory as described in the various operator training manuals and according to accepted industry standards for process control. Process control, maintenance, and operations records shall be retained at the facility site, or shall be readily available for review by a TCEQ representative, for a period of three years.

2. Upon request by the Executive Director, the permittee shall take appropriate samples and provide proper analysis in order to demonstrate compliance with Commission rules. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall comply with all applicable provisions of 30 TAC Chapter 312 concerning sewage sludge use and disposal and 30 TAC §§ 319.21 - 319.29 concerning the discharge of certain hazardous metals.

3. Domestic wastewater treatment facilities shall comply with the following provisions:

    a. The permittee shall notify the Municipal Permits Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, in writing, of any facility expansion at least 90 days prior to conducting such activity.

    b. The permittee shall submit a closure plan for review and approval to the Municipal Permits Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, for any closure activity at least 90 days prior to conducting such activity. Closure is the act of permanently taking a waste management unit or treatment facility out of service and includes the permanent removal from service of any pit, tank, pond, lagoon, surface impoundment and/or other treatment unit regulated by this permit.

4. The permittee is responsible for installing prior to plant start-up, and subsequently maintaining, adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures by means of alternate power sources, standby generators, and/or retention of inadequately treated wastewater.

5. Unless otherwise specified, the permittee shall provide a readily accessible sampling point and, where applicable, an effluent flow measuring device or other acceptable means by which effluent flow may be determined.

6. The permittee shall remit an annual water quality fee to the Commission as required by 30 TAC Chapter 21. Failure to pay the fee may result in revocation of this permit under TWC § 7.302(b)(6).

7. Documentation

    For all written notifications to the Commission required of the permittee by this permit, the permittee shall keep and make available a copy of each such notification under the same conditions as self-monitoring data are required to be kept and made available. Except for information required for TPDES permit applications, effluent data, including effluent data in permits, draft permits and permit applications, and other information specified as not confidential in 30 TAC §§ 1.5(d), any information submitted pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted in the manner prescribed in the application form or by stamping the words confidential business information on each page containing such information. If no claim is made at the time of submission, information may be made available to the public without further notice. If the Commission or Executive Director agrees with the designation of confidentiality, the TCEQ will not provide the information for public inspection unless required by the Texas Attorney General or a court pursuant to an open records request. If the Executive Director does not agree with the designation of confidentiality, the person submitting the information will be notified.

8. Facilities that generate domestic wastewater shall comply with the following provisions; domestic wastewater treatment facilities at permitted industrial sites are excluded.

   a. Whenever flow measurements for any domestic sewage treatment facility reach 75% of the permitted daily average or annual average flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the domestic wastewater treatment and/or collection facilities. Whenever the flow reaches 90% of the permitted daily average or annual average flow for three consecutive months, the permittee shall obtain necessary authorization from the Commission to commence construction of the necessary additional treatment and/or collection facilities. In the case of a domestic wastewater treatment facility which reaches 75% of the permitted daily average or annual average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee shall submit an engineering report supporting this claim to the Executive Director of the Commission.

      If in the judgment of the Executive Director the population to be served will not cause permit noncompliance, then the requirement of this section may be waived. To be effective, any waiver must be in writing and signed by the Director of the Enforcement Division (MC 169) of the Commission, and such waiver of these requirements will be reviewed upon expiration of the existing permit; however, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter.

   b. The plans and specifications for domestic sewage collection and treatment works associated with any domestic permit must be approved by the Commission and failure to secure approval before commencing construction of such works or making a discharge is a violation of this permit and each day is an additional violation until approval has been secured.

   c. Permits for domestic wastewater treatment plants are granted subject to the policy of the Commission to encourage the development of area-wide waste collection, treatment, and disposal systems. The Commission reserves the right to amend any domestic wastewater permit in accordance with applicable procedural requirements to require the system covered by this permit to be integrated into an area-wide system, should such be developed; to require the delivery of the wastes authorized to be collected in, treated by or discharged from said system, to such area-wide system; or to amend this permit in any other particular to effectuate the Commission's policy. Such amendments may be made when the changes required are advisable for water quality control purposes and are feasible on the basis of waste treatment technology, engineering, financial, and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

9. Domestic wastewater treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency at the required level as defined in 30 TAC Chapter 30.

10. For Publicly Owned Treatment Works (POTWs), the 30-day average (or monthly average) percent removal for BOD and TSS shall not be less than 85%, unless otherwise authorized by this permit.

11. Facilities that generate industrial solid waste as defined in 30 TAC § 335.1 shall comply with these provisions:

    a. Any solid waste, as defined in 30 TAC § 335.1 (including but not limited to such wastes as garbage, refuse, sludge from a waste treatment, water supply treatment plant or air pollution control facility, discarded materials, discarded materials to be recycled, whether the waste is solid, liquid, or semisolid), generated by the permittee during the management and treatment of wastewater, must be managed in accordance with all applicable provisions of 30 TAC Chapter 335, relating to Industrial Solid Waste Management.

    b. Industrial wastewater that is being collected, accumulated, stored, or processed before discharge through any final discharge outfall, specified by this permit, is considered to be industrial solid waste until the wastewater passes through the actual point source discharge and must be managed in accordance with all applicable provisions of 30 TAC Chapter 335.

    c. The permittee shall provide written notification, pursuant to the requirements of 30 TAC § 335.8(b)(1), to the Environmental Cleanup Section (MC 127) of the Remediation Division informing the Commission of any closure activity involving an Industrial Solid Waste Management Unit, at least 90 days prior to conducting such an activity.

    d. Construction of any industrial solid waste management unit requires the prior written notification of the proposed activity to the Registration and Reporting Section (MC 129) of the Registration, Review, and Reporting Division. No person shall dispose of industrial solid waste, including sludge or other solids from wastewater treatment processes, prior to fulfilling the deed recordation requirements of 30 TAC § 335.5.

    e. The term "industrial solid waste management unit" means a landfill, surface impoundment, waste-pile, industrial furnace, incinerator, cement kiln, injection well, container, drum, salt dome waste containment cavern, or any other structure vessel, appurtenance, or other improvement on land used to manage industrial solid waste.

    f. The permittee shall keep management records for all sludge (or other waste) removed from any wastewater treatment process. These records shall fulfill all applicable requirements of 30 TAC § 335 and must include the following, as it pertains to wastewater treatment and discharge:

        i. Volume of waste and date(s) generated from treatment process;
        ii. Volume of waste disposed of on-site or shipped off-site;

iii. Date(s) of disposal;
iv. Identity of hauler or transporter;
v. Location of disposal site; and
vi. Method of final disposal.

The above records shall be maintained on a monthly basis. The records shall be retained at the facility site, or shall be readily available for review by authorized representatives of the TCEQ for at least five years.

12. For industrial facilities to which the requirements of 30 TAC § 335 do not apply, sludge and solid wastes, including tank cleaning and contaminated solids for disposal, shall be disposed of in accordance with THSC § 361.

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SLUDGE PROVISIONS

The permittee is authorized to dispose of sludge only at a Texas Commission on Environmental Quality (TCEQ) authorized land application site or co-disposal landfill. **The disposal of sludge by land application on property owned, leased or under the direct control of the permittee is a violation of the permit unless the site is authorized with the TCEQ. This provision does not authorize Distribution and Marketing of sludge. This provision does not authorize land application of Class A or Class AB Sewage Sludge. This provision does not authorize the permittee to land apply sludge on property owned, leased or under the direct control of the permittee.**

SECTION I. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE LAND APPLICATION

A. General Requirements

1. The permittee shall handle and dispose of sewage sludge in accordance with 30 TAC § 312 and all other applicable state and federal regulations in a manner that protects public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants that may be present in the sludge.

2. In all cases, if the person (permit holder) who prepares the sewage sludge supplies the sewage sludge to another person for land application use or to the owner or lease holder of the land, the permit holder shall provide necessary information to the parties who receive the sludge to assure compliance with these regulations.

3. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

B. Testing Requirements

1. Sewage sludge shall be tested annually in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I [Toxicity Characteristic Leaching Procedure (TCLP)] or other method that receives the prior approval of the TCEQ for the contaminants listed in 40 CFR Part 261.24, Table 1. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal. Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TCEQ Registration and Reporting Section (MC 129) of the Permitting and Remediation Support Division and the Regional Director (MC Region 11) within seven (7) days after failing the TCLP Test.

The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to: Director, Registration, Review, and Reporting Division (MC 129), Texas Commission on Environmental Quality, P.O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TCEQ Regional Office (MC Region 11) and the Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30th of each year.

2. Sewage sludge shall not be applied to the land if the concentration of the pollutants exceeds the pollutant concentration criteria in Table 1. The frequency of testing for pollutants in Table 1 is found in Section I.C.

TABLE 1

Pollutant	Ceiling Concentration (Milligrams per kilogram)*
Arsenic	75
Cadmium	85
Chromium	3000
Copper	4300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
PCBs	49
Selenium	100
Zinc	7500

* Dry weight basis

3. Pathogen Control

All sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site must be treated by one of the following methods to ensure that the sludge meets either the Class A, Class AB or Class B pathogen requirements.

a. For sewage sludge to be classified as Class A with respect to pathogens, the density of fecal coliform in the sewage sludge be less than 1,000 most probable number (MPN) per gram of total solids (dry weight basis), or the density of Salmonella sp. bacteria in the sewage sludge be less than three MPN per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. In addition, one of the alternatives listed below must be met.

<u>Alternative 1</u> - The temperature of the sewage sludge that is used or disposed shall be maintained at or above a specific value for a period of time. See 30 TAC § 312.82(a)(2)(A) for specific information.

Alternative 5 (PFRP) - Sewage sludge that is used or disposed of must be treated in one of the Processes to Further Reduce Pathogens (PFRP) described in 40 CFR Part 503, Appendix B. PFRP include composting, heat drying, heat treatment, and thermophilic aerobic digestion.

Alternative 6 (PFRP Equivalent) - Sewage sludge that is used or disposed of must be treated in a process that has been approved by the U. S. Environmental Protection Agency as being equivalent to those in Alternative 5.

b. For sewage sludge to be classified as Class AB with respect to pathogens, the density of fecal coliform in the sewage sludge be less than 1,000 MPN per gram of total solids (dry weight basis), or the density of Salmonella sp. bacteria in the sewage sludge be less than three MPN per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. In addition, one of the alternatives listed below must be met.

<u>Alternative 2</u> - The pH of the sewage sludge that is used or disposed shall be raised to above 12 std. units and shall remain above 12 std. units for 72 hours.

The temperature of the sewage sludge shall be above 52° Celsius for 12 hours or longer during the period that the pH of the sewage sludge is above 12 std. units.

At the end of the 72-hour period during which the pH of the sewage sludge is above 12 std. units, the sewage sludge shall be air dried to achieve a percent solids in the sewage sludge greater than 50%.

<u>Alternative 3</u> - The sewage sludge shall be analyzed for enteric viruses prior to pathogen treatment. The limit for enteric viruses is less than one Plaque-forming Unit per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 30 TAC § 312.82(a)(2)(C)(i-iii) for specific information. The sewage sludge shall be analyzed for viable helminth ova prior to pathogen treatment. The limit for viable helminth ova is less than one per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 30 TAC § 312.82(a)(2)(C)(iv-vi) for specific information.

<u>Alternative 4</u> - The density of enteric viruses in the sewage sludge shall be less than one Plaque-forming Unit per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. The density of viable helminth ova in the sewage sludge shall be less than one per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed.

c. Sewage sludge that meets the requirements of Class AB sewage sludge may be classified a Class A sewage sludge if a variance request is submitted in writing that is supported by substantial documentation demonstrating equivalent methods for reducing odors and written approval is granted by the executive director. The executive director may deny the variance request or revoke that approved variance if it is determined that the variance may potentially endanger human health or the environment, or create nuisance odor conditions.

d. Three alternatives are available to demonstrate compliance with Class B criteria for sewage sludge.

Alternative 1

i. A minimum of seven random samples of the sewage sludge shall be collected within 48 hours of the time the sewage sludge is used or disposed of during each monitoring episode for the sewage sludge.

ii. The geometric mean of the density of fecal coliform in the samples collected shall be less than either 2,000,000 MPN per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).

Alternative 2 - Sewage sludge that is used or disposed of shall be treated in one of the Processes to Significantly Reduce Pathogens (PSRP) described in 40 CFR Part 503, Appendix B, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. An independent Texas Licensed Professional Engineer must make a certification to the generator of a sewage sludge that the wastewater treatment facility generating the sewage sludge is designed to achieve one of the PSRP at the permitted design loading of the facility. The certification need only be repeated if the design loading of the facility is increased. The certification shall include a statement indicating the design meets all the applicable standards specified in Appendix B of 40 CFR Part 503;

iii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U.S. Environmental Protection Agency final guidance;

iv. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review; and

v. If the sewage sludge is generated from a mixture of sources, resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the PSRP, and shall meet the certification, operation, and record keeping requirements of this paragraph.

Alternative 3 - Sewage sludge shall be treated in an equivalent process that has been approved by the U.S. Environmental Protection Agency, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U.S. Environmental Protection Agency final guidance;

iii. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review;

iv. The Executive Director will accept from the U.S. Environmental Protection Agency a finding of equivalency to the defined PSRP; and

v. If the sewage sludge is generated from a mixture of sources resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the Processes to Significantly Reduce Pathogens, and shall meet the certification, operation, and record keeping requirements of this paragraph.

<u>In addition</u>, the following site restrictions must be met if Class B sludge is land applied:

i. Food crops with harvested parts that touch the sewage sludge/soil mixture and are totally above the land surface shall not be harvested for 14 months after application of sewage sludge.

ii. Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of sewage sludge when the sewage sludge remains on the land surface for 4 months or longer prior to incorporation into the soil.

iii. Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of sewage sludge when the sewage sludge remains on the land surface for less than 4 months prior to incorporation into the soil.

iv. Food crops, feed crops, and fiber crops shall not be harvested for 30 days after application of sewage sludge.

v. Animals shall not be allowed to graze on the land for 30 days after application of sewage sludge.

vi. Turf grown on land where sewage sludge is applied shall not be harvested for 1 year after application of the sewage sludge when the harvested turf is placed on either land with a high potential for public exposure or a lawn.

vii. Public access to land with a high potential for public exposure shall be restricted for 1 year after application of sewage sludge.

viii. Public access to land with a low potential for public exposure shall be restricted for 30 days after application of sewage sludge.

ix. Land application of sludge shall be in accordance with the buffer zone requirements found in 30 TAC § 312.44.

4. Vector Attraction Reduction Requirements

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following Alternatives 1 through 10 for vector attraction reduction.

Alternative 1 -	The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38%.
Alternative 2 -	If Alternative 1 cannot be met for an anaerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30° and 37° Celsius. Volatile solids must be reduced by less than 17% to demonstrate compliance.
Alternative 3 -	If Alternative 1 cannot be met for an aerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge with percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20° Celsius. Volatile solids must be reduced by less than 15% to demonstrate compliance.
Alternative 4 -	The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20° Celsius.
Alternative 5 -	Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40° Celsius and the average temperature of the sewage sludge shall be higher than 45° Celsius.
Alternative 6 -	The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali shall remain at 12 or higher for two hours and then remain at a pH of 11.5 or higher for an additional 22 hours at the time the sewage sludge is prepared for sale or given away in a bag or other container.
Alternative 7 -	The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75% based on the moisture content and total solids prior to mixing with other materials. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

Alternative 8 - The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90% based on the moisture content and total solids prior to mixing with other materials at the time the sludge is used. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

Alternative 9 -

i. Sewage sludge shall be injected below the surface of the land.

ii. No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected.

iii. When sewage sludge that is injected below the surface of the land is Class A or Class AB with respect to pathogens, the sewage sludge shall be injected below the land surface within eight hours after being discharged from the pathogen treatment process.

Alternative 10-

i. Sewage sludge applied to the land surface or placed on a surface disposal site shall be incorporated into the soil within six hours after application to or placement on the land.

ii. When sewage sludge that is incorporated into the soil is Class A or Class AB with respect to pathogens, the sewage sludge shall be applied to or placed on the land within eight hours after being discharged from the pathogen treatment process.

C. Monitoring Requirements

Toxicity Characteristic Leaching Procedure (TCLP) Test	- annually
PCBs	- annually

All metal constituents and fecal coliform or Salmonella sp. bacteria shall be monitored at the appropriate frequency shown below, pursuant to 30 TAC § 312.46(a)(1):

Amount of sewage sludge (*) metric tons per 365-day period	Monitoring Frequency
0 to less than 290	Once/Year
290 to less than 1,500	Once/Quarter
1,500 to less than 15,000	Once/Two Months
15,000 or greater	Once/Month

(*) *The amount of bulk sewage sludge applied to the land (dry wt. basis).*

Representative samples of sewage sludge shall be collected and analyzed in accordance with the methods referenced in 30 TAC § 312.7

SECTION II. REQUIREMENTS SPECIFIC TO BULK SEWAGE SLUDGE FOR APPLICATION TO THE LAND MEETING CLASS A, CLASS AB or B PATHOGEN REDUCTION AND THE CUMULATIVE LOADING RATES IN TABLE 2, OR CLASS B PATHOGEN REDUCTION AND THE POLLUTANT CONCENTRATIONS IN TABLE 3

For those permittees meeting Class A, Class AB or B pathogen reduction requirements and that meet the cumulative loading rates in Table 2 below, or the Class B pathogen reduction requirements and contain concentrations of pollutants below listed in Table 3, the following conditions apply:

A. Pollutant Limits

Table 2

Pollutant	Cumulative Pollutant Loading Rate (pounds per acre)*
Arsenic	36
Cadmium	35
Chromium	2677
Copper	1339
Lead	268
Mercury	15
Molybdenum	Report Only
Nickel	375
Selenium	89
Zinc	2500

Table 3

Pollutant	Monthly Average Concentration (milligrams per kilogram)*
Arsenic	41
Cadmium	39
Chromium	1200
Copper	1500
Lead	300
Mercury	17
Molybdenum	Report Only
Nickel	420
Selenium	36
Zinc	2800

*Dry weight basis

B. Pathogen Control

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, a reclamation site, shall be treated by either Class A, Class AB or Class B pathogen reduction requirements as defined above in Section I.B.3.

C. Management Practices

1. Bulk sewage sludge shall not be applied to agricultural land, forest, a public contact site, or a reclamation site that is flooded, frozen, or snow-covered so that the bulk sewage sludge enters a wetland or other waters in the State.

2. Bulk sewage sludge not meeting Class A requirements shall be land applied in a manner which complies with Applicability in accordance with 30 TAC §312.41 and the Management Requirements in accordance with 30 TAC § 312.44.

3. Bulk sewage sludge shall be applied at or below the agronomic rate of the cover crop.

4. An information sheet shall be provided to the person who receives bulk sewage sludge sold or given away. The information sheet shall contain the following information:

    a. The name and address of the person who prepared the sewage sludge that is sold or given away in a bag or other container for application to the land.

    b. A statement that application of the sewage sludge to the land is prohibited except in accordance with the instruction on the label or information sheet.

    c. The annual whole sludge application rate for the sewage sludge application rate for the sewage sludge that does not cause any of the cumulative pollutant loading rates in Table 2 above to be exceeded, unless the pollutant concentrations in Table 3 found in Section II above are met.

D. Notification Requirements

1. If bulk sewage sludge is applied to land in a State other than Texas, written notice shall be provided prior to the initial land application to the permitting authority for the State in which the bulk sewage sludge is proposed to be applied. The notice shall include:

    a. The location, by street address, and specific latitude and longitude, of each land application site.

    b. The approximate time period bulk sewage sludge will be applied to the site.

    c. The name, address, telephone number, and National Pollutant Discharge Elimination System permit number (if appropriate) for the person who will apply the bulk sewage sludge.

2. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

E. Record keeping Requirements

The sludge documents will be retained at the facility site and/or shall be readily available for review by a TCEQ representative. The person who prepares bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TCEQ representative for a period of five years. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC § 312.47 for persons who land apply.

1. The concentration (mg/kg) in the sludge of each pollutant listed in Table 3 above and the applicable pollutant concentration criteria (mg/kg), or the applicable cumulative pollutant loading rate and the applicable cumulative pollutant loading rate limit (lbs/ac) listed in Table 2 above.
2. A description of how the pathogen reduction requirements are met (including site restrictions for Class AB and Class B sludge, if applicable).
3. A description of how the vector attraction reduction requirements are met.
4. A description of how the management practices listed above in Section II.C are being met.
5. The following certification statement:

   "I certify, under penalty of law, that the applicable pathogen requirements in 30 TAC § 312.82(a) or (b) and the vector attraction reduction requirements in 30 TAC § 312.83(b) have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."
6. The recommended agronomic loading rate from the references listed in Section II.C.3. above, as well as the actual agronomic loading rate shall be retained. The person who applies bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TCEQ representative indefinitely. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC § 312.47 for persons who land apply:

   a. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment. See 30 TAC § 312.47(a)(4)(A)(ii) or 30 TAC § 312.47(a)(5)(A)(ii), as applicable, and to the permittee's specific sludge treatment activities.

   b. The location, by street address, and specific latitude and longitude, of each site on which sludge is applied.

   c. The number of acres in each site on which bulk sludge is applied.

   d. The date and time sludge is applied to each site.

e. The cumulative amount of each pollutant in pounds/acre listed in Table 2 applied to each site.

f. The total amount of sludge applied to each site in dry tons.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

F. Reporting Requirements

The permittee shall report annually to the TCEQ Regional Office (MC Region 11) and Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division, by September 30th of each year the following information:

1. Results of tests performed for pollutants found in either Table 2 or 3 as appropriate for the permittee's land application practices.
2. The frequency of monitoring listed in Section I.C. that applies to the permittee.
3. Toxicity Characteristic Leaching Procedure (TCLP) results.
4. Identity of hauler(s) and TCEQ transporter number.
5. PCB concentration in sludge in mg/kg.
6. Date(s) of disposal.
7. Owner of disposal site(s).
8. Texas Commission on Environmental Quality registration number, if applicable.
9. Amount of sludge disposal dry weight (lbs/acre) at each disposal site.
10. The concentration (mg/kg) in the sludge of each pollutant listed in Table 1 (defined as a monthly average) as well as the applicable pollutant concentration criteria (mg/kg) listed in Table 3 above, or the applicable pollutant loading rate limit (lbs/acre) listed in Table 2 above if it exceeds 90% of the limit.
11. Level of pathogen reduction achieved (Class A, Class AB or Class B).
12. Alternative used as listed in Section I.B.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met. If Class B sludge, include information on how site restrictions were met.
13. Vector attraction reduction alternative used as listed in Section I.B.4.
14. Annual sludge production in dry tons/year.
15. Amount of sludge land applied in dry tons/year.
16. The certification statement listed in either 30 TAC § 312.47(a)(4)(A)(ii) or 30 TAC § 312.47(a)(5)(A)(ii) as applicable to the permittee's sludge treatment activities, shall be attached to the annual reporting form.

17. When the amount of any pollutant applied to the land exceeds 90% of the cumulative pollutant loading rate for that pollutant, as described in Table 2, the permittee shall report the following information as an attachment to the annual reporting form.

    a. The location, by street address, and specific latitude and longitude.

    b. The number of acres in each site on which bulk sewage sludge is applied.

    c. The date and time bulk sewage sludge is applied to each site.

    d. The cumulative amount of each pollutant (i.e., pounds/acre) listed in Table 2 in the bulk sewage sludge applied to each site.

    e. The amount of sewage sludge (i.e., dry tons) applied to each site.

    The above records shall be maintained on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

SECTION III. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE DISPOSED IN A MUNICIPAL SOLID WASTE LANDFILL

A. The permittee shall handle and dispose of sewage sludge in accordance with 30 TAC § 330 and all other applicable state and federal regulations to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants that may be present. The permittee shall ensure that the sewage sludge meets the requirements in 30 TAC § 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.

B. If the permittee generates sewage sludge and supplies that sewage sludge to the owner or operator of a municipal solid waste landfill (MSWLF) for disposal, the permittee shall provide to the owner or operator of the MSWLF appropriate information needed to be in compliance with the provisions of this permit.

C. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

D. Sewage sludge shall be tested annually in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I (Toxicity Characteristic Leaching Procedure) or other method, which receives the prior approval of the TCEQ for contaminants listed in Table 1 of 40 CFR § 261.24. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal.

Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TCEQ Registration and Reporting Section (MC 129) of the Permitting and Remediation Support Division and the Regional Director (MC Region 11) of the appropriate TCEQ field office within 7 days after failing the TCLP Test.

The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to: Director, Registration, Review, and Reporting Division (MC 129), Texas Commission on Environmental Quality, P. O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TCEQ Regional Office (MC Region 11) and the Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30 of each year.

E. Sewage sludge shall be tested as needed, in accordance with the requirements of 30 TAC Chapter 330.

F. Record keeping Requirements

The permittee shall develop the following information and shall retain the information for five years.

1. The description (including procedures followed and the results) of all liquid Paint Filter Tests performed.

2. The description (including procedures followed and results) of all TCLP tests performed.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

G. Reporting Requirements

The permittee shall report annually to the TCEQ Regional Office (MC Region 11) and Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30th of each year the following information:

1. Toxicity Characteristic Leaching Procedure (TCLP) results.

2. Annual sludge production in dry tons/year.

3. Amount of sludge disposed in a municipal solid waste landfill in dry tons/year.

4. Amount of sludge transported interstate in dry tons/year.

5. A certification that the sewage sludge meets the requirements of 30 TAC § 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.

6. Identity of hauler(s) and transporter registration number.

7. Owner of disposal site(s).

8. Location of disposal site(s).

9. Date(s) of disposal.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

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OTHER REQUIREMENTS

1. The permittee shall employ or contract with one or more licensed wastewater treatment facility operators or wastewater system operations companies holding a valid license or registration according to the requirements of 30 TAC Chapter 30, Occupational Licenses and Registrations, and, in particular, 30 TAC Chapter 30, Subchapter J, Wastewater Operators and Operations Companies.

   This Category A facility must be operated by a chief operator or an operator holding a Category A license or higher. The facility must be operated a minimum of five days per week by the licensed chief operator or an operator holding the required level of license or higher. The licensed chief operator or operator holding the required level of license or higher must be available by telephone or pager seven days per week. Where shift operation of the wastewater treatment facility is necessary, each shift that does not have the on-site supervision of the licensed chief operator must be supervised by an operator in charge who is licensed not less than one level below the category for the facility.

2. The facility is not located in the Coastal Management Program boundary.

3. The mixing zone is defined as 300 feet downstream and 100 feet upstream from the point of discharge. Chronic toxic criteria apply at the edge of the mixing zone.

4. The permittee is hereby placed on notice that this permit may be reviewed by the TCEQ after the completion of any new intensive water quality survey on Segment No. 1428 of the Colorado River Basin and any subsequent updating of the water quality model for Segment No. 1428 to determine if the limitations and conditions contained herein are consistent with any such revised model. The permit may be amended, pursuant to 30 TAC §305.62, as a result of such review. The permittee is also hereby placed on notice that effluent limits may be made more stringent at renewal based on, for example, any change to modeling protocol approved in the TCEQ Continuing Planning Process.

5. The permittee shall comply with the requirements of 30 TAC § 309.13(a) through (d). In addition, by ownership of the required buffer zone area, the permittee shall comply with the requirements of 30 TAC § 309.13(e).

6. The permittee shall provide facilities for the protection of its wastewater treatment facility from a 100-year flood.

7. In accordance with 30 TAC § 319.9, a permittee that has at least twelve months of uninterrupted compliance with its bacteria limit may notify the commission in writing of its compliance and request a less frequent measurement schedule. To request a less frequent schedule, the permittee shall submit a written request to the TCEQ Wastewater Permitting Section (MC 148) for each phase that includes a different monitoring frequency. The request must contain all of the reported bacteria values (Daily Avg. and Daily Max/Single Grab) for the twelve consecutive months immediately prior to the request. If the Executive Director finds that a less frequent measurement schedule is protective of human health and the environment, the permittee may be given a less frequent measurement schedule. For this permit, 5/week may be reduced to 3/week. **A violation of any bacteria limit by a facility that has been granted a less frequent measurement schedule will require the permittee to return to the standard frequency schedule and submit written notice to the TCEQ Wastewater Permitting Section (MC 148).** The

permittee may not apply for another reduction in measurement frequency for at least 24 months from the date of the last violation. The Executive Director may establish a more frequent measurement schedule if necessary to protect human health or the environment.

8. Annual average effluent limitations of 5 mg/l CBOD5, 5 mg/l TSS and 2 mg/l NH3-N shall be maintained. The annual average is the sum of the monthly average divided by 12 based on a calender year. The results shall be submitted to the TCEQ Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division of the TCEQ in January of each year.

9. The sludge generated from the treatment facility may be transported via pipeline to the Hornsby Bend Biosolids Treatment Plant, TPDES Permit No. WQ0003823000 to be thickened, digested, dewatered, and then disposed of with bulk of sludge from the plant accepting the sludge.

   The permittee shall keep records of all sludge removed from the wastewater treatment plant site, and these records shall include the following information:

   a. The volume of sludge transported;
   b. The date(s) that sludge was transported;
   c. The identity of transporting; and
   d. The permittee, TCEQ permit number, and location of the facility to which the sludge is transported.

   These records shall be maintained on a monthly basis and shall be reported to the TCEQ Regional Office (MC Region 11) and the TCEQ Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30 of each year.

CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS

1. The permittee shall operate an industrial pretreatment program in accordance with Sections 402(b)(8) and (9) of the Clean Water Act, the General Pretreatment Regulations (40 CFR Part 403), and the approved **City of Austin Publicly Owned Treatment Works** (POTW) pretreatment program submitted by the permittee. The pretreatment program was approved on **December 24, 1983,** modified on **July 22, 1994,** and subsequently modified on **June 2, 2005.**

   The POTW pretreatment program is hereby incorporated by reference and shall be implemented in a manner consistent with the following requirements:

   a. Industrial user (IU) information shall be kept current according to 40 CFR §§403.8(f)(2)(i) and (ii) and updated at a frequency set forth in the approved pretreatment program to reflect accurate characterization of all IUs;

   b. The frequency and nature of IU compliance monitoring activities by the permittee shall be consistent with the approved POTW pretreatment program and commensurate with the character, consistency, and volume of waste. The permittee is required to inspect and sample the effluent from each significant industrial user (SIU) at least once per year, except as specified in 40 CFR § 403.8 (f)(2)(v). This is in addition to any industrial self-monitoring activities;

   c. The permittee shall enforce and obtain remedies for IU noncompliance with applicable pretreatment standards and requirements and the approved POTW pretreatment program;

   d. The permittee shall control through permit, order, or similar means, the contribution to the POTW by each IU to ensure compliance with applicable pretreatment standards and requirements and the approved POTW pretreatment program. In the case of SIUs (identified as significant under 40 CFR § 403.3 (v)), this control shall be achieved through individual permits or general control mechanisms, in accordance with 40 CFR § 403.8(f)(1)(iii).

      Both individual and general control mechanisms must be enforceable and contain, at a minimum, the following conditions:

      (1) Statement of duration (in no case more than five years);
      (2) Statement of non-transferability without, at a minimum, prior notification to the POTW and provision of a copy of the existing control mechanism to the new owner or operator;
      (3) Effluent limits, which may include enforceable best management practices (BMPs), based on applicable general pretreatment standards, categorical pretreatment standards, local limits, and State and local law;
      (4) Self-monitoring, sampling, reporting, notification and record keeping requirements, identification of the pollutants to be monitored (including, if applicable, the process for seeking a waiver for a pollutant neither present nor expected to be present in the IU's discharge in accordance with 40 CFR §403.12(e)(2) or a specific waived pollutant in the case of an individual control mechanism), sampling location, sampling frequency, and sample type based on the applicable general pretreatment standards in 40 CFR Part 403, categorical pretreatment standards, local limits, and State and local law;

(5) Statement of applicable civil and criminal penalties for violation of pretreatment standards and requirements and any applicable compliance schedule. Such schedules may not extend the compliance date beyond federal deadlines; and

(6) Requirements to control slug discharges if determined by the POTW to be necessary.

e. For those IUs who are covered by a general control mechanism, in order to implement 40 CFR § 403.8(f)(1)(iii)(A)(2), a monitoring waiver for a pollutant neither present nor expected to be present in the IU's discharge is not effective in the general control mechanism until after the POTW has provided written notice to the SIU that such a waiver request has been granted in accordance with 40 CFR § 403.12(e)(2);

f. The permittee shall evaluate, whether each SIU needs a plan or other action to control slug discharges, in accordance with 40 CFR § 403.8(f)(2)(vi). If the POTW decides that a slug control plan is needed, the plan shall contain at least the minimum elements required in 40 CFR § 403.8(f)(2)(vi);

g. The permittee shall provide adequate staff, equipment, and support capabilities to carry out all elements of the pretreatment program; and

h. The approved program shall not be modified by the permittee without the prior approval of the Executive Director, according to 40 CFR § 403.18.

2. The permittee is under a continuing duty to establish and enforce specific local limits to implement the provisions of 40 CFR § 403.5, develop and enforce local limits as necessary, and modify the approved pretreatment program as necessary to comply with federal, state, and local law, as amended. The permittee may develop BMPs to implement paragraphs 40 CFR §§ 403.5(c)(1) and (c)(2). Such BMPs shall be considered local limits and pretreatment standards. The permittee is required to effectively enforce such limits and to modify its pretreatment program, including the Legal Authority, Enforcement Response Plan, and Standard Operating Procedures (including forms), if required by the Executive Director, to reflect changing conditions at the POTW. Substantial modifications will be approved in accordance with 40 CFR § 403.18, and modifications will become effective upon approval by the Executive Director in accordance with 40 CFR § 403.18.

   The legal authority and the POTW's pretreatment program are not in compliance with the current 40 CFR Part 403 regulations *[rev. Federal Register/ Vol. 70/ No. 198/ Friday, October 14, 2005/ Rules and Regulations, pages 60134-60798]* and the 30 TAC Chapter 315, as amended. The permittee has submitted a substantial modification package revising the existing the Legal Authority, and additional modifications to the pretreatment program including an Enforcement Response Plan, Standard Operating Procedures, and forms to incorporate all required [*i.e.* more stringent] Streamlining Rule provisions *[rev. Federal Register/ Vol. 70/ No. 198/ Friday, October 14, 2005/ Rules and Regulations, pages 60134-60798].* In addition, the package includes the technical evaluation revising the existing technically based local limits (TBLLs). The Executive Director is currently reviewing this substantial modification package. If after review of the modification submission, the Executive Director determines that the submission does not comply with applicable requirements, including 40 CFR §§ 403.8 and 403.9, the Executive Director will notify the permittee. According to 40 CFR § 403.11(c), the notification will include suggested modifications to bring the modification submission into compliance with applicable requirements, including 40 CFR §§ 403.8(b) and (f), and 40 CFR § 403.9(b). In such a case, revised information will be necessary for the Executive Director to make a determination on whether to approve or deny the permittee's modification submission.

Upon approval by the Executive Director of the substantial modification to this approved POTW pretreatment program, the requirement to develop and enforce specific prohibitions and/or limits to implement the prohibitions and limits set forth in 40 CFR §§ 403.5 (a)(1), (b), (c)(1) and (3), and (d) is a condition of this permit. The specific prohibitions set out in 40 CFR § 403.5(b) shall be enforced by the permittee unless modified under this provision.

3. The permittee shall analyze the treatment facility influent and effluent for the presence of the toxic pollutants listed in the Texas Surface Water Quality Standards [30 TAC Chapter 307], and listed in 40 CFR Part 122, Appendix D, Table II at least **once per six months** and the toxic pollutants in Table III at least **once per two months**. If, based upon information available to the permittee, there is reason to suspect the presence of any toxic or hazardous pollutant listed in 40 CFR Part 122, Appendix D, Table V, or any other pollutant, known or suspected to adversely affect treatment plant operation, receiving water quality, or solids disposal procedures, analysis for those pollutants shall be performed at least **once per two months** on both the influent and the effluent.

   The influent and effluent samples collected shall be composite samples consisting of at least 12 aliquots collected at approximately equal intervals over a representative 24 hour period and composited according to flow. Sampling and analytical procedures shall be in accordance with guidelines established in 40 CFR Part 136, as amended; as approved by the EPA through the application for alternate test procedures; or as suggested in Tables E-1 and E-2 of the *Procedures to Implement the Texas Surface Water Quality Standards* (RG-194), June 2010, as amended and adopted by the TCEQ. The effluent samples shall be analyzed to the minimum analytical level (MAL). Where composite samples are inappropriate, due to sampling, holding time, or analytical constraints, at least four (4) grab samples shall be taken at equal intervals over a representative 24-hour period.

4. The permittee shall prepare annually a list of IUs which, during the preceding twelve (12) months, were in significant noncompliance (SNC) with applicable pretreatment requirements. For the purposes of this section of the permit, "CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS", SNC shall be determined based upon the more stringent of either criteria established at 40 CFR § 403.8(f)(2)(viii) *[rev. 10/14/05]* or criteria established in the approved POTW pretreatment program. This list is to be published annually during the month of **December** in a newspaper of general circulation that provides meaningful public notice within the jurisdiction(s) served by the POTW.

   In addition, each **December** the permittee shall submit an updated pretreatment program annual status report, in accordance with 40 CFR §§ 403.12(i) and (m), to the TCEQ Stormwater & Pretreatment Team (MC148) of the Water Quality Division. The report summary shall be submitted on the Pretreatment Performance Summary (PPS) form [TCEQ-20218]. The report shall contain the following information as well as the information on the tables in this section:

   a. An updated list of all regulated IUs as indicated in this section. For each listed IU, the following information shall be included:

(1) Standard Industrial Classification (SIC) or North American Industry Classification System (NAICS) code *and* categorical determination.

(2) If the pretreatment program has been modified and approved to incorporate reduced monitoring for any of the categorical IUs as provided by 40 CFR Part 403 [*rev. 10/14/05*], then the list must also identify:

- categorical IUs subject to the conditions for reduced monitoring and reporting requirements under 40 CFR §§ 403.12(e)(1) and (3);
- those IUs that are non-significant categorical industrial users (NSCIUs) under 40 CFR § 403.3(v)(2); and
- those IUs that are middle tier categorical industrial users (MTCIUs) under 40 CFR § 403.12(e)(3).

(3) Control mechanism status.

- Indicate whether the IU has an effective individual or general control mechanism, and the date such control mechanism was last issued, reissued, or modified;
- Indicate which IUs were added to the system, or newly identified, during the pretreatment year reporting period;
- Include the type of general control mechanisms; and
- Report all NSCIU annual evaluations performed, as applicable.

(4) A summary of all compliance monitoring activities performed by the POTW during the pretreatment year reporting period. The following information shall be reported:

- Total number of inspections performed; and
- Total number of sampling events conducted.

(5) Status of IU compliance with effluent limitations, reporting, and narrative standard (which may include enforceable BMPs, narrative limits, and/or operational standards) requirements. Compliance status shall be defined as follows:

- Compliant (C) - no violations during the pretreatment year reporting period;
- Non-compliant (NC) - one or more violations during the pretreatment year reporting period but does not meet the criteria for SNC; and
- Significant Noncompliance (SNC) - in accordance with requirements described above in this section.

(6) a. For noncompliant IUs indicate the nature of the violations, the type and number of actions taken (notice of violation, administrative order, criminal or civil suit, fines or penalties collected, etc.) and current compliance status. If any IU was on a schedule to attain compliance with effluent limits or narrative standards, indicate the date the schedule was issued, and the date compliance is to be attained.

b. A list of each IU whose authorization to discharge was terminated or revoked during the pretreatment year reporting period and the reason for termination.

c. A report on any interference, pass through, upset, or POTW permit violations known or suspected to be caused by IUs and response actions taken by the permittee.

d. The results of all influent and effluent analyses performed pursuant to Item 3 of this section.

e. An original newspaper public notice, or copy of the newspaper publication with official affidavit, of the list of IUs that meet the criteria of SNC, giving the name of the newspaper and date the list was published.

f. The daily average water quality based effluent concentrations (from the TCEQ's Texas Toxicity Modeling Program (TexTox)) necessary to attain the Texas Surface Water Quality Standards, 30 TAC Chapter 307, in water in the state.

g. The maximum allowable headworks loading (MAHL) in pounds per day (lb/day) of the approved TBLLs or for each pollutant of concern (POC) for which the permittee has calculated a MAHL. In addition, the influent loading as a percent of the MAHL, using the annual average flow of the wastewater treatment plant in million gallons per day (MGD) during the pretreatment year reporting period, for each pollutant that has an adopted TBLL or for each POC for which the permittee has calculated a MAHL. (*See Endnotes No. 2 at the end of this section for the influent loading as a percent of the MAHL equation.*)

h. The permittee may submit the updated pretreatment program annual status report information in tabular form using the example table format provided. Please attach, on a separate sheet, explanations to document the various pretreatment activities, including IU permits that have expired, BMP violations, and any sampling events that were not conducted by the permittee as required.

i. A summary of changes to the POTW's pretreatment program that have not been previously reported to the Approval Authority.

5. The permittee shall provide adequate written notification to the Executive Director care of the Wastewater Permitting Section (MC 148) of the Water Quality Division, within 30 days of the permittee's knowledge of the following:

a. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Sections 301 and 306 of the Clean Water Act if the indirect discharger was directly discharging those pollutants; and

b. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit.

Adequate notice shall include information on the quality and quantity of effluent to be introduced into the treatment works, and any anticipated impact of the change on the quality or quantity of effluent to be discharged from the POTW.

TPDES Pretreatment Program Annual Report Form for Updated Industrial Users List

Reporting month/year: ___________, _____ to ___________, _____

TPDES Permit No.: _______ Permittee:________ Treatment Plant: ____________

PRETREATMENT PROGRAM STATUS REPORT UPDATED INDUSTRIAL USERS[1] LIST																
			CONTROL MECHANISM							COMPLIANCE STATUS During the Pretreatment Year Reporting Period [4] (C = Compliant, NC = Noncompliant, SNC= Significant Noncompliance)						
										REPORTS						
Industrial User Name	SIC or NAICS Code	CIU[2]	Y/N or NR[5]	IND or GEN or NR	Last Action[6]	TBLLs or TBLLs only[7]	New User [3] (Y or N)	Times Inspected by the CA	Times Sampled by the CA	BMR	90-Day	Semi-Annual	Self-Monitoring[8]	NSCIU Certifications	Effluent Limits	Narrative Standards

1 Include all significant industrial users (SIUs), non-significant categorical industrial users (NSCIUs) as defined in 40 CFR § 403.3(v)(2), and/or middle tier categorical industrial users (MTCIUs) as defined in 40 CFR § 403.12(e)(3). Please do not include non-significant noncategorical IUs that are covered under best management practices (BMPs) or general control mechanisms.

2 Categorical determination (include 40 CFR citation and NSCIU or MTCIU status, if applicable).

3 Indicate whether the IU is a new user. If the answer is No or N, then indicate the expiration date of the last issued IU permit.

4 The term SNC applies to a broader range of violations, such as daily maximum, long-term average, instantaneous limits, and narrative standards (which may include enforceable BMPs, narrative limits and/or operational standards). Any other violation, or group of violations, which the POTW determines will adversely affect the operation or implementation of the local Pretreatment Program now includes BMP violations (40 CFR § 403.8(f)(2)(viii)(H)).

5 Code NR= None required (NSCIUs only); IND = individual control mechanism; GEN = general control mechanism. Include as a footnote (or on a separate page) the name of the general control mechanism used for similar groups of IUs, identify the similar types of operations and types of wastes that are the same for each general control mechanism. Any BMPs through general control mechanisms that are applied to nonsignificant IUs need to be reported separately, *e.g.* the sector type and BMP description.

6 Permit or NSCIU evaluations as applicable.

7 According to 40 CFR § 403.12(i)(1), indicate whether the IU is subject to technically based local limits (TBLLs) that are more stringent than categorical pretreatment standards, *e.g.* where there is one end-of-pipe sampling point at a CIU, and you have determined that the TBLLs are more stringent than the categorical pretreatment standards for any pollutant at the end-of-pipe sampling point; **OR** the IU is subject only to local limits (TBLLs only), *e.g.* the IU is a non-categorical SIU subject only to TBLLs at the end-of-pipe sampling point.

8 For those IUs where a monitoring waiver has been granted, please add the code "W" (after either C, NC, or SNC codes) and indicate the pollutant(s) for which the waiver has been granted.

TPDES Pretreatment Program Annual Report Form for Industrial User Inventory Modifications

Reporting month/year: ___________, _____ to ___________, _____

TPDES Permit No: ________ **Permittee:** _______ **Treatment Plant:** _____________

INDUSTRIAL USER INVENTORY MODIFICATIONS					
FACILITY NAME, ADDRESS AND CONTACT PERSON	ADD, CHANGE, DELETE (Including categorical reclassification to NSCIU or MTCIU)	IF DELETION: Reason For Deletion	IF ADDITION OR SIGNIFICANT CHANGE:		
			PROCESS DESCRIPTION	POLLUTANTS (Including any sampling waiver given for each pollutant not present)	FLOW RATE [9] (In gpd) R = Regulated U = Unregulated T = Total

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9 For NSCIUs, total flow must be given, if regulated flow is not determined.

TPDES Pretreatment Program Annual Report Form for Enforcement Actions Taken

Reporting month/year: ___________, _____ to ___________, _____

TPDES Permit No: __________Permittee:________Treatment Plant: ____________

Overall SNC ___% SNC [10] based on: Effluent Violations_____%
Reporting Violations_____% Narrative Standard Violations___%

Noncompliant Industrial Users - Enforcement Actions Taken

Industrial User Name	Nature of Violation [11]				Number of Actions Taken					Penalties Collected (Do not Include Surcharge)	Compliance Schedule			Current Status Returned to Compliance: (Y or N)	Comments
	Effluent Limits	Reports	NSCIU Certifications	Narrative Standards	NOV	A.O.	Civil	Criminal	Other		Y or N	Date Issued	Date Due		

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10 # %
__ __ Pretreatment Standards [WENDB-PSNC] (Local Limits/Categorical Standards)
__ __ Reporting Requirements [WENDB-PSNC]
__ __ Narrative Standards

11 Please specify a separate number for each type of violation, *e.g.* report, notification, and/or NSCIU certification.

TPDES Pretreatment Program Annual Report Form for Influent and Effluent Monitoring Results[1]

Reporting month/year: ___________, _____ to ___________, _____

TPDES Permit No.: ________ Permittee:____________Treatment Plant: ________

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS											
POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L) [3]	Effluent Measured in µg/L (Actual Concentration or < MAL) [4]			
		Date	Date	Date	Date			Date	Date	Date	Date
METALS, CYANIDE AND PHENOLS											
Antimony, Total											
Arsenic, Total											
Beryllium, Total											
Cadmium, Total											
Chromium, Total											
Chromium (Hex)											
Chromium (Tri)[5]											
Copper, Total											
Lead, Total											
Mercury, Total											
Nickel, Total											
Selenium, Total											
Silver, Total											
Thallium, Total											
Zinc, Total											
Cyanide, Available [6]											
Cyanide, Total											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
		Date	Date	Date	Date			Date	Date	Date	Date
Phenols, Total											
VOLATILE COMPOUNDS											
Acrolein											
Acrylonitrile											
Benzene											
Bromoform							See TTHM				
Carbon Tetrachloride											
Chlorobenzene											
Chlorodibromomethane							See TTHM				
Chloroethane											
2-Chloroethylvinyl Ether											
Chloroform							See TTHM				
Dichlorobromomethane							See TTHM				
1,1-Dichloroethane											
1,2-Dichloroethane											
1,1-Dichloroethylene											
1,2-Dichloropropane											
1,3-Dichloropropylene											
Ethyl benzene											
Methyl Bromide											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL^{2}	Daily Average Effluent Limit (µg/L) ^{3}	Effluent Measured in µg/L (Actual Concentration or < MAL) ^{4}			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Methyl Chloride							▨				
Methylene Chloride							▨				
1,1,2,2-Tetra-chloroethane							▨				
Tetrachloroethylene											
Toluene							▨				
1,2-Trans-Dichloroethylene							▨				
1,1,1-Trichloroethane											
1,1,2-Trichloroethane							▨				
Trichloroethylene											
Vinyl Chloride											
ACID COMPOUNDS											
2-Chlorophenol							▨				
2,4-Dichlorophenol							▨				
2,4-Dimethylphenol							▨				
4,6-Dinitro-o-Cresol							▨				
2,4-Dinitrophenol							▨				
2-Nitrophenol							▨				
4-Nitrophenol							▨				
P-Chloro-m-Cresol							▨				
Pentachlorophenol											
Phenol											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L) [3]	Effluent Measured in µg/L (Actual Concentration or < MAL) [4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
2,4,6-Trichlorophenol							▨				
BASE/NEUTRAL COMPOUNDS											
Acenaphthene							▨				
Acenaphthylene							▨				
Anthracene							▨				
Benzidine											
Benzo(a)Anthracene											
Benzo(a)Pyrene											
3,4-Benzofluoranthene							▨				
Benzo(ghi)Perylene							▨				
Benzo(k)Fluoranthene							▨				
Bis(2-Chloroethoxy)Methane							▨				
Bis(2-Chloroethyl)Ether							▨				
Bis(2-Chloroisopropyl)Ether							▨				
Bis(2-Ethylhexyl)Phthalate							▨				
4-Bromophenyl Phenyl Ether							▨				
Butylbenzyl Phthalate							▨				
2-Chloronaphthalene							▨				
4-Chlorophenyl Phenyl Ether							▨				

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS											
POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L) [3]	Effluent Measured in µg/L (Actual Concentration or < MAL) [4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Chrysene											
Dibenzo(a,h)Anthracene							▨				
1,2-Dichlorobenzene							▨				
1,3-Dichlorobenzene							▨				
1,4-Dichlorobenzene											
3,3-Dichlorobenzidine							▨				
Diethyl Phthalate							▨				
Dimethyl Phthalate							▨				
Di-n-Butyl Phthalate							▨				
2,4-Dinitrotoluene							▨				
2,6-Dinitrotoluene							▨				
Di-n-Octyl Phthalate							▨				
1,2-Diphenyl Hydrazine							▨				
Fluoranthene							▨				
Fluorene							▨				
Hexachlorobenzene											
Hexachlorobutadiene											
Hexachloro-cyclopentadiene							▨				
Hexachloroethane											
Indeno(1,2,3-cd)pyrene							▨				
Isophorone							▨				

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L) [3]	Effluent Measured in µg/L (Actual Concentration or < MAL) [4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Naphthalene							▨				
Nitrobenzene											
N-Nitrosodimethylamine							▨				
N-Nitrosodi-n-Propylamine							▨				
N-Nitrosodiphenylamine							▨				
Phenanthrene											
Pyrene							▨				
1,2,4-Trichlorobenzene							▨				
PESTICIDES											
Aldrin											
Alpha-hexachlorocyclohexane (BHC)											
beta-BHC											
gamma-BHC (Lindane)											
delta-BHC							▨				
Chlordane											
4,4-DDT											
4,4-DDE											
4,4-DDD											
Dieldrin											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS											
POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
		Date	Date	Date	Date			Date	Date	Date	Date
alpha-Endosulfan											
beta-Endosulfan											
Endosulfan Sulfate											
Endrin											
Endrin Aldehyde											
Heptachlor											
Heptachlor Epoxide											
Polychlorinated biphenols (PCBs) *The sum of PCB concentrations not to exceed daily average value.*											
PCB-1242							See PCBs				
PCB-1254							See PCBs				
PCB-1221							See PCBs				
PCB-1232							See PCBs				
PCB-1248							See PCBs				
PCB-1260							See PCBs				
PCB-1016							See PCBs				
Toxaphene											
ADDITIONAL TOXIC POLLUTANTS REGULATED UNDER 30 TAC CHAPTER 307											
Aluminum											
Barium											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L) [3]	Effluent Measured in µg/L (Actual Concentration or < MAL) [4]			
		Date	Date	Date	Date			Date	Date	Date	Date
Bis(chloromethyl) ether [7]											
Carbaryl											
Chloropyrifos											
Cresols											
2,4-D											
Danitol [8]											
Demeton											
Diazinon											
Dicofol											
Dioxin/Furans [9]											
Diuron											
Fluoride											
Guthion											
Hexachlorophene											
Malathion											
Methoxychlor											
Methyl Ethyl Ketone											
Mirex											
Nitrate-Nitrogen											
N-Nitrosodiethylamine											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
		Date	Date	Date	Date			Date	Date	Date	Date
N-Nitroso-di-n-Butylamine											
Nonylphenol											
Parathion											
Pentachlorobenzene											
Pyridine											
1,2-Dibromoethane											
1,2,4,5-Tetrachlorobenzene											
2,4,5-TP (Silvex)											
Tributyltin[9]											
2,4,5-Trichlorophenol											
TTHM (Total Trihalomethanes)											

Endnotes:

1. It is advised that the permittee collect the influent and effluent samples considering flow detention time through each wastewater treatment plant (WWTP).

2. The MAHL of the approved TBLLs or for each pollutant of concern (POC) for which the permittee has calculated a MAHL. Only complete the column labeled, "Average Influent % of the MAHL", as a percentage, for pollutants that have approved TBLLs or for each POC for which the permittee has calculated a MAHL (U.S. Environmental Protection Agency *Local Limits Development Guidance*, July 2004, EPA933-R-04-002A).

   The % of the MAHL is to be calculated using the following formulas:

   Equation A: $L_{INF} = (C_{POLL} \times Q_{WWTP} \times 8.34) / 1000$

   Equation B: $L_{\%} = (L_{INF} / MAHL) \times 100$

   Where:

L_{INF} =	Current Average (Avg) influent loading in lb/day
C_{POLL} =	Avg concentration in µg/L of all influent samples collected during the pretreatment year.
Q_{WWTP} =	Annual average flow of the WWTP in MGD, defined as the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months (or during the pretreatment year), and as described in the Definitions and Standard Permit Conditions section.
$L_{\%}$ =	% of the MAHL
MAHL =	Calculated MAHL in lb/day
8.34 =	Unit conversion factor

3. Daily average effluent limit (metal values are for total metals) as derived by the Texas Toxicity Modeling Program (TexTox). Effluent limits as calculated are designed to be protective of the Texas Surface Water Quality Standards. The permittee shall determine and indicate which effluent limit is the most stringent between the 30 TAC Chapter 319, Subchapter B (Hazardous Metals) limit, TexTox values, or any applicable limit in the Effluent Limitations and Monitoring Requirements Section of the TPDES permit. Shaded blocks need not be filled in unless the permittee has received a permit requirement/limit for the particular parameter.

4. Minimum analytical levels (MALs) and analytical methods as suggested in Tables E-1 and E-2 of the *Procedures to Implement the Texas Surface Water Quality Standards* (June 2010), as amended and adopted by the TCEQ. Pollutants that are not detectable above the MAL need to be reported as less than (<) the MAL numeric value.

5. Report result by subtracting Hexavalent Chromium from Total Chromium.

6. Either the method for Amenable to Chlorination or Weak-Acid Dissociable is authorized.

7. Hydrolyzes in water. Will not require permittee to analyze at this time.

8. EPA procedure not approved. Will not require permittee to analyze at this time.

9. Analyses are not required at this time for these pollutants unless there is reason to believe these pollutants may be present.

BIOMONITORING REQUIREMENTS

CHRONIC BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this section apply to Outfall 001 for WET testing.

1. Scope, Frequency, and Methodology

   a. The permittee shall test the effluent for toxicity in accordance with the provisions below. Such testing will determine if an appropriately dilute effluent sample adversely affects the survival, reproduction, or growth of the test organisms.

   b. The permittee shall conduct the following toxicity tests using the test organisms, procedures, and quality assurance requirements specified in this part of this permit and in accordance with "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms" (EPA-821-R-02-013), fourth edition or its most recent update:

      1) Chronic static renewal 7-day survival and reproduction test using the water flea (*Ceriodaphnia dubia*) (Method 1002.0). This test should be terminated when 60% of the surviving adults in the control produce three broods or at the end of eight days, whichever occurs first. This test shall be conducted once per quarter.

      2) Chronic static renewal 7-day larval survival and growth test using the fathead minnow (*Pimephales promelas*) (Method 1000.0). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution. This test shall be conducted once per quarter.

   The permittee must perform and report a valid test for each test species during the prescribed reporting period. An invalid test must be repeated during the same reporting period. An invalid test is defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit.

   c. The permittee shall use five effluent dilution concentrations and a control in each toxicity test. These effluent dilution concentrations are 16%, 22%, 29%, 39%, and 52% effluent. The critical dilution, defined as 39% effluent, is the effluent concentration representative of the proportion of effluent in the receiving water during critical low flow or critical mixing conditions.

   d. This permit may be amended to require a WET limit, a chemical-specific effluent limit, a best management practice, or other appropriate actions to address toxicity. The permittee may be required to conduct a toxicity reduction evaluation (TRE) after multiple toxic events.

   e. Testing Frequency Reduction

      1) If none of the first four consecutive quarterly tests demonstrates significant toxicity, the permittee may submit this information in writing

and, upon approval, reduce the testing frequency to once per six months for the invertebrate test species and once per year for the vertebrate test species.

2) If one or more of the first four consecutive quarterly tests demonstrates significant toxicity, the permittee shall continue quarterly testing for that species until this permit is reissued. If a testing frequency reduction had been previously granted and a subsequent test demonstrates significant toxicity, the permittee shall resume a quarterly testing frequency for that species until this permit is reissued.

2. Required Toxicity Testing Conditions

a. Test Acceptance - The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fail to meet the following criteria:

1) a control mean survival of 80% or greater;

2) a control mean number of water flea neonates per surviving adult of 15 or greater;

3) a control mean dry weight of surviving fathead minnow larvae of 0.25 mg or greater;

4) a control coefficient of variation percent (CV%) of 40 or less in between replicates for the young of surviving females in the water flea test; and the growth and survival endpoints in the fathead minnow test;

5) a critical dilution CV% of 40 or less for the young of surviving females in the water flea test; and the growth and survival endpoints for the fathead minnow test. However, if statistically significant lethal or nonlethal effects are exhibited at the critical dilution, a CV% greater than 40 shall not invalidate the test;

6) a percent minimum significant difference of 47 or less for water flea reproduction; and

7) a percent minimum significant difference of 30 or less for fathead minnow growth.

b. Statistical Interpretation

1) For the water flea survival test, the statistical analyses used to determine if there is a significant difference between the control and an effluent dilution shall be the Fisher's exact test as described in the manual referenced in in Part 1.b.

2) For the water flea reproduction test and the fathead minnow larval survival and growth tests, the statistical analyses used to determine if there is a significant difference between the control and an effluent dilution shall be in accordance with the manual referenced in Part 1.b.

3) The permittee is responsible for reviewing test concentration-response relationships to ensure that calculated test-results are interpreted and reported correctly. The document entitled "Method Guidance and Recommendation for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136)" (EPA 821-B-00-004) provides guidance on determining the validity of test results.

4) If significant lethality is demonstrated (that is, there is a statistically significant difference in survival at the critical dilution when compared to the survival in the control), the conditions of test acceptability are met, and the survival of the test organisms are equal to or greater than 80% in the critical dilution and all dilutions below that, then the permittee shall report a survival No Observed Effect Concentration (NOEC) of not less than the critical dilution for the reporting requirements.

5) The NOEC is defined as the greatest effluent dilution at which no significant effect is demonstrated. The Lowest Observed Effect Concentration (LOEC) is defined as the lowest effluent dilution at which a significant effect is demonstrated. A significant effect is defined as a statistically significant difference between the survival, reproduction, or growth of the test organism in a specified effluent dilution when compared to the survival, reproduction, or growth of the test organism in the control.

6) The use of NOECs and LOECs assumes either a monotonic (continuous) concentration-response relationship or a threshold model of the concentration-response relationship. For any test result that demonstrates a non-monotonic (non-continuous) response, the NOEC should be determined based on the guidance manual referenced in Item 3.

7) Pursuant to the responsibility assigned to the permittee in Part 2.b.3), test results that demonstrate a non-monotonic (non-continuous) concentration-response relationship may be submitted, prior to the due date, for technical review. The guidance manual referenced in Item 3 will be used when making a determination of test acceptability.

8) TCEQ staff will review test results for consistency with rules, procedures, and permit requirements.

c. Dilution Water

1) Dilution water used in the toxicity tests must be the receiving water collected at a point upstream of the discharge point as close as possible to the discharge point but unaffected by the discharge. Where the toxicity tests are conducted on effluent discharges to receiving waters that are classified as intermittent streams, or where the toxicity tests are conducted on effluent discharges where no receiving water is available due to zero flow conditions, the permittee shall:

a) substitute a synthetic dilution water that has a pH, hardness, and alkalinity similar to that of the closest downstream perennial water unaffected by the discharge; or

b) use the closest downstream perennial water unaffected by the discharge.

2) Where the receiving water proves unsatisfactory as a result of pre-existing instream toxicity (i.e. fails to fulfill the test acceptance criteria of Part 2.a.), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

a) a synthetic lab water control was performed (in addition to the receiving water control) which fulfilled the test acceptance requirements of Part 2.a;

b) the test indicating receiving water toxicity was carried out to completion (i.e., 7 days); and

c) the permittee submitted all test results indicating receiving water toxicity with the reports and information required in Part 3.

3) The synthetic dilution water shall consist of standard, moderately hard, reconstituted water. Upon approval, the permittee may substitute other appropriate dilution water with chemical and physical characteristics similar to that of the receiving water.

d. Samples and Composites

1) The permittee shall collect a minimum of three composite samples from Outfall 001. The second and third composite samples will be used for the renewal of the dilution concentrations for each toxicity test.

2) The permittee shall collect the composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance being discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the first composite sample. The holding time for any subsequent composite sample shall not exceed 72 hours. Samples shall be maintained at a temperature of 0-6 degrees Centigrade during collection, shipping, and storage.

4) If Outfall 001 ceases discharging during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions, and the sample holding time are waived during that sampling period. However, the permittee must have collected an effluent composite sample volume sufficient to complete the required toxicity tests with renewal of the effluent. When possible, the

effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report.

5) The effluent samples shall not be dechlorinated after sample collection.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in this section shall be submitted to the attention of the Standards Implementation Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted in accordance with the manual referenced in Part 1.b. for every valid and invalid toxicity test initiated whether carried to completion or not.

b. The permittee shall routinely report the results of each biomonitoring test on the Table 1 forms provided with this permit.

1) Annual biomonitoring test results are due on or before January 20th for biomonitoring conducted during the previous 12-month period.

2) Semiannual biomonitoring test results are due on or before July 20th and January 20th for biomonitoring conducted during the previous 6-month period.

3) Quarterly biomonitoring test results are due on or before April 20th, July 20th, October 20th, and January 20th for biomonitoring conducted during the previous calendar quarter.

4) Monthly biomonitoring test results are due on or before the 20th day of the month following sampling.

c. Enter the following codes for the appropriate parameters for valid tests only:

1) For the water flea, Parameter TLP3B, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

2) For the water flea, Parameter TOP3B, report the NOEC for survival.

3) For the water flea, Parameter TXP3B, report the LOEC for survival.

4) For the water flea, Parameter TWP3B, enter a "1" if the NOEC for reproduction is less than the critical dilution; otherwise, enter a "0."

5) For the water flea, Parameter TPP3B, report the NOEC for reproduction.

6) For the water flea, Parameter TYP3B, report the LOEC for reproduction.

7) For the fathead minnow, Parameter TLP6C, enter a "1" if the NOEC for

survival is less than the critical dilution; otherwise, enter a "0."

8) For the fathead minnow, Parameter TOP6C, report the NOEC for survival.

9) For the fathead minnow, Parameter TXP6C, report the LOEC for survival.

10) For the fathead minnow, Parameter TWP6C, enter a "1" if the NOEC for growth is less than the critical dilution; otherwise, enter a "0."

11) For the fathead minnow, Parameter TPP6C, report the NOEC for growth.

12) For the fathead minnow, Parameter TYP6C, report the LOEC for growth.

d. Enter the following codes for retests only:

1) For retest number 1, Parameter 22415, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

2) For retest number 2, Parameter 22416, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

4. Persistent Toxicity

The requirements of this Part apply only when a test demonstrates a significant effect at the critical dilution. Significant lethality and significant effect were defined in Part 2.b. Significant sublethality is defined as a statistically significant difference in growth/reproduction at the critical dilution when compared to the growth/reproduction in the control.

a. The permittee shall conduct a total of 2 additional tests (retests) for any species that demonstrates a significant effect (lethal or sublethal) at the critical dilution. The two retests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two retests in lieu of routine toxicity testing. All reports shall be submitted within 20 days of test completion. Test completion is defined as the last day of the test.

b. If the retests are performed due to a demonstration of significant lethality, and one or both of the two retests specified in Part 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5. The provisions of Part 4.a. are suspended upon completion of the two retests and submittal of the TRE action plan and schedule defined in Part 5.

If neither test demonstrates significant lethality and the permittee is testing under the reduced testing frequency provision of Part 1.e., the permittee shall return to a quarterly testing frequency for that species.

c. If the two retests are performed due to a demonstration of significant sublethality, and one or both of the two retests specified in Part 4.a. demonstrates significant lethality, the permittee shall again perform two retests as stipulated in Part 4.a.

d. If the two retests are performed due to a demonstration of significant sublethality, and neither test demonstrates significant lethality, the permittee shall continue testing at the quarterly frequency.

e. Regardless of whether retesting for lethal or sublethal effects, or a combination of the two, no more than one retest per month is required for a species.

5. Toxicity Reduction Evaluation

a. Within 45 days of the retest that demonstrates significant lethality, or within 45 days of being so instructed due to multiple toxic events, the permittee shall submit a general outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the retest that demonstrates significant lethality, or within 90 days of being so instructed due to multiple toxic events, the permittee shall submit a TRE action plan and schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A TRE is a step-wise investigation combining toxicity testing with physical and chemical analyses to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE action plan shall describe an approach for the reduction or elimination of lethality for both test species defined in Part 1.b. At a minimum, the TRE action plan shall include the following:

1) Specific Activities - The TRE action plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA/600/6-91/005F) or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE action plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/identification/confirmation procedures and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects a

specific pollutant and source of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and suspected pollutant and source of effluent toxicity;

3) Quality Assurance Plan - The TRE action plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, and mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE action plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE action plan and schedule, the permittee shall implement the TRE.

d. The permittee shall submit quarterly TRE activities reports concerning the progress of the TRE. The quarterly reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and suspected pollutant performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and substantiating documentation which identifies the pollutant(s) and source of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data that identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution; and

6) any changes to the initial TRE plan and schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE activities report shall also be submitted to the U.S. EPA Region 6 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species. Testing for the less sensitive species shall continue at the frequency specified in Part 1.b.

f. If the effluent ceases to effect significant lethality, i.e., there is a cessation of lethality, the permittee may end the TRE. A cessation of lethality is defined as no significant lethality for a period of 12 consecutive months with at least monthly testing. At the end of the 12 months, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b.

This provision accommodates situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality. This provision does not apply as a result of corrective actions taken by the permittee. Corrective actions are defined as proactive efforts that eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, the permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing and replacing the WET limit with an alternate toxicity control measure by identifying and confirming the toxicant and an appropriate control measure.

g. The permittee shall complete the TRE and submit a final report on the TRE activities no later than 28 months from the last test day of the retest that confirmed significant lethal effects at the critical dilution. The permittee may petition the Executive Director (in writing) for an extension of the 28-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in its pursuit of the toxicity identification evaluation/TRE and must prove that circumstances beyond its control stalled the toxicity identification evaluation/TRE. The report shall provide information pertaining to the specific control mechanism selected that will, when implemented, result in the reduction of effluent toxicity to no significant lethality at the critical dilution. The report shall also provide a specific corrective action schedule for implementing the selected control mechanism. A copy of the TRE final report shall also be submitted to the U.S. EPA Region 6 office.

h. Based on the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements, where necessary, require a compliance schedule for implementation of corrective actions, specify a WET limit, specify a best management practice, and specify a chemical-specific limit.

TABLE 1 (SHEET 1 OF 4)

BIOMONITORING REPORTING

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION

		Date Time		Date Time
Dates and Times Composites Collected	No. 1 FROM:	____________________	TO:	______________________
	No. 2 FROM:	____________________	TO:	______________________
	No. 3 FROM:	____________________	TO:	______________________

Test initiated: ____________________________am/pm ___________________________date

Dilution water used: ________ Receiving water _______ Synthetic Dilution water

NUMBER OF YOUNG PRODUCED PER ADULT AT END OF TEST

REP	Percent effluent					
	0%	16%	22%	29%	39%	52%
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
Survival Mean						
Total Mean						
CV%*						
PMSD						

*Coefficient of Variation = standard deviation x 100/mean (calculation based on young of the surviving adults)

Designate males (M), and dead females (D), along with number of neonates (x) released prior to death.

TABLE 1 (SHEET 2 OF 4)

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION TEST

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

Is the mean number of young produced per adult significantly less than the number of young per adult in the control for the % effluent corresponding to significant nonlethal effects?

CRITICAL DILUTION (39%): _______ YES _______ NO

PERCENT SURVIVAL

	Percent effluent					
Time of Reading	0%	16%	22%	29%	39%	52%
24h						
48h						
End of Test						

2. Fisher's Exact Test:

Is the mean survival at test end significantly less than the control survival for the % effluent corresponding to lethality?

CRITICAL DILUTION (39%): _______ YES _______ NO

3. Enter percent effluent corresponding to each NOEC\LOEC below:

a.) NOEC survival = ___________% effluent

b.) LOEC survival = ___________% effluent

c.) NOEC reproduction = ___________% effluent

d.) LOEC reproduction = ___________% effluent

TABLE 1 (SHEET 3 OF 4)

BIOMONITORING REPORTING

FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL

		Date Time		Date Time
Dates and Times Composites Collected	No. 1	FROM: ______________________	TO:	__________________
	No. 2	FROM: ______________________	TO:	__________________
	No. 3	FROM: ______________________	TO:	__________________

Test initiated: __________________________am/pm __________________________date

Dilution water used: _________ Receiving water _________ Synthetic dilution water

FATHEAD MINNOW GROWTH DATA

Effluent Concentration	Average Dry Weight in replicate chambers					Mean Dry Weight	CV%*
	A	B	C	D	E		
0%							
16%							
22%							
29%							
39%							
52%							
PMSD							

* Coefficient of Variation = standard deviation x 100/mean

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean dry weight (growth) at 7 days significantly less than the control's dry weight (growth) for the % effluent corresponding to significant nonlethal effects?

   CRITICAL DILUTION (39%): _______ YES _______ NO

TABLE 1 (SHEET 4 OF 4)

BIOMONITORING REPORTING

FATHEAD MINNOW GROWTH AND SURVIVAL TEST

FATHEAD MINNOW SURVIVAL DATA

Effluent Concentration	Percent Survival in replicate chambers					Mean percent survival			CV%*
	A	B	C	D	E	24h	48h	7 day	
0%									
16%									
22%									
29%									
39%									
52%									

* Coefficient of Variation = standard deviation x 100/mean

2. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

Is the mean survival at 7 days significantly less than the control survival for the % effluent corresponding to lethality?

CRITICAL DILUTION (39%): _______ YES _______ NO

3. Enter percent effluent corresponding to each NOEC\LOEC below:

a.) NOEC survival = ___________% effluent

b.) LOEC survival = ___________% effluent

c.) NOEC growth = ___________% effluent

d.) LOEC growth = ___________% effluent

24-HOUR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this section apply to Outfall 001 for WET testing.

1. Scope, Frequency, and Methodology

   a. The permittee shall test the effluent for lethality in accordance with the provisions in this section. Such testing will determine compliance with Texas Surface Water Quality Standard 30 TAC § 307.6(e)(2)(B), which requires greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

   b. The toxicity tests specified shall be conducted once per six months. The permittee shall conduct the following toxicity tests using the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms" (EPA-821-R-02-012), fifth edition or its most recent update:

      1) Acute 24-hour static toxicity test using the water flea (*Daphnia pulex* or *Ceriodaphnia dubia*). A minimum of five replicates with eight organisms per replicate shall be used in the control and each dilution.

      2) Acute 24-hour static toxicity test using the fathead minnow (*Pimephales promelas*). A minimum of five replicates with eight organisms per replicate shall be used in the control and each dilution.

      A valid test result must be submitted for each reporting period. The permittee must report, and then repeat, an invalid test during the same reporting period. The repeat test shall include the control and the 100% effluent dilution and use the appropriate number of organisms and replicates, as specified above. An invalid test is defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit.

   c. In addition to an appropriate control, a 100% effluent concentration shall be used in the toxicity tests. The control and dilution water shall consist of standard, synthetic, moderately hard, reconstituted water.

   d. This permit may be amended to require a WET limit, a best management practice, a chemical-specific limit, or other appropriate actions to address toxicity. The permittee may be required to conduct a toxicity reduction evaluation (TRE) after multiple toxic events.

2. Required Toxicity Testing Conditions

   a. Test Acceptance - The permittee shall repeat any toxicity test, including the control, if the control fails to meet a mean survival equal to or greater than 90%.

   b. Dilution Water - In accordance with Part 1.c., the control and dilution water shall consist of standard, synthetic, moderately hard, reconstituted water.

c. Samples and Composites

1) The permittee shall collect one composite sample from Outfall 001.

2) The permittee shall collect the composite sample such that the sample is representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance being discharged.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the composite sample. The sample shall be maintained at a temperature of 0-6 degrees Centigrade during collection, shipping, and storage.

4) If Outfall 001 ceases discharging during the collection of the effluent composite sample, the requirements for the minimum number of effluent portions are waived. However, the permittee must have collected a composite sample volume sufficient for completion of the required test. The abbreviated sample collection, duration, and methodology must be documented in the full report.

5) The effluent sample shall not be dechlorinated after sample collection.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in this section shall be submitted to the attention of the Standards Implementation Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted in accordance with the manual referenced in Part 1.b. for every valid and invalid toxicity test initiated.

b. The permittee shall routinely report the results of each biomonitoring test on the Table 2 forms provided with this permit.

1) Semiannual biomonitoring test results are due on or before July 20th and January 20th for biomonitoring conducted during the previous 6-month period.

2) Quarterly biomonitoring test results are due on or before April 20th, July 20th, and October 20th, and January 20th for biomonitoring conducted during the previous calendar quarter.

c. Enter the following codes for the appropriate parameters for valid tests only:

1) For the water flea, Parameter TIE3D, enter a "0" if the mean survival at 24 hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

2) For the fathead minnow, Parameter TIE6C, enter a "0" if the mean survival at 24 hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

d. Enter the following codes for retests only:

1) For retest number 1, Parameter 22415, enter a "0" if the mean survival at 24 hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

2) For retest number 2, Parameter 22416, enter a "0" if the mean survival at 24 hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

4. Persistent Mortality

The requirements of this part apply when a toxicity test demonstrates significant lethality, which is defined as a mean mortality of 50% or greater of organisms exposed to the 100% effluent concentration for 24 hours.

a. The permittee shall conduct 2 additional tests (retests) for each species that demonstrates significant lethality. The two retests shall be conducted once per week for 2 weeks. Five effluent dilution concentrations in addition to an appropriate control shall be used in the retests. These effluent concentrations are 6%, 13%, 25%, 50% and 100% effluent. The first retest shall be conducted within 15 days of the laboratory determination of significant lethality. All test results shall be submitted within 20 days of test completion of the second retest. Test completion is defined as the 24th hour.

b. If one or both of the two retests specified in Part 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5.

5. Toxicity Reduction Evaluation

a. Within 45 days of the retest that demonstrates significant lethality, the permittee shall submit a general outline for initiating a TRE. The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the retest that demonstrates significant lethality, the permittee shall submit a TRE action plan and schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A TRE is a step-wise investigation combining toxicity testing with physical and chemical analyses to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE action plan shall lead to the successful elimination of significant lethality for both test species defined in Part 1.b. At a minimum, the TRE action plan shall include the following:

1) Specific Activities - The TRE action plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA/600/6-91/003) or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled "Methods for Aquatic Toxicity Identification Evaluations: Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations: Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE action plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/identification/confirmation procedures and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant and source of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and suspected pollutant and source of effluent toxicity;

3) Quality Assurance Plan - The TRE action plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, and mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE action plan and schedule, the permittee shall implement the TRE.

d. The permittee shall submit quarterly TRE activities reports concerning the progress of the TRE. The quarterly TRE activities reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and suspected pollutant performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and substantiating documentation that identifies the pollutant and source of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data that identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to eliminate significant lethality; and

6) any changes to the initial TRE plan and schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE activities report shall also be submitted to the U.S. EPA Region 6 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species. Testing for the less sensitive species shall continue at the frequency specified in Part 1.b.

f. If the effluent ceases to effect significant lethality, i.e., there is a cessation of lethality, the permittee may end the TRE. A cessation of lethality is defined as no significant lethality for a period of 12 consecutive weeks with at least weekly testing. At the end of the 12 weeks, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b.

This provision accommodates situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality. This provision does not apply as a result of corrective actions taken by the permittee. Corrective actions are defined as proactive efforts that eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, the permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing and replacing the WET limit with an alternate toxicity control measure by identifying and confirming the toxicant and an appropriate control measure.

g. The permittee shall complete the TRE and submit a final report on the TRE activities no later than 18 months from the last test day of the retest that demonstrates significant lethality. The permittee may petition the Executive Director (in writing) for an extension of the 18-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in its pursuit of the toxicity identification evaluation/TRE and must prove that circumstances beyond its control stalled the toxicity identification evaluation/TRE. The report shall specify the control mechanism that will, when implemented, reduce effluent toxicity as specified in Part 5.h. The report shall also specify a corrective action schedule for implementing the selected control mechanism. A copy of the TRE final report shall also be submitted to the U.S. EPA Region 6 office.

h. Within 3 years of the last day of the test confirming toxicity, the permittee shall comply with 30 TAC § 307.6(e)(2)(B), which requires greater than 50% survival of the test organism in 100% effluent at the end of 24-hours. The permittee may petition the Executive Director (in writing) for an extension of the 3-year limit. However, to warrant an extension the permittee must have demonstrated due diligence in its pursuit of the toxicity identification evaluation/TRE and must prove that circumstances beyond its control stalled the toxicity identification evaluation/TRE.

The permittee may be exempted from complying with 30 TAC § 307.6(e)(2)(B) upon proving that toxicity is caused by an excess, imbalance, or deficiency of dissolved salts. This exemption excludes instances where individually toxic components (e.g., metals) form a salt compound. Following the exemption, this permit may be amended to include an ion-adjustment protocol, alternate species testing, or single species testing.

i. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements where necessary, require a compliance schedule for implementation of corrective actions, specify a WET limit, specify a best management practice, and specify a chemical-specific limit.

TABLE 2 (SHEET 1 OF 2)

WATER FLEA SURVIVAL

GENERAL INFORMATION

	Time	Date
Composite Sample Collected		
Test Initiated		

PERCENT SURVIVAL

Time	Rep	Percent effluent					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN						

Enter percent effluent corresponding to the LC50 below:

24 hour LC50 = _______% effluent

TABLE 2 (SHEET 2 OF 2)

FATHEAD MINNOW SURVIVAL

GENERAL INFORMATION

	Time	Date
Composite Sample Collected		
Test Initiated		

PERCENT SURVIVAL

Time	Rep	Percent effluent					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN						

Enter percent effluent corresponding to the LC50 below:

24 hour LC50 = _______% effluent

Austin SWIFT Loan Application
Part D, Item 62
Walnut Creek WWTP TPDES Permit

TPDES PERMIT NO. WQ0010543011
*[For TCEQ office use only - EPA I.D.
No. TX0046981]*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
P.O. Box 13087
Austin, Texas 78711-3087

This is a renewal that replaces TPDES Permit No. WQ0010543011 issued April 22, 2010.

PERMIT TO DISCHARGE WASTES
under provisions of
Section 402 of the Clean Water Act
and Chapter 26 of the Texas Water Code

City of Austin

whose mailing address is

P.O. Box 1088
Austin, Texas 78767

is authorized to treat and discharge wastes from the Walnut Creek Wastewater Treatment Facility, SIC Code 4952

located at 7113 Farm-to-Market Road 969, Austin in Travis County, Texas 78724

to Colorado River Below Lady Bird Lake/Town Lake in Segment No. 1428 of the Colorado River Basin

only according with effluent limitations, monitoring requirements and other conditions set forth in this permit, as well as the rules of the Texas Commission on Environmental Quality (TCEQ), the laws of the State of Texas, and other orders of the TCEQ. The issuance of this permit does not grant to the permittee the right to use private or public property for conveyance of wastewater along the discharge route described in this permit. This includes, but is not limited to, property belonging to any individual, partnership, corporation, or other entity. Neither does this permit authorize any invasion of personal rights nor any violation of federal, state, or local laws or regulations. It is the responsibility of the permittee to acquire property rights as may be necessary to use the discharge route.

This permit shall expire at midnight, **September 01, 2019**.

ISSUED DATE: January 13, 2015

For the Commission

EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Outfall Number 001

1. During the period beginning upon the date of issuance and lasting through the date of expiration, the permittee is authorized to discharge subject to the following effluent limitations:

   The annual average flow of effluent shall not exceed 75 million gallons per day (MGD); nor shall the average discharge during any two-hour period (2-hour peak) exceed 114,583 gallons per minute (gpm).

Effluent Characteristic	Discharge Limitations				Min. Self-Monitoring Requirements	
					Report Daily Avg. & Daily Max.	
	Daily Avg	7-day Avg	Daily Max	Single Grab		
	mg/l (lbs/day)	mg/l	mg/l	mg/l	Measurement Frequency	Sample Type
Flow, MGD	Report	N/A	Report	N/A	Continuous	Totalizing Meter
*Carbonaceous Biochemical Oxygen Demand (5-day)	10 (6255)	15	25	35	One/day	Composite
Total Suspended Solids	15 (9383)	25	40	60	One/day	Composite
Ammonia Nitrogen	2 (1251)	5	10	15	One/day	Composite
E. coli, CFU or MPN/100 ml	126	N/A	399	N/A	Five/week	Grab

2. The effluent shall contain a chlorine residual of at least 1.0 mg/l after a detention time of at least 20 minutes (based on peak flow) and shall be monitored daily by grab sample. The permittee shall dechlorinate the chlorinated effluent to less than 0.1 mg/l chlorine residual and shall monitor chlorine residual daily by grab sample after the dechlorination process. An equivalent method of disinfection may be substituted only with prior approval of the Executive Director.
3. The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored once per day by grab sample.
4. There shall be no discharge of floating solids or visible foam in other than trace amounts and no discharge of visible oil.
5. Effluent monitoring samples shall be taken at the following location(s): Following the final treatment unit. During flows less than 120 MGD, the chlorine residual shall be monitored at the end of the chlorine contact basins. During flows equal to or greater than 120 MGD, the chlorine residual shall be monitored at the outfall junction box immediately upstream of the location where sulfur dioxide solution is injected. (See Attachment A).
6. The effluent shall contain a minimum dissolved oxygen of 6.0 mg/l and shall be monitored once per day by grab sample.
7. The annual average flow and maximum 2-hour peak flow shall be reported monthly.

**Effective April 1998 all permits containing BOD5 limitations with associated ammonia limitations are revised to replace BOD5 limits with CBOD5 limits as established at 30 TAC 309.1(c).*

DEFINITIONS AND STANDARD PERMIT CONDITIONS

As required by Title 30 Texas Administrative Code (TAC) Chapter 305, certain regulations appear as standard conditions in waste discharge permits. 30 TAC § 305.121 - 305.129 (relating to Permit Characteristics and Conditions) as promulgated under the Texas Water Code (TWC) §§ 5.103 and 5.105, and the Texas Health and Safety Code (THSC) §§ 361.017 and 361.024(a), establish the characteristics and standards for waste discharge permits, including sewage sludge, and those sections of 40 Code of Federal Regulations (CFR) Part 122 adopted by reference by the Commission. The following text includes these conditions and incorporates them into this permit. All definitions in TWC § 26.001 and 30 TAC Chapter 305 shall apply to this permit and are incorporated by reference. Some specific definitions of words or phrases used in this permit are as follows:

1. Flow Measurements

   a. Annual average flow - the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months. The annual average flow determination shall consist of daily flow volume determinations made by a totalizing meter, charted on a chart recorder and limited to major domestic wastewater discharge facilities with one million gallons per day or greater permitted flow.

   b. Daily average flow - the arithmetic average of all determinations of the daily flow within a period of one calendar month. The daily average flow determination shall consist of determinations made on at least four separate days. If instantaneous measurements are used to determine the daily flow, the determination shall be the arithmetic average of all instantaneous measurements taken during that month. Daily average flow determination for intermittent discharges shall consist of a minimum of three flow determinations on days of discharge.

   c. Daily maximum flow - the highest total flow for any 24-hour period in a calendar month.

   d. Instantaneous flow - the measured flow during the minimum time required to interpret the flow measuring device.

   e. 2-hour peak flow (domestic wastewater treatment plants) - the maximum flow sustained for a two-hour period during the period of daily discharge. The average of multiple measurements of instantaneous maximum flow within a two-hour period may be used to calculate the 2-hour peak flow.

   f. Maximum 2-hour peak flow (domestic wastewater treatment plants) - the highest 2-hour peak flow for any 24-hour period in a calendar month.

2. Concentration Measurements

   a. Daily average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar month, consisting of at least four separate representative measurements.

      i. For domestic wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values in the previous four consecutive month period consisting of at least four measurements shall be utilized as the daily average concentration.

  ii. For all other wastewater treatment plants - When four samples are not available in a calendar month, the arithmetic average (weighted by flow) of all values taken during the month shall be utilized as the daily average concentration.

b. 7-day average concentration - the arithmetic average of all effluent samples, composite or grab as required by this permit, within a period of one calendar week, Sunday through Saturday.

c. Daily maximum concentration - the maximum concentration measured on a single day, by the sample type specified in the permit, within a period of one calendar month.

d. Daily discharge - the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the daily discharge is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the daily discharge is calculated as the average measurement of the pollutant over the sampling day.

   The daily discharge determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily discharge determination of concentration shall be the arithmetic average (weighted by flow value) of all samples collected during that day.

e. Bacteria concentration (*E. coli* or Enterococci) - Colony Forming Units (CFU) or Most Probable Number (MPN) of bacteria per 100 milliliters effluent. The daily average bacteria concentration is a geometric mean of the values for the effluent samples collected in a calendar month. The geometric mean shall be determined by calculating the nth root of the product of all measurements made in a calendar month, where n equals the number of measurements made; or, computed as the antilogarithm of the arithmetic mean of the logarithms of all measurements made in a calendar month. For any measurement of bacteria equaling zero, a substituted value of one shall be made for input into either computation method. If specified, the 7-day average for bacteria is the geometric mean of the values for all effluent samples collected during a calendar week.

f. Daily average loading (lbs/day) - the arithmetic average of all daily discharge loading calculations during a period of one calendar month. These calculations must be made for each day of the month that a parameter is analyzed. The daily discharge, in terms of mass (lbs/day), is calculated as (Flow, MGD x Concentration, mg/l x 8.34).

g. Daily maximum loading (lbs/day) - the highest daily discharge, in terms of mass (lbs/day), within a period of one calendar month.

3. Sample Type

a. Composite sample - For domestic wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (a). For industrial wastewater, a composite sample is a sample made up of a minimum of three effluent portions collected in a continuous 24-hour period or during the period of daily discharge if less than 24 hours, and combined in volumes proportional to flow, and collected at the intervals required by 30 TAC § 319.9 (b).

b. Grab sample - an individual sample collected in less than 15 minutes.

4. Treatment Facility (facility) - wastewater facilities used in the conveyance, storage, treatment, recycling, reclamation and/or disposal of domestic sewage, industrial wastes, agricultural wastes, recreational wastes, or other wastes including sludge handling or disposal facilities under the jurisdiction of the Commission.

5. The term "sewage sludge" is defined as solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in 30 TAC Chapter 312. This includes the solids that have not been classified as hazardous waste separated from wastewater by unit processes.

6. Bypass - the intentional diversion of a waste stream from any portion of a treatment facility.

MONITORING AND REPORTING REQUIREMENTS

1. Self-Reporting

   Monitoring results shall be provided at the intervals specified in the permit. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall conduct effluent sampling and reporting in accordance with 30 TAC §§ 319.4 - 319.12. Unless otherwise specified, a monthly effluent report shall be submitted each month, to the Enforcement Division (MC 224), by the 20th day of the following month for each discharge which is described by this permit whether or not a discharge is made for that month. Monitoring results must be reported on an approved self-report form that is signed and certified as required by Monitoring and Reporting Requirements No. 10.

   As provided by state law, the permittee is subject to administrative, civil and criminal penalties, as applicable, for negligently or knowingly violating the Clean Water Act (CWA); TWC §§ 26, 27, and 28; and THSC § 361, including but not limited to knowingly making any false statement, representation, or certification on any report, record, or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance, or falsifying, tampering with or knowingly rendering inaccurate any monitoring device or method required by this permit or violating any other requirement imposed by state or federal regulations.

2. Test Procedures

   a. Unless otherwise specified in this permit, test procedures for the analysis of pollutants shall comply with procedures specified in 30 TAC §§ 319.11 - 319.12. Measurements, tests, and calculations shall be accurately accomplished in a representative manner.

   b. All laboratory tests submitted to demonstrate compliance with this permit must meet the requirements of 30 TAC § 25, Environmental Testing Laboratory Accreditation and Certification.

3. Records of Results

   a. Monitoring samples and measurements shall be taken at times and in a manner so as to be representative of the monitored activity.

   b. Except for records of monitoring information required by this permit related to the permittee's sewage sludge use and disposal activities, which shall be retained for a period of at least five years (or longer as required by 40 CFR Part 503), monitoring and reporting records, including strip charts and records of calibration and maintenance, copies of all records required by this permit, records of all data used to complete the application for this permit, and the certification required by 40 CFR § 264.73(b)(9) shall be retained at the facility site, or shall be readily available for review by a TCEQ representative for a period of three years from the date of the record or sample, measurement, report, application or certification. This period shall be extended at the request of the Executive Director.

c. Records of monitoring activities shall include the following:

   i. date, time and place of sample or measurement;

   ii. identity of individual who collected the sample or made the measurement.

   iii. date and time of analysis;

   iv. identity of the individual and laboratory who performed the analysis;

   v. the technique or method of analysis; and

   vi. the results of the analysis or measurement and quality assurance/quality control records.

   The period during which records are required to be kept shall be automatically extended to the date of the final disposition of any administrative or judicial enforcement action that may be instituted against the permittee.

4. Additional Monitoring by Permittee

   If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit using approved analytical methods as specified above, all results of such monitoring shall be included in the calculation and reporting of the values submitted on the approved self-report form. Increased frequency of sampling shall be indicated on the self-report form.

5. Calibration of Instruments

   All automatic flow measuring or recording devices and all totalizing meters for measuring flows shall be accurately calibrated by a trained person at plant start-up and as often thereafter as necessary to ensure accuracy, but not less often than annually unless authorized by the Executive Director for a longer period. Such person shall verify in writing that the device is operating properly and giving accurate results. Copies of the verification shall be retained at the facility site and/or shall be readily available for review by a TCEQ representative for a period of three years.

6. Compliance Schedule Reports

   Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of the permit shall be submitted no later than 14 days following each schedule date to the Regional Office and the Enforcement Division (MC 224).

7. Noncompliance Notification

a. In accordance with 30 TAC § 305.125(9) any noncompliance which may endanger human health or safety, or the environment shall be reported by the permittee to the TCEQ. Report of such information shall be provided orally or by facsimile transmission (FAX) to the Regional Office within 24 hours of becoming aware of the noncompliance. A written submission of such information shall also be provided by the permittee to the Regional Office and the Enforcement Division (MC 224) within five working days of becoming aware of the noncompliance. The written submission shall contain a description of the noncompliance and its cause; the potential danger to human health or safety, or the environment; the period of noncompliance, including exact dates and times; if the noncompliance has not been corrected, the time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance, and to mitigate its adverse effects.

b. The following violations shall be reported under Monitoring and Reporting Requirement 7.a.:

   i. Unauthorized discharges as defined in Permit Condition 2(g).

   ii. Any unanticipated bypass that exceeds any effluent limitation in the permit.

   iii. Violation of a permitted maximum daily discharge limitation for pollutants listed specifically in the Other Requirements section of an Industrial TPDES permit.

c. In addition to the above, any effluent violation which deviates from the permitted effluent limitation by more than 40% shall be reported by the permittee in writing to the Regional Office and the Enforcement Division (MC 224) within 5 working days of becoming aware of the noncompliance.

d. Any noncompliance other than that specified in this section, or any required information not submitted or submitted incorrectly, shall be reported to the Enforcement Division (MC 224) as promptly as possible. For effluent limitation violations, noncompliances shall be reported on the approved self-report form.

8. In accordance with the procedures described in 30 TAC §§ 35.301 - 35.303 (relating to Water Quality Emergency and Temporary Orders) if the permittee knows in advance of the need for a bypass, it shall submit prior notice by applying for such authorization.

9. Changes in Discharges of Toxic Substances

All existing manufacturing, commercial, mining, and silvicultural permittees shall notify the Regional Office, orally or by facsimile transmission within 24 hours, and both the Regional Office and the Enforcement Division (MC 224) in writing within five (5) working days, after becoming aware of or having reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant listed at 40 CFR Part 122, Appendix D, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

i. One hundred micrograms per liter (100 μg/L);

ii. Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

iii. Five (5) times the maximum concentration value reported for that pollutant in the permit application; or

iv. The level established by the TCEQ.

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

i. Five hundred micrograms per liter (500 μg/L);

ii. One milligram per liter (1 mg/L) for antimony;

iii. Ten (10) times the maximum concentration value reported for that pollutant in the permit application; or
iv. The level established by the TCEQ.

10. Signatories to Reports

All reports and other information requested by the Executive Director shall be signed by the person and in the manner required by 30 TAC § 305.128 (relating to Signatories to Reports).

11. All Publicly Owned Treatment Works (POTWs) must provide adequate notice to the Executive Director of the following:

a. Any new introduction of pollutants into the POTW from an indirect discharger which would be subject to CWA § 301 or § 306 if it were directly discharging those pollutants;

b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit; and

c. For the purpose of this paragraph, adequate notice shall include information on:

i. The quality and quantity of effluent introduced into the POTW; and

ii. Any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

PERMIT CONDITIONS

1. General

a. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in an application or in any report to the Executive Director, it shall promptly submit such facts or information.

b. This permit is granted on the basis of the information supplied and representations made by the permittee during action on an application, and relying upon the accuracy and completeness of that information and those representations. After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked, in whole or in part, in accordance with 30 TAC Chapter 305, Subchapter D, during its term for good cause including, but not limited to, the following:

   i. Violation of any terms or conditions of this permit;

   ii. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

   iii. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

c. The permittee shall furnish to the Executive Director, upon request and within a reasonable time, any information to determine whether cause exists for amending, revoking, suspending or terminating the permit. The permittee shall also furnish to the Executive Director, upon request, copies of records required to be kept by the permit.

2. Compliance

   a. Acceptance of the permit by the person to whom it is issued constitutes acknowledgment and agreement that such person will comply with all the terms and conditions embodied in the permit, and the rules and other orders of the Commission.

   b. The permittee has a duty to comply with all conditions of the permit. Failure to comply with any permit condition constitutes a violation of the permit and the Texas Water Code or the Texas Health and Safety Code, and is grounds for enforcement action, for permit amendment, revocation, or suspension, or for denial of a permit renewal application or an application for a permit for another facility.

   c. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

   d. The permittee shall take all reasonable steps to minimize or prevent any discharge or sludge use or disposal or other permit violation that has a reasonable likelihood of adversely affecting human health or the environment.

   e. Authorization from the Commission is required before beginning any change in the permitted facility or activity that may result in noncompliance with any permit requirements.

   f. A permit may be amended, suspended and reissued, or revoked for cause in accordance with 30 TAC §§ 305.62 and 305.66 and TWC§ 7.302. The filing of a request by the permittee for a permit amendment, suspension and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

   g. There shall be no unauthorized discharge of wastewater or any other waste. For the purpose of this permit, an unauthorized discharge is considered to be any discharge of wastewater into or adjacent to water in the state at any location not permitted as an outfall or otherwise defined in the Other Requirements section of this permit.

h. In accordance with 30 TAC § 305.535(a), the permittee may allow any bypass to occur from a TPDES permitted facility which does not cause permitted effluent limitations to be exceeded or an unauthorized discharge to occur, but only if the bypass is also for essential maintenance to assure efficient operation.

i. The permittee is subject to administrative, civil, and criminal penalties, as applicable, under TWC §§ 7.051 - 7.075 (relating to Administrative Penalties), 7.101 - 7.111 (relating to Civil Penalties), and 7.141 - 7.202 (relating to Criminal Offenses and Penalties) for violations including, but not limited to, negligently or knowingly violating the federal CWA §§ 301, 302, 306, 307, 308, 318, or 405, or any condition or limitation implementing any sections in a permit issued under the CWA § 402, or any requirement imposed in a pretreatment program approved under the CWA §§ 402 (a)(3) or 402 (b)(8).

3. Inspections and Entry

   a. Inspection and entry shall be allowed as prescribed in the TWC Chapters 26, 27, and 28, and THSC § 361.

   b. The members of the Commission and employees and agents of the Commission are entitled to enter any public or private property at any reasonable time for the purpose of inspecting and investigating conditions relating to the quality of water in the state or the compliance with any rule, regulation, permit or other order of the Commission. Members, employees, or agents of the Commission and Commission contractors are entitled to enter public or private property at any reasonable time to investigate or monitor or, if the responsible party is not responsive or there is an immediate danger to public health or the environment, to remove or remediate a condition related to the quality of water in the state. Members, employees, Commission contractors, or agents acting under this authority who enter private property shall observe the establishment's rules and regulations concerning safety, internal security, and fire protection, and if the property has management in residence, shall notify management or the person then in charge of his presence and shall exhibit proper credentials. If any member, employee, Commission contractor, or agent is refused the right to enter in or on public or private property under this authority, the Executive Director may invoke the remedies authorized in TWC § 7.002. The statement above, that Commission entry shall occur in accordance with an establishment's rules and regulations concerning safety, internal security, and fire protection, is not grounds for denial or restriction of entry to any part of the facility, but merely describes the Commission's duty to observe appropriate rules and regulations during an inspection.

4. Permit Amendment and/or Renewal

   a. The permittee shall give notice to the Executive Director as soon as possible of any planned physical alterations or additions to the permitted facility if such alterations or additions would require a permit amendment or result in a violation of permit requirements. Notice shall also be required under this paragraph when:

      i. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in accordance with 30 TAC § 305.534 (relating to New Sources and New Dischargers); or

ii. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants that are subject neither to effluent limitations in the permit, nor to notification requirements in Monitoring and Reporting Requirements No. 9;

iii. The alteration or addition results in a significant change in the permittee's sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use or disposal sites not reported during the permit application process or not reported pursuant to an approved land application plan.

b. Prior to any facility modifications, additions, or expansions that will increase the plant capacity beyond the permitted flow, the permittee must apply for and obtain proper authorization from the Commission before commencing construction.

c. The permittee must apply for an amendment or renewal at least 180 days prior to expiration of the existing permit in order to continue a permitted activity after the expiration date of the permit. If an application is submitted prior to the expiration date of the permit, the existing permit shall remain in effect until the application is approved, denied, or returned. If the application is returned or denied, authorization to continue such activity shall terminate upon the effective date of the action. If an application is not submitted prior to the expiration date of the permit, the permit shall expire and authorization to continue such activity shall terminate.

d. Prior to accepting or generating wastes which are not described in the permit application or which would result in a significant change in the quantity or quality of the existing discharge, the permittee must report the proposed changes to the Commission. The permittee must apply for a permit amendment reflecting any necessary changes in permit conditions, including effluent limitations for pollutants not identified and limited by this permit.

e. In accordance with the TWC § 26.029(b), after a public hearing, notice of which shall be given to the permittee, the Commission may require the permittee, from time to time, for good cause, in accordance with applicable laws, to conform to new or additional conditions.

f. If any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under CWA § 307(a) for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition. The permittee shall comply with effluent standards or prohibitions established under CWA § 307(a) for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

5. Permit Transfer

a. Prior to any transfer of this permit, Commission approval must be obtained. The Commission shall be notified in writing of any change in control or ownership of facilities authorized by this permit. Such notification should be sent to the Applications Review and Processing Team (MC 148) of the Water Quality Division.

b. A permit may be transferred only according to the provisions of 30 TAC § 305.64 (relating to Transfer of Permits) and 30 TAC § 50.133 (relating to Executive Director Action on Application or WQMP update).

6. Relationship to Hazardous Waste Activities

This permit does not authorize any activity of hazardous waste storage, processing, or disposal that requires a permit or other authorization pursuant to the Texas Health and Safety Code.

7. Relationship to Water Rights

Disposal of treated effluent by any means other than discharge directly to water in the state must be specifically authorized in this permit and may require a permit pursuant to TWC Chapter 11.

8. Property Rights

A permit does not convey any property rights of any sort, or any exclusive privilege.

9. Permit Enforceability

The conditions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstances, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

10. Relationship to Permit Application

The application pursuant to which the permit has been issued is incorporated herein; provided, however, that in the event of a conflict between the provisions of this permit and the application, the provisions of the permit shall control.

11. Notice of Bankruptcy

a. Each permittee shall notify the Executive Director, in writing, immediately following the filing of a voluntary or involuntary petition for bankruptcy under any chapter of Title 11 (Bankruptcy) of the United States Code (11 USC) by or against:

    i. the permittee;

    ii. an entity (as that term is defined in 11 USC, § 101(14)) controlling the permittee or listing the permit or permittee as property of the estate; or

    iii. an affiliate (as that term is defined in 11 USC, § 101(2)) of the permittee.

b. This notification must indicate:

    i. the name of the permittee and the permit number(s);

    ii. the bankruptcy court in which the petition for bankruptcy was filed; and

    iii. the date of filing of the petition.

OPERATIONAL REQUIREMENTS

1. The permittee shall at all times ensure that the facility and all of its systems of collection, treatment, and disposal are properly operated and maintained. This includes, but is not limited to, the regular, periodic examination of wastewater solids within the treatment plant by the operator in order to maintain an appropriate quantity and quality of solids inventory as described in the various operator training manuals and according to accepted industry standards for process control. Process control, maintenance, and operations records shall be retained at the facility site, or shall be readily available for review by a TCEQ representative, for a period of three years.

2. Upon request by the Executive Director, the permittee shall take appropriate samples and provide proper analysis in order to demonstrate compliance with Commission rules. Unless otherwise specified in this permit or otherwise ordered by the Commission, the permittee shall comply with all applicable provisions of 30 TAC Chapter 312 concerning sewage sludge use and disposal and 30 TAC §§ 319.21 - 319.29 concerning the discharge of certain hazardous metals.

3. Domestic wastewater treatment facilities shall comply with the following provisions:

    a. The permittee shall notify the Municipal Permits Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, in writing, of any facility expansion at least 90 days prior to conducting such activity.

    b. The permittee shall submit a closure plan for review and approval to the Municipal Permits Team, Wastewater Permitting Section (MC 148) of the Water Quality Division, for any closure activity at least 90 days prior to conducting such activity. Closure is the act of permanently taking a waste management unit or treatment facility out of service and includes the permanent removal from service of any pit, tank, pond, lagoon, surface impoundment and/or other treatment unit regulated by this permit.

4. The permittee is responsible for installing prior to plant start-up, and subsequently maintaining, adequate safeguards to prevent the discharge of untreated or inadequately treated wastes during electrical power failures by means of alternate power sources, standby generators, and/or retention of inadequately treated wastewater.

5. Unless otherwise specified, the permittee shall provide a readily accessible sampling point and, where applicable, an effluent flow measuring device or other acceptable means by which effluent flow may be determined.

6. The permittee shall remit an annual water quality fee to the Commission as required by 30 TAC Chapter 21. Failure to pay the fee may result in revocation of this permit under TWC § 7.302(b)(6).

7. Documentation

    For all written notifications to the Commission required of the permittee by this permit, the permittee shall keep and make available a copy of each such notification under the same conditions as self-monitoring data are required to be kept and made available. Except for information required for TPDES permit applications, effluent data, including effluent data in permits, draft permits and permit applications, and other information specified as not confidential in 30 TAC §§ 1.5(d), any information submitted pursuant to this permit may be claimed as confidential by the submitter. Any such claim must be asserted in the manner prescribed in the application form or by stamping the words confidential business information on each page containing such information. If no claim is made at the time of submission, information may be made available to the public without further notice. If the Commission or Executive Director agrees with the designation of confidentiality, the TCEQ will not provide the information for public inspection unless required by the Texas Attorney General or a court pursuant to an open records request. If the Executive Director does not agree with the designation of confidentiality, the person submitting the information will be notified.

8. Facilities that generate domestic wastewater shall comply with the following provisions; domestic wastewater treatment facilities at permitted industrial sites are excluded.

   a. Whenever flow measurements for any domestic sewage treatment facility reach 75% of the permitted daily average or annual average flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the domestic wastewater treatment and/or collection facilities. Whenever the flow reaches 90% of the permitted daily average or annual average flow for three consecutive months, the permittee shall obtain necessary authorization from the Commission to commence construction of the necessary additional treatment and/or collection facilities. In the case of a domestic wastewater treatment facility which reaches 75% of the permitted daily average or annual average flow for three consecutive months, and the planned population to be served or the quantity of waste produced is not expected to exceed the design limitations of the treatment facility, the permittee shall submit an engineering report supporting this claim to the Executive Director of the Commission.

      If in the judgment of the Executive Director the population to be served will not cause permit noncompliance, then the requirement of this section may be waived. To be effective, any waiver must be in writing and signed by the Director of the Enforcement Division (MC 169) of the Commission, and such waiver of these requirements will be reviewed upon expiration of the existing permit; however, any such waiver shall not be interpreted as condoning or excusing any violation of any permit parameter.

   b. The plans and specifications for domestic sewage collection and treatment works associated with any domestic permit must be approved by the Commission and failure to secure approval before commencing construction of such works or making a discharge is a violation of this permit and each day is an additional violation until approval has been secured.

   c. Permits for domestic wastewater treatment plants are granted subject to the policy of the Commission to encourage the development of area-wide waste collection, treatment, and disposal systems. The Commission reserves the right to amend any domestic wastewater permit in accordance with applicable procedural requirements to require the system covered by this permit to be integrated into an area-wide system, should such be developed; to require the delivery of the wastes authorized to be collected in, treated by or discharged from said system, to such area-wide system; or to amend this permit in any other particular to effectuate the Commission's policy. Such amendments may be made when the changes required are advisable for water quality control purposes and are feasible on the basis of waste treatment technology, engineering, financial, and related considerations existing at the time the changes are required, exclusive of the loss of investment in or revenues from any then existing or proposed waste collection, treatment or disposal system.

9. Domestic wastewater treatment plants shall be operated and maintained by sewage plant operators holding a valid certificate of competency at the required level as defined in 30 TAC Chapter 30.

10. For Publicly Owned Treatment Works (POTWs), the 30-day average (or monthly average) percent removal for BOD and TSS shall not be less than 85%, unless otherwise authorized by this permit.

11. Facilities that generate industrial solid waste as defined in 30 TAC § 335.1 shall comply with these provisions:

    a. Any solid waste, as defined in 30 TAC § 335.1 (including but not limited to such wastes as garbage, refuse, sludge from a waste treatment, water supply treatment plant or air pollution control facility, discarded materials, discarded materials to be recycled, whether the waste is solid, liquid, or semisolid), generated by the permittee during the management and treatment of wastewater, must be managed in accordance with all applicable provisions of 30 TAC Chapter 335, relating to Industrial Solid Waste Management.

    b. Industrial wastewater that is being collected, accumulated, stored, or processed before discharge through any final discharge outfall, specified by this permit, is considered to be industrial solid waste until the wastewater passes through the actual point source discharge and must be managed in accordance with all applicable provisions of 30 TAC Chapter 335.

    c. The permittee shall provide written notification, pursuant to the requirements of 30 TAC § 335.8(b)(1), to the Environmental Cleanup Section (MC 127) of the Remediation Division informing the Commission of any closure activity involving an Industrial Solid Waste Management Unit, at least 90 days prior to conducting such an activity.

    d. Construction of any industrial solid waste management unit requires the prior written notification of the proposed activity to the Registration and Reporting Section (MC 129) of the Registration, Review, and Reporting Division. No person shall dispose of industrial solid waste, including sludge or other solids from wastewater treatment processes, prior to fulfilling the deed recordation requirements of 30 TAC § 335.5.

    e. The term "industrial solid waste management unit" means a landfill, surface impoundment, waste-pile, industrial furnace, incinerator, cement kiln, injection well, container, drum, salt dome waste containment cavern, or any other structure vessel, appurtenance, or other improvement on land used to manage industrial solid waste.

    f. The permittee shall keep management records for all sludge (or other waste) removed from any wastewater treatment process. These records shall fulfill all applicable requirements of 30 TAC § 335 and must include the following, as it pertains to wastewater treatment and discharge:

        i. Volume of waste and date(s) generated from treatment process;
        ii. Volume of waste disposed of on-site or shipped off-site;

   iii. Date(s) of disposal;
   iv. Identity of hauler or transporter;
   v. Location of disposal site; and
   vi. Method of final disposal.

   The above records shall be maintained on a monthly basis. The records shall be retained at the facility site, or shall be readily available for review by authorized representatives of the TCEQ for at least five years.

12. For industrial facilities to which the requirements of 30 TAC § 335 do not apply, sludge and solid wastes, including tank cleaning and contaminated solids for disposal, shall be disposed of in accordance with THSC § 361.

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SLUDGE PROVISIONS

The permittee is authorized to dispose of sludge only at a Texas Commission on Environmental Quality (TCEQ) authorized land application site or co-disposal landfill. **The disposal of sludge by land application on property owned, leased or under the direct control of the permittee is a violation of the permit unless the site is authorized with the TCEQ. This provision does not authorize Distribution and Marketing of sludge. This provision does not authorize land application of Class A Sludge. This provision does not authorize the permittee to land apply sludge on property owned, leased or under the direct control of the permittee.**

SECTION I. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE LAND APPLICATION

A. General Requirements

1. The permittee shall handle and dispose of sewage sludge in accordance with 30 TAC § 312 and all other applicable state and federal regulations in a manner that protects public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants that may be present in the sludge.

2. In all cases, if the person (permit holder) who prepares the sewage sludge supplies the sewage sludge to another person for land application use or to the owner or lease holder of the land, the permit holder shall provide necessary information to the parties who receive the sludge to assure compliance with these regulations.

3. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

B. Testing Requirements

1. Sewage sludge shall be tested annually in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I Toxicity Characteristic Leaching Procedure (TCLP) or other method that receives the prior approval of the TCEQ for the contaminants listed in 40 CFR Part 261.24, Table 1. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal. Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TCEQ Registration and Reporting Section (MC 129) of the Permitting and Remediation Support Division and the Regional Director (MC Region 11) within seven (7) days after failing the TCLP Test.

   The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to:

Director, Registration, Review, and Reporting Division (MC 129), Texas Commission on Environmental Quality, P.O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TCEQ Regional Office (MC Region 11) and the Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30 of each year.

2. Sewage sludge shall not be applied to the land if the concentration of the pollutants exceeds the pollutant concentration criteria in Table 1. The frequency of testing for pollutants in Table 1 is found in Section I.C.

TABLE 1

Pollutant	Ceiling Concentration (Milligrams per kilogram)*
Arsenic	75
Cadmium	85
Chromium	3000
Copper	4300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
PCBs	49
Selenium	100
Zinc	7500

* Dry weight basis

3. Pathogen Control

All sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following methods to ensure that the sludge meets either the Class A or Class B pathogen requirements.

a. Six alternatives are available to demonstrate compliance with Class A sewage sludge. The first 4 options require either the density of fecal coliform in the sewage sludge be less than 1000 Most Probable Number (MPN) per gram of total solids (dry weight basis), or the density of Salmonella sp. bacteria in the sewage sludge be less than three MPN per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. Below are the additional requirements necessary to meet the definition of a Class A sludge.

Alternative 1 - The temperature of the sewage sludge that is used or disposed shall be maintained at or above a specific value for a period of time. See 30 TAC § 312.82(a)(2)(A) for specific information.

Alternative 2 - The pH of the sewage sludge that is used or disposed shall be raised to above 12 std. units and shall remain above 12 std. units for 72 hours.

The temperature of the sewage sludge shall be above 52° Celsius for 12 hours or longer during the period that the pH of the sewage sludge is above 12 std. units.

At the end of the 72-hour period during which the pH of the sewage sludge is above 12 std. units, the sewage sludge shall be air dried to achieve a percent solids in the sewage sludge greater than 50%.

Alternative 3 - The sewage sludge shall be analyzed for enteric viruses prior to pathogen treatment. The limit for enteric viruses is less than one Plaque-forming Unit per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 30 TAC § 312.82(a)(2)(C)(i-iii) for specific information. The sewage sludge shall be analyzed for viable helminth ova prior to pathogen treatment. The limit for viable helminth ova is less than one per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 30 TAC § 312.82(a)(2)(C)(iv-vi) for specific information.

Alternative 4 - The density of enteric viruses in the sewage sludge shall be less than one Plaque-forming Unit per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed. The density of viable helminth ova in the sewage sludge shall be less than one per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed.

Alternative 5 (PFRP) - Sewage sludge that is used or disposed of shall be treated in one of the processes to Further Reduce Pathogens (PFRP) described in 40 CFR Part 503, Appendix B. PFRP include composting, heat drying, heat treatment, and thermophilic aerobic digestion.

Alternative 6 (PFRP Equivalent) - Sewage sludge that is used or disposed of shall be treated in a process that has been approved by the U.S. Environmental Protection Agency as being equivalent to those in Alternative 5.

b. Three alternatives are available to demonstrate compliance with Class B criteria for sewage sludge.

Alternative 1

i. A minimum of seven random samples of the sewage sludge shall be collected within 48 hours of the time the sewage sludge is used or disposed of during each monitoring episode for the sewage sludge.

ii. The geometric mean of the density of fecal coliform in the samples collected shall be less than either 2,000,000 MPN per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).

Alternative 2 - Sewage sludge that is used or disposed of shall be treated in one of the Processes to Significantly Reduce Pathogens (PSRP) described in 40 CFR Part 503, Appendix B, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. An independent Texas Licensed Professional Engineer must make a certification to the generator of a sewage sludge that the wastewater treatment facility generating the sewage sludge is designed to achieve one of the PSRP at the permitted design loading of the facility. The certification need only be repeated if the design loading of the facility is increased. The certification shall include a statement indicating the design meets all the applicable standards specified in Appendix B of 40 CFR Part 503;

iii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U.S. Environmental Protection Agency final guidance;

iv. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review; and

v. If the sewage sludge is generated from a mixture of sources, resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the PSRP, and shall meet the certification, operation, and record keeping requirements of this paragraph.

Alternative 3 - Sewage sludge shall be treated in an equivalent process that has been approved by the U.S. Environmental Protection Agency, so long as all of the following requirements are met by the generator of the sewage sludge.

i. Prior to use or disposal, all the sewage sludge must have been generated from a single location, except as provided in paragraph v. below;

ii. Prior to any off-site transportation or on-site use or disposal of any sewage sludge generated at a wastewater treatment facility, the chief certified operator of the wastewater treatment facility or other responsible official who manages the processes to significantly reduce pathogens at the wastewater treatment facility for the permittee, shall certify that the sewage sludge underwent at least the minimum operational requirements necessary in order to meet one of the PSRP. The acceptable processes and the minimum operational and record keeping requirements shall be in accordance with established U.S. Environmental Protection Agency final guidance;

iii. All certification records and operational records describing how the requirements of this paragraph were met shall be kept by the generator for a minimum of three years and be available for inspection by commission staff for review;

iv. The Executive Director will accept from the U.S. Environmental Protection Agency a finding of equivalency to the defined PSRP; and

v. If the sewage sludge is generated from a mixture of sources resulting from a person who prepares sewage sludge from more than one wastewater treatment facility, the resulting derived product shall meet one of the Processes to Significantly Reduce Pathogens, and shall meet the certification, operation, and record keeping requirements of this paragraph.

In addition, the following site restrictions must be met if Class B sludge is land applied:

i. Food crops with harvested parts that touch the sewage sludge/soil mixture and are totally above the land surface shall not be harvested for 14 months after application of sewage sludge.

ii. Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of sewage sludge when the sewage sludge remains on the land surface for 4 months or longer prior to incorporation into the soil.

iii. Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of sewage sludge when the sewage sludge remains on the land surface for less than 4 months prior to incorporation into the soil.

iv. Food crops, feed crops, and fiber crops shall not be harvested for 30 days after application of sewage sludge.

v. Animals shall not be allowed to graze on the land for 30 days after application of sewage sludge.

vi. Turf grown on land where sewage sludge is applied shall not be harvested for 1 year after application of the sewage sludge when the harvested turf is placed on either land with a high potential for public exposure or a lawn.

vii. Public access to land with a high potential for public exposure shall be restricted for 1 year after application of sewage sludge.

viii. Public access to land with a low potential for public exposure shall be restricted for 30 days after application of sewage sludge.

ix. Land application of sludge shall be in accordance with the buffer zone requirements found in 30 TAC § 312.44.

4. Vector Attraction Reduction Requirements

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following Alternatives 1 through 10 for vector attraction reduction.

Alternative 1 - The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38%.

<u>Alternative 2</u> - If Alternative 1 cannot be met for an anaerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30° and 37° Celsius. Volatile solids must be reduced by less than 17% to demonstrate compliance.

<u>Alternative 3</u> - If Alternative 1 cannot be met for an aerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge with percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20° Celsius. Volatile solids must be reduced by less than 15% to demonstrate compliance.

<u>Alternative 4</u> - The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20° Celsius.

<u>Alternative 5</u> - Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40° Celsius and the average temperature of the sewage sludge shall be higher than 45° Celsius.

<u>Alternative 6</u> - The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali shall remain at 12 or higher for two hours and then remain at a pH of 11.5 or higher for an additional 22 hours at the time the sewage sludge is prepared for sale or given away in a bag or other container.

<u>Alternative 7</u> - The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75% based on the moisture content and total solids prior to mixing with other materials. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

<u>Alternative 8</u> - The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90% based on the moisture content and total solids prior to mixing with other materials at the time the sludge is used. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

<u>Alternative 9</u> -

i. Sewage sludge shall be injected below the surface of the land.

ii. No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected.

iii. When sewage sludge that is injected below the surface of the land is Class A with respect to pathogens, the sewage sludge shall be injected below the land surface within eight hours after being discharged from the pathogen treatment process.

Alternative 10-

i. Sewage sludge applied to the land surface or placed on a surface disposal site shall be incorporated into the soil within six hours after application to or placement on the land.

ii. When sewage sludge that is incorporated into the soil is Class A with respect to pathogens, the sewage sludge shall be applied to or placed on the land within eight hours after being discharged from the pathogen treatment process.

C. Monitoring Requirements

Toxicity Characteristic Leaching Procedure (TCLP) Test	- annually
PCBs	- annually

All metal constituents and fecal coliform or Salmonella sp. bacteria shall be monitored at the appropriate frequency shown below, pursuant to 30 TAC § 312.46(a)(1):

Amount of sewage sludge (*) metric tons per 365-day period	Monitoring Frequency
0 to less than 290	Once/Year
290 to less than 1,500	Once/Quarter
1,500 to less than 15,000	Once/Two Months
15,000 or greater	Once/Month

(*) *The amount of bulk sewage sludge applied to the land (dry weight basis).*

Representative samples of sewage sludge shall be collected and analyzed in accordance with the methods referenced in 30 TAC § 312.7

SECTION II. REQUIREMENTS SPECIFIC TO BULK SEWAGE SLUDGE FOR APPLICATION TO THE LAND MEETING CLASS A or B PATHOGEN REDUCTION AND THE CUMULATIVE LOADING RATES IN TABLE 2, OR CLASS B PATHOGEN REDUCTION AND THE POLLUTANT CONCENTRATIONS IN TABLE 3

For those permittees meeting Class A or B pathogen reduction requirements and that meet the cumulative loading rates in Table 2 below, or the Class B pathogen reduction requirements and contain concentrations of pollutants below listed in Table 3, the following conditions apply:

A. Pollutant Limits

Table 2

Pollutant	Cumulative Pollutant Loading Rate (pounds per acre)*
Arsenic	36
Cadmium	35
Chromium	2677
Copper	1339
Lead	268
Mercury	15
Molybdenum	Report Only
Nickel	375
Selenium	89
Zinc	2500

Table 3

Pollutant	Monthly Average Concentration (milligrams per kilogram)*
Arsenic	41
Cadmium	39
Chromium	1200
Copper	1500
Lead	300
Mercury	17
Molybdenum	Report Only
Nickel	420
Selenium	36
Zinc	2800

*Dry weight basis

B. Pathogen Control

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, a reclamation site, shall be treated by either Class A or Class B pathogen reduction requirements as defined above in Section I.B.3.

C. Management Practices

1. Bulk sewage sludge shall not be applied to agricultural land, forest, a public contact site, or a reclamation site that is flooded, frozen, or snow-covered so that the bulk sewage sludge enters a wetland or other waters in the State.

2. Bulk sewage sludge not meeting Class A requirements shall be land applied in a manner which complies with the Management Requirements in accordance with 30 TAC § 312.44.

3. Bulk sewage sludge shall be applied at or below the agronomic rate of the cover crop.

4. An information sheet shall be provided to the person who receives bulk sewage sludge sold or given away. The information sheet shall contain the following information:

   a. The name and address of the person who prepared the sewage sludge that is sold or given away in a bag or other container for application to the land.

   b. A statement that application of the sewage sludge to the land is prohibited except in accordance with the instruction on the label or information sheet.

   c. The annual whole sludge application rate for the sewage sludge application rate for the sewage sludge that does not cause any of the cumulative pollutant loading rates in Table 2 above to be exceeded, unless the pollutant concentrations in Table 3 found in Section II above are met.

D. Notification Requirements

1. If bulk sewage sludge is applied to land in a State other than Texas, written notice shall be provided prior to the initial land application to the permitting authority for the State in which the bulk sewage sludge is proposed to be applied. The notice shall include:

   a. The location, by street address, and specific latitude and longitude, of each land application site.

   b. The approximate time period bulk sewage sludge will be applied to the site.

   c. The name, address, telephone number, and National Pollutant Discharge Elimination System permit number (if appropriate) for the person who will apply the bulk sewage sludge.

2. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

E. Record keeping Requirements

The sludge documents will be retained at the facility site and/or shall be readily available for review by a TCEQ representative. The person who prepares bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TCEQ representative for a period of five years. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC § 312.47 for persons who land apply.

1. The concentration (mg/kg) in the sludge of each pollutant listed in Table 3 above and the applicable pollutant concentration criteria (mg/kg), or the applicable cumulative pollutant loading rate and the applicable cumulative pollutant loading rate limit (lbs/ac) listed in Table 2 above.

2. A description of how the pathogen reduction requirements are met (including site restrictions for Class B sludge, if applicable).

3. A description of how the vector attraction reduction requirements are met.

4. A description of how the management practices listed above in Section II.C are being met.

5. The following certification statement:

   "I certify, under penalty of law, that the applicable pathogen requirements in 30 TAC § 312.82(a) or (b) and the vector attraction reduction requirements in 30 TAC § 312.83(b) have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."

6. The recommended agronomic loading rate from the references listed in Section II.C.3. above, as well as the actual agronomic loading rate shall be retained. The person who applies bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information at the facility site and/or shall be readily available for review by a TCEQ representative indefinitely. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for record keeping found in 30 TAC § 312.47 for persons who land apply:

   a. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment. See 30 TAC § 312.47(a)(4)(A)(ii) or 30 TAC § 312.47(a)(5)(A)(ii), as applicable, and to the permittee's specific sludge treatment activities.

   b. The location, by street address, and specific latitude and longitude, of each site on which sludge is applied.

   c. The number of acres in each site on which bulk sludge is applied.

   d. The date and time sludge is applied to each site.

   e. The cumulative amount of each pollutant in pounds/acre listed in Table 2 applied to each site.

   f. The total amount of sludge applied to each site in dry tons.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

F. Reporting Requirements

The permittee shall report annually to the TCEQ Regional Office (MC Region 11) and Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division, by September 30 of each year the following information:

1. Results of tests performed for pollutants found in either Table 2 or 3 as appropriate for the permittee's land application practices.
2. The frequency of monitoring listed in Section I.C. that applies to the permittee.
3. Toxicity Characteristic Leaching Procedure (TCLP) results.
4. Identity of hauler(s) and TCEQ transporter number.
5. PCB concentration in sludge in mg/kg.
6. Date(s) of disposal.
7. Owner of disposal site(s).
8. Texas Commission on Environmental Quality registration number, if applicable.
9. Amount of sludge disposal dry weight (lbs/acre) at each disposal site.
10. The concentration (mg/kg) in the sludge of each pollutant listed in Table 1 (defined as a monthly average) as well as the applicable pollutant concentration criteria (mg/kg) listed in Table 3 above, or the applicable pollutant loading rate limit (lbs/acre) listed in Table 2 above if it exceeds 90% of the limit.
11. Level of pathogen reduction achieved (Class A or Class B).
12. Alternative used as listed in Section I.B.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met. If Class B sludge, include information on how site restrictions were met.
13. Vector attraction reduction alternative used as listed in Section I.B.4.
14. Annual sludge production in dry tons/year.
15. Amount of sludge land applied in dry tons/year.
16. The certification statement listed in either 30 TAC § 312.47(a)(4)(A)(ii) or 30 TAC § 312.47(a)(5)(A)(ii) as applicable to the permittee's sludge treatment activities, shall be attached to the annual reporting form.
17. When the amount of any pollutant applied to the land exceeds 90% of the cumulative pollutant loading rate for that pollutant, as described in Table 2, the permittee shall report the following information as an attachment to the annual reporting form.

a. The location, by street address, and specific latitude and longitude.

b. The number of acres in each site on which bulk sewage sludge is applied.

c. The date and time bulk sewage sludge is applied to each site.

d. The cumulative amount of each pollutant (i.e., pounds/acre) listed in Table 2 in the bulk sewage sludge applied to each site.

e. The amount of sewage sludge (i.e., dry tons) applied to each site.

The above records shall be maintained on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

SECTION III. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE DISPOSED IN A MUNICIPAL SOLID WASTE LANDFILL

A. The permittee shall handle and dispose of sewage sludge in accordance with 30 TAC § 330 and all other applicable state and federal regulations to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants that may be present. The permittee shall ensure that the sewage sludge meets the requirements in 30 TAC § 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.

B. If the permittee generates sewage sludge and supplies that sewage sludge to the owner or operator of a municipal solid waste landfill (MSWLF) for disposal, the permittee shall provide to the owner or operator of the MSWLF appropriate information needed to be in compliance with the provisions of this permit.

C. The permittee shall give 180 days prior notice to the Executive Director in care of the Wastewater Permitting Section (MC 148) of the Water Quality Division of any change planned in the sewage sludge disposal practice.

D. Sewage sludge shall be tested annually in accordance with the method specified in both 40 CFR Part 261, Appendix II and 40 CFR Part 268, Appendix I (Toxicity Characteristic Leaching Procedure) or other method, which receives the prior approval of the TCEQ for contaminants listed in Table 1 of 40 CFR § 261.24. Sewage sludge failing this test shall be managed according to RCRA standards for generators of hazardous waste, and the waste's disposition must be in accordance with all applicable requirements for hazardous waste processing, storage, or disposal.

Following failure of any TCLP test, the management or disposal of sewage sludge at a facility other than an authorized hazardous waste processing, storage, or disposal facility shall be prohibited until such time as the permittee can demonstrate the sewage sludge no longer exhibits the hazardous waste toxicity characteristics (as demonstrated by the results of the TCLP tests). A written report shall be provided to both the TCEQ Registration and Reporting Section (MC 129) of the Permitting and Remediation Support Division and the Regional Director (MC Region 11) of the appropriate TCEQ field office within 7 days after failing the TCLP Test.

The report shall contain test results, certification that unauthorized waste management has stopped and a summary of alternative disposal plans that comply with RCRA standards for the management of hazardous waste. The report shall be addressed to: Director, Registration, Review, and Reporting Division (MC 129), Texas Commission on Environmental Quality, P. O. Box 13087, Austin, Texas 78711-3087. In addition, the permittee shall prepare an annual report on the results of all sludge toxicity testing. This annual report shall be submitted to the TCEQ Regional Office (MC Region 11) and the Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30 of each year.

E. Sewage sludge shall be tested as needed, in accordance with the requirements of 30 TAC Chapter 330.

F. Record keeping Requirements

The permittee shall develop the following information and shall retain the information for five years.

1. The description (including procedures followed and the results) of all liquid Paint Filter Tests performed.
2. The description (including procedures followed and results) of all TCLP tests performed.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

G. Reporting Requirements

The permittee shall report annually to the TCEQ Regional Office (MC Region 11) and Water Quality Compliance Monitoring Team (MC 224) of the Enforcement Division by September 30 of each year the following information:

1. Toxicity Characteristic Leaching Procedure (TCLP) results.
2. Annual sludge production in dry tons/year.
3. Amount of sludge disposed in a municipal solid waste landfill in dry tons/year.
4. Amount of sludge transported interstate in dry tons/year.
5. A certification that the sewage sludge meets the requirements of 30 TAC § 330 concerning the quality of the sludge disposed in a municipal solid waste landfill.
6. Identity of hauler(s) and transporter registration number.
7. Owner of disposal site(s).
8. Location of disposal site(s).
9. Date(s) of disposal.

The above records shall be maintained on-site on a monthly basis and shall be made available to the Texas Commission on Environmental Quality upon request.

OTHER REQUIREMENTS

1. The permittee shall employ or contract with one or more licensed wastewater treatment facility operators or wastewater system operations companies holding a valid license or registration according to the requirements of 30 TAC Chapter 30, Occupational Licenses and Registrations and in particular 30 TAC Chapter 30, Subchapter J, Wastewater Operators and Operations Companies.

   This Category A facility must be operated by a chief operator or an operator holding a Category A license or higher. The facility must be operated a minimum of five days per week by the licensed chief operator or an operator holding the required level of license or higher. The licensed chief operator or operator holding the required level of license or higher must be available by telephone or pager seven days per week. Where shift operation of the wastewater treatment facility is necessary, each shift that does not have the on-site supervision of the licensed chief operator must be supervised by an operator in charge who is licensed not less than one level below the category for the facility.

2. The facility is not located in the Coastal Management Program boundary.

3. Chronic toxic criteria apply at the edge of the mixing zone. The mixing zone is defined as 300 feet downstream and 100 feet upstream from the point of discharge.

4. The permittee is hereby placed on notice that this permit may be reviewed by the TCEQ after the completion of any new intensive water quality survey on Segment No. 1428 of the Colorado River Basin and any subsequent updating of the water quality model for Segment No. 1428, in order to determine if the limitations and conditions contained herein are consistent with any such revised model. The permit may be amended, pursuant to 30 TAC §305.62, as a result of such review. The permittee is also hereby placed on notice that effluent limits may be made more stringent at renewal based on, for example, any change to modeling protocol approved in the TCEQ Continuing Planning Process.

5. The permittee shall comply with the requirements of 30 TAC § 309.13 (a) through (d). In addition, by ownership of the required buffer zone area, the permittee shall comply with the requirements of 30 TAC § 309.13(e).

6. The permittee shall provide facilities for the protection of its wastewater treatment facilities from a 100-year flood.

7. Annual average effluent limitations of 5 mg/l $CBOD_5$, 5 mg/l TSS, and 2 mg/l NH_3-N, shall be maintained. The annual average is the sum of the monthly averages divided by 12 based on the calendar year. The results shall be submitted to the Water Quality Information Management Team of the Enforcement Division in January of each year.

8. In accordance with 30 TAC §319.9, a permittee that has at least twelve months of uninterrupted compliance with its bacteria limit may notify the commission in writing of its compliance and request a less frequent measurement schedule. To request a less frequent schedule, the permittee shall submit a written request to the TCEQ Wastewater Permitting Section (MC 148) for each phase that includes a different monitoring frequency. The request must contain all of the reported bacteria values (Daily Avg. and Daily Max/Single Grab) for the twelve consecutive months immediately prior to the request. If the Executive Director finds that a less frequent measurement schedule is protective of human health and the

environment, the permittee may be given a less frequent measurement schedule. For this permit, 5/week may be reduced to 3/week. **A violation of any bacteria limit by a facility that has been granted a less frequent measurement schedule will require the permittee to return to the standard frequency schedule and submit written notice to the TCEQ Wastewater Permitting Section (MC 148).** The permittee may not apply for another reduction in measurement frequency for at least 24 months from the date of the last violation. The Executive Director may establish a more frequent measurement schedule if necessary to protect human health or the environment.

9. The sludge from the treated process may be sent via pipeline to the Hornsby Bend Treatment Facility, Permit No. WQ0003823000 to be digested, dewatered and then disposed of with the bulk of the sludge from the plant accepting the sludge. The permittee shall keep records of all sludge removed from the wastewater treatment plant site. Such records will include the following information.

   a. Volume of sludge hauled.
   b. Date(s) of disposal.
   c. Identity of hauler(s).
   d. Location of the treatment plant to which the sludge is hauled.
   e. Owner of treatment plant and TCEQ permit number.

   The above records shall be maintained on a monthly basis and shall be reported to the TCEQ Regional Office (MC Region 11) and the Water Quality Information Management Systems Team (MC 224) of the Enforcement Division by September 30 of each year.

CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS

1. The permittee shall operate an industrial pretreatment program in accordance with Sections 402(b)(8) and (b)(9) of the Clean Water Act, the General Pretreatment Regulations (40 CFR Part 403) and the approved **City of Austin** POTW pretreatment program submitted by the permittee. The pretreatment program was approved on **December 24, 1983,** modified on **July 22, 1994,** and subsequently modified on **June 2, 2005.**

   The POTW pretreatment program is hereby incorporated by reference and shall be implemented in a manner consistent with the following requirements:

   a. Industrial user (IU) information shall be kept current according to 40 CFR §§403.8(f)(2)(i) and (ii) and updated at a frequency set forth in the approved pretreatment program to reflect accurate characterization of all IUs;

   b. The frequency and nature of IU compliance monitoring activities by the permittee shall be consistent with the approved POTW pretreatment program and commensurate with the character, consistency, and volume of waste. The permittee is required to inspect and sample the effluent from each significant industrial user (SIU) at least once per year, except as specified in 40 CFR §403.8 (f)(2)(v). This is in addition to any industrial self-monitoring activities;

   c. The permittee shall enforce and obtain remedies for IU noncompliance with applicable pretreatment standards and requirements and the approved POTW pretreatment program;

   d. The permittee shall control through permit, order, or similar means, the contribution to the POTW by each IU to ensure compliance with applicable pretreatment standards and requirements and the approved POTW pretreatment program. In the case of SIUs (identified as significant under 40 CFR §403.3 (v)), this control shall be achieved through individual permits or general control mechanisms, in accordance with 40 CFR §403.8(f)(1)(iii).

      Both individual and general control mechanisms must be enforceable and contain, at a minimum, the following conditions:

      (1) Statement of duration (in no case more than five years);
      (2) Statement of non-transferability without, at a minimum, prior notification to the POTW and provision of a copy of the existing control mechanism to the new owner or operator;
      (3) Effluent limits, which may include enforceable best management practices (BMPs), based on applicable general pretreatment standards, categorical pretreatment standards, local limits, and State and local law;
      (4) Self-monitoring, sampling, reporting, notification and record keeping requirements, identification of the pollutants to be monitored (including, if applicable, the process for seeking a waiver for a pollutant neither present nor expected to be present in the IU's discharge in accordance with 40 CFR §403.12(e)(2), or a specific waived pollutant in the case of an individual control mechanism), sampling location, sampling frequency, and sample type, based on the applicable general pretreatment standards in 40 CFR Part 403, categorical pretreatment standards, local limits, and State and local law;
      (5) Statement of applicable civil and criminal penalties for violation of

pretreatment standards and requirements, and any applicable compliance schedule. Such schedules may not extend the compliance date beyond federal deadlines; and,

(6) Requirements to control slug discharges, if determined by the POTW to be necessary.

e. For those IUs who are covered by a general control mechanism, in order to implement 40 CFR §403.8(f)(1)(iii)(A)(2), a monitoring waiver for a pollutant neither present nor expected to be present in the IU's discharge is not effective in the general control mechanism until after the POTW has provided written notice to the SIU that such a waiver request has been granted in accordance with 40 CFR §403.12(e)(2);

f. The permittee shall evaluate, whether each SIU needs a plan or other action to control slug discharges, in accordance with 40 CFR §403.8(f)(2)(vi). If the POTW decides that a slug control plan is needed, the plan shall contain at least the minimum elements required in 40 CFR §403.8(f)(2)(vi);

g. The permittee shall provide adequate staff, equipment, and support capabilities to carry out all elements of the pretreatment program; and,

h. The approved program shall not be modified by the permittee without the prior approval of the Executive Director, according to 40 CFR §403.18.

2. The permittee is under a continuing duty to: establish and enforce specific local limits to implement the provisions of 40 CFR §403.5, develop and enforce local limits as necessary, and modify the approved pretreatment program as necessary to comply with federal, state and local law, as amended. The permittee may develop BMPs to implement paragraphs 40 CFR §§403.5(c)(1) and (c)(2). Such BMPs shall be considered local limits and pretreatment standards. The permittee is required to effectively enforce such limits and to modify their pretreatment program, including the Legal Authority, Enforcement Response Plan, and Standard Operating Procedures (including forms), if required by the Executive Director to reflect changing conditions at the POTW. Substantial modifications will be approved in accordance with 40 CFR §403.18, and modifications will become effective upon approval by the Executive Director in accordance with 40 CFR §403.18.

   The legal authority and the POTW's pretreatment program are not in compliance with the current 40 CFR Part 403 regulations *[rev. Federal Register/ Vol. 70/ No. 198/ Friday, October 14, 2005/ Rules and Regulations, pages 60134-60798]* and the 30 TAC Chapter 315, as amended. The permittee has submitted a substantial modification package revising the existing the Legal Authority, and additional modifications to the pretreatment program including an Enforcement Response Plan, Standard Operating Procedures, and forms to incorporate all required [*i.e.* more stringent] Streamlining Rule provisions *[rev. Federal Register/ Vol. 70/ No. 198/ Friday, October 14, 2005/ Rules and Regulations, pages 60134-60798]*. In addition, the package includes the technical evaluation revising the existing technically based local limits (TBLLs). The Executive Director is currently reviewing this substantial modification package. If after review of the modification submission, the Executive Director determines that the submission does not comply with applicable requirements, including 40 CFR §§403.8 and 403.9, the Executive Director will notify the permittee. According to 40 CFR §403.11(c), the notification will include suggested modifications to bring the modification submission into compliance with applicable requirements, including 40 CFR §§403.8(b) and (f), and 40 CFR §403.9(b). In such a case, revised information will be necessary for the Executive Director to make a determination on whether to approve or deny the permittee's modification submission.

Upon approval by the Executive Director of the substantial modification to this approved POTW pretreatment program, the requirement to develop and enforce specific prohibitions and/or limits to implement the prohibitions and limits set forth in 40 CFR §§403.5 (a)(1), (b), (c)(1) and (3), and (d) is a condition of this permit. The specific prohibitions set out in 40 CFR §403.5(b) shall be enforced by the permittee unless modified under this provision.

3. The permittee shall analyze the treatment facility influent and effluent for the presence of the toxic pollutants listed in the Texas Surface Water Quality Standards [30 TAC Chapter 307], and in 40 CFR Part 122 Appendix D Table II at least **once per six months** and the toxic pollutants in Table III at least **once per three months**. If, based upon information available to the permittee, there is reason to suspect the presence of any toxic or hazardous pollutant listed in 40 CFR Part 122 Appendix D Table V, or any other pollutant, known or suspected to adversely affect treatment plant operation, receiving water quality, or solids disposal procedures, analysis for those pollutants shall be performed at least **once per three months** on both the influent and the effluent.
   The influent and effluent samples collected shall be composite samples consisting of at least 12 aliquots collected at approximately equal intervals over a representative 24 hour period and composited according to flow. Sampling and analytical procedures shall be in accordance with guidelines established in 40 CFR Part 136, as amended; as approved by the EPA through the application for alternate test procedures; or as suggested in Tables E-1 and E-2 of the *Procedures to Implement the Texas Surface Water Quality Standards* (RG-194), June 2010, as amended and adopted by the TCEQ. The effluent samples shall be analyzed to the minimum analytical level (MAL). Where composite samples are inappropriate, due to sampling, holding time, or analytical constraints, at least four (4) grab samples, taken at equal intervals over a representative 24 hour period, shall be taken.

4. The permittee shall prepare annually a list of IUs which during the preceding twelve (12) months were in significant noncompliance (SNC) with applicable pretreatment requirements. For the purposes of this section of the permit, "CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS", SNC shall be determined based upon the more stringent of either criteria established at 40 CFR §403.8(f)(2)(viii) *[rev. 10/14/05]* or criteria established in the approved POTW pretreatment program. This list is to be published annually during the month of **December** in a newspaper of general circulation that provides meaningful public notice within the jurisdiction(s) served by the POTW.

   In addition, each **December** the permittee shall submit an updated pretreatment program annual status report, in accordance with 40 CFR §§403.12(i) and (m), to the TCEQ Stormwater & Pretreatment Team (MC148) of the Water Quality Division. The report shall contain the following information as well as the information on the tables in this section. The report summary shall be submitted on the Pretreatment Performance Summary (PPS) form [TCEQ-20218].

   a. An updated list of all regulated IUs as indicated in this section. For each listed IU, the following information shall be included:

      (1) Standard Industrial Classification (SIC) or North American Industry Classification System (NAICS) code *and* categorical determination.

(2) If the pretreatment program has been modified and approved to incorporate reduced monitoring for any of the categorical IUs as provided by 40 CFR Part 403 [*rev. 10/14/05*], then the list must also identify:

- categorical IUs subject to the conditions for reduced monitoring and reporting requirements under 40 CFR §§ 403.12(e)(1) and (3);
- those IUs that are non-significant categorical industrial users (NSCIUs) under 40 CFR §403.3(v)(2); and
- those IUs that are middle tier categorical industrial users (MTCIUs) under 40 CFR §403.12(e)(3).

(3) Control mechanism status.

- Indicate whether the IU has an effective individual or general control mechanism, and the date such control mechanism was last issued, reissued, or modified;
- Indicate which IUs were added to the system, or newly identified, during the pretreatment year reporting period;
- Include the type of general control mechanisms; and
- Report all NSCIU annual evaluations performed, as applicable.

(4) A summary of all compliance monitoring activities performed by the POTW during the pretreatment year reporting period. The following information shall be reported:

- Total number of inspections performed; and
- Total number of sampling events conducted.

(5) Status of IU compliance with effluent limitations, reporting, and narrative standard (which may include enforceable BMPs, narrative limits, and/or operational standards) requirements. Compliance status shall be defined as follows:

- Compliant (C) - no violations during the pretreatment year reporting period;
- Non-compliant (NC) - one or more violations during the pretreatment year reporting period but does not meet the criteria for SNC; and
- Significant Noncompliance (SNC) - in accordance with requirements described above in this section.

(6) For noncompliant IUs indicate the nature of the violations, the type and number of actions taken (notice of violation, administrative order, criminal or civil suit, fines or penalties collected, etc.) and current compliance status. If any IU was on a schedule to attain compliance with effluent limits or narrative standards, indicate the date the schedule was issued, and the date compliance is to be attained.

b. A list of each IU whose authorization to discharge was terminated or revoked during the pretreatment year reporting period and the reason for termination.

c. A report on any interference, pass through, upset, or POTW permit violations known or suspected to be caused by IUs and response actions taken by the permittee.

d. The results of all influent and effluent analyses performed pursuant to Item 3 of this section.

e. An original newspaper public notice, or copy of the newspaper publication with official affidavit, of the list of IUs that meet the criteria of SNC, giving the name of the newspaper and date the list was published.

f. The daily average water quality based effluent concentrations (from the TCEQ's Texas Toxicity Modeling Program (TexTox)) necessary to attain the Texas Surface Water Quality Standards, 30 TAC Chapter 307, in water in the state.

g. The maximum allowable headworks loading (MAHL) in pounds per day (lb/day) of the approved TBLLs or for each pollutant of concern (POC) for which the permittee has calculated a MAHL. In addition, the influent loading as a percent of the MAHL, using the annual average flow of the wastewater treatment plant in million gallons per day (MGD) during the pretreatment year reporting period, for each pollutant that has an adopted TBLL or for each POC for which the permittee has calculated a MAHL. (*See Endnotes No. 2 at the end of this section for the influent loading as a percent of the MAHL equation.*)

h. The permittee may submit the updated pretreatment program annual status report information in tabular form using the example table format provided. Please attach, on a separate sheet, explanations to document the various pretreatment activities, including IU permits that have expired, BMP violations, and any sampling events that were not conducted by the permittee as required.

i. A summary of changes to the POTW's pretreatment program that have not been previously reported to the Approval Authority.

5. The permittee shall provide adequate written notification to the Executive Director care of the Wastewater Permitting Section (MC 148) of the Water Quality Division, within 30 days of the permittee's knowledge of the following:

    a. Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Sections 301 and 306 of the Clean Water Act if the indirect discharger was directly discharging those pollutants; and

    b. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit.

    Adequate notice shall include information on the quality and quantity of effluent to be introduced into the treatment works, and any anticipated impact of the change on the quality or quantity of effluent to be discharged from the POTW.

Revised March 2014

TPDES Pretreatment Program Annual Report Form for Updated Industrial Users List

Reporting month/year: ____________, _____ to ____________, _____

TPDES Permit No.: _______ Permittee:________ Treatment Plant: _____________

PRETREATMENT PROGRAM STATUS REPORT UPDATED INDUSTRIAL USERS[1] LIST																
Industrial User Name	SIC or NAICS Code	CIU[2]	CONTROL MECHANISM				New User[3] (Y or N)	Times Inspected by the CA	Times Sampled by the CA	COMPLIANCE STATUS During the Pretreatment Year Reporting Period[4] (C = Compliant, NC = Noncompliant, SNC= Significant Noncompliance)						
			Y/N or NR[5]	IND or GEN or NR	Last Action[6]	TBLLs or TBLLs only[7]				REPORTS				NSCIU Certifications	Effluent Limits	Narrative Standards
										BMR	90-Day	Semi-Annual	Self-Monitoring[8]			

1 Include all significant industrial users (SIUs), non-significant categorical industrial users (NSCIUs) as defined in 40 CFR §403.3(v)(2), and/or middle tier categorical industrial users (MTCIUs) as defined in 40 CFR §403.12(e)(3). Please do not include non-significant noncategorical IUs that are covered under best management practices (BMPs) or general control mechanisms.

2 Categorical determination (include 40 CFR citation and NSCIU or MTCIU status, if applicable).

3 Indicate whether the IU is a new user. If the answer is No or N, then indicate the expiration date of the last issued IU permit.

4 The term SNC applies to a broader range of violations, such as daily maximum, long-term average, instantaneous limits, and narrative standards (which may include enforceable BMPs, narrative limits and/or operational standards). Any other violation, or group of violations, which the POTW determines will adversely affect the operation or implementation of the local Pretreatment Program now includes BMP violations (40 CFR §403.8(f)(2)(viii)(H)).

5 Code NR= None required (NSCIUs only); IND = individual control mechanism; GEN = general control mechanism. Include as a footnote (or on a separate page) the name of the general control mechanism used for similar groups of IUs, identify the similar types of operations and types of wastes that are the same for each general control mechanism. Any BMPs through general control mechanisms that are applied to nonsignificant IUs need to be reported separately, *e.g.* the sector type and BMP description.

6 Permit or NSCIU evaluations as applicable.

7 According to 40 CFR §403.12(i)(1), indicate whether the IU is subject to technically based local limits (TBLLs) that are more stringent than categorical pretreatment standards, *e.g.* where there is one end-of-pipe sampling point at a CIU, and you have determined that the TBLLs are more stringent than the categorical pretreatment standards for any pollutant at the end-of-pipe sampling point; **OR** the IU is subject only to local limits (TBLLs only), *e.g.* the IU is a non-categorical SIU subject only to TBLLs at the end-of-pipe sampling point.

8 For those IUs where a monitoring waiver has been granted, please add the code "W" (after either C, NC, or SNC codes) and indicate the pollutant(s) for which the waiver has been granted.

TPDES Pretreatment Program Annual Report Form for Industrial User Inventory Modifications

Reporting month/year: ___________, _____ to ___________, _____

TPDES Permit No: ________ Permittee: _______ Treatment Plant: _____________

INDUSTRIAL USER INVENTORY MODIFICATIONS					
FACILITY NAME, ADDRESS AND CONTACT PERSON	ADD, CHANGE, DELETE (Including categorical reclassification to NSCIU or MTCIU)	IF DELETION: Reason For Deletion	IF ADDITION OR SIGNIFICANT CHANGE:		
			PROCESS DESCRIPTION	POLLUTANTS (Including any sampling waiver given for each pollutant not present)	FLOW RATE [9] (In gpd) R = Regulated U = Unregulated T = Total

---

[9] For NSCIUs, total flow must be given, if regulated flow is not determined.

TPDES Pretreatment Program Annual Report Form for Enforcement Actions Taken

Reporting month/year: ___________, _____ to ___________, _____

TPDES Permit No: __________Permittee:________Treatment Plant: ____________

Overall SNC ___% SNC[10] based on: Effluent Violations_____%
Reporting Violations_____% Narrative Standard Violations___%

Noncompliant Industrial Users - Enforcement Actions Taken

Industrial User Name	Nature of Violation [11]				Number of Actions Taken					Penalties Collected (Do not Include Surcharge)	Compliance Schedule			Current Status Returned to Compliance: (Y or N)	Comments
	Effluent Limits	Reports	NSCIU Certifications	Narrative Standards	NOV	A.O.	Civil	Criminal	Other		Y or N	Date Issued	Date Due		

---

10 # %
__ __ Pretreatment Standards [WENDB-PSNC] (Local Limits/Categorical Standards)
__ __ Reporting Requirements [WENDB-PSNC]
__ __ Narrative Standards

11 Please specify a separate number for each type of violation, *e.g.* report, notification, and/or NSCIU certification.

TPDES Pretreatment Program Annual Report Form for Influent and Effluent Monitoring Results[1]

Reporting month/year: ____________, _____ to ____________, _____

TPDES Permit No.: ________ Permittee:_____________Treatment Plant: ________

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS											
POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
METALS, CYANIDE AND PHENOLS											
Antimony, Total							▨				
Arsenic, Total											
Beryllium, Total							▨				
Cadmium, Total											
Chromium, Total											
Chromium (Hex)											
Chromium (Tri)[5]											
Copper, Total											
Lead, Total											
Mercury, Total											
Nickel, Total											
Selenium, Total											
Silver, Total											
Thallium, Total							▨				
Zinc, Total											
Cyanide, Available[6]											
Cyanide, Total											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L) [3]	Effluent Measured in µg/L (Actual Concentration or < MAL) [4]			
		Date	Date	Date	Date			Date	Date	Date	Date
Phenols, Total											
VOLATILE COMPOUNDS											
Acrolein											
Acrylonitrile											
Benzene											
Bromoform							See TTHM				
Carbon Tetrachloride											
Chlorobenzene											
Chlorodibromomethane							See TTHM				
Chloroethane											
2-Chloroethylvinyl Ether											
Chloroform							See TTHM				
Dichlorobromomethane							See TTHM				
1,1-Dichloroethane											
1,2-Dichloroethane											
1,1-Dichloroethylene											
1,2-Dichloropropane											
1,3-Dichloropropylene											
Ethyl benzene											
Methyl Bromide											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Methyl Chloride							▨				
Methylene Chloride							▨				
1,1,2,2-Tetra-chloroethane							▨				
Tetrachloroethylene											
Toluene							▨				
1,2-Trans-Dichloroethylene							▨				
1,1,1-Trichloroethane											
1,1,2-Trichloroethane							▨				
Trichloroethylene											
Vinyl Chloride											
ACID COMPOUNDS											
2-Chlorophenol							▨				
2,4-Dichlorophenol							▨				
2,4-Dimethylphenol							▨				
4,6-Dinitro-o-Cresol							▨				
2,4-Dinitrophenol							▨				
2-Nitrophenol							▨				
4-Nitrophenol							▨				
P-Chloro-m-Cresol							▨				
Pentachlorophenol											
Phenol											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
		Date	Date	Date	Date			Date	Date	Date	Date
2,4,6-Trichlorophenol											
BASE/NEUTRAL COMPOUNDS											
Acenaphthene											
Acenaphthylene											
Anthracene											
Benzidine											
Benzo(a)Anthracene											
Benzo(a)Pyrene											
3,4-Benzofluoranthene											
Benzo(ghi)Perylene											
Benzo(k)Fluoranthene											
Bis(2-Chloroethoxy)Methane											
Bis(2-Chloroethyl)Ether											
Bis(2-Chloroisopropyl)Ether											
Bis(2-Ethylhexyl)Phthalate											
4-Bromophenyl Phenyl Ether											
Butylbenzyl Phthalate											
2-Chloronaphthalene											
4-Chlorophenyl Phenyl Ether											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Chrysene											
Dibenzo(a,h)Anthracene							▨				
1,2-Dichlorobenzene							▨				
1,3-Dichlorobenzene							▨				
1,4-Dichlorobenzene											
3,3-Dichlorobenzidine							▨				
Diethyl Phthalate							▨				
Dimethyl Phthalate							▨				
Di-n-Butyl Phthalate							▨				
2,4-Dinitrotoluene							▨				
2,6-Dinitrotoluene							▨				
Di-n-Octyl Phthalate							▨				
1,2-Diphenyl Hydrazine							▨				
Fluoranthene							▨				
Fluorene							▨				
Hexachlorobenzene											
Hexachlorobutadiene											
Hexachloro-cyclopentadiene							▨				
Hexachloroethane											
Indeno(1,2,3-cd)pyrene							▨				
Isophorone							▨				

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in μg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (μg/L)[3]	Effluent Measured in μg/L (Actual Concentration or < MAL)[4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Naphthalene							▨				
Nitrobenzene											
N-Nitrosodimethylamine							▨				
N-Nitrosodi-n-Propylamine							▨				
N-Nitrosodiphenylamine							▨				
Phenanthrene											
Pyrene							▨				
1,2,4-Trichlorobenzene							▨				
PESTICIDES											
Aldrin											
Alpha-hexachlorocyclohexane (BHC)											
beta-BHC											
gamma-BHC (Lindane)											
delta-BHC							▨				
Chlordane											
4,4-DDT											
4,4-DDE											
4,4-DDD											
Dieldrin											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in µg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (µg/L)[3]	Effluent Measured in µg/L (Actual Concentration or < MAL)[4]			
		Date	Date	Date	Date			Date	Date	Date	Date
alpha-Endosulfan											
beta-Endosulfan											
Endosulfan Sulfate											
Endrin											
Endrin Aldehyde											
Heptachlor											
Heptachlor Epoxide											
Polychlorinated biphenols (PCBs) *The sum of PCB concentrations not to exceed daily average value.*											
PCB-1242							See PCBs				
PCB-1254							See PCBs				
PCB-1221							See PCBs				
PCB-1232							See PCBs				
PCB-1248							See PCBs				
PCB-1260							See PCBs				
PCB-1016							See PCBs				
Toxaphene											
ADDITIONAL TOXIC POLLUTANTS REGULATED UNDER 30 TAC CHAPTER 307											
Aluminum											
Barium											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS

POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in μg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (μg/L)[3]	Effluent Measured in μg/L (Actual Concentration or < MAL)[4]			
▨	▨	Date	Date	Date	Date	▨	▨	Date	Date	Date	Date
Bis(chloromethyl) ether[7]											
Carbaryl											
Chloropyrifos											
Cresols											
2,4-D											
Danitol[8]											
Demeton											
Diazinon											
Dicofol											
Dioxin/Furans[9]											
Diuron											
Fluoride											
Guthion											
Hexachlorophene											
Malathion											
Methoxychlor											
Methyl Ethyl Ketone											
Mirex											
Nitrate-Nitrogen											
N-Nitrosodiethylamine											

PRETREATMENT PROGRAM INFLUENT AND EFFLUENT MONITORING RESULTS											
POLLUTANT	MAHL, if Applicable in lb/day	Influent Measured in μg/L (Actual Concentration or < MAL)				Average Influent % of the MAHL[2]	Daily Average Effluent Limit (μg/L)[3]	Effluent Measured in μg/L (Actual Concentration or < MAL)[4]			
		Date	Date	Date	Date			Date	Date	Date	Date
N-Nitroso-di-n-Butylamine											
Nonylphenol											
Parathion											
Pentachlorobenzene											
Pyridine											
1,2-Dibromoethane											
1,2,4,5-Tetrachlorobenzene											
2,4,5-TP (Silvex)											
Tributyltin[9]											
2,4,5-Trichlorophenol											
TTHM (Total Trihalomethanes)											

Footnotes:

1. It is advised that the permittee collect the influent and effluent samples considering flow detention time through each wastewater treatment plant (WWTP).

2. The MAHL of the approved TBLLs or for each pollutant of concern (POC) for which the permittee has calculated a MAHL. Only complete the column labeled, "Average Influent % of the MAHL", as a percentage, for pollutants that have approved TBLLs or for each POC for which the permittee has calculated a MAHL (U.S. Environmental Protection Agency *Local Limits Development Guidance*, July 2004, EPA933-R-04-002A).

   The % of the MAHL is to be calculated using the following formulas:

   Equation A: $L_{INF} = (C_{POLL} \times Q_{WWTP} \times 8.34) / 1000$

   Equation B: $L_{\%} = (L_{INF} / MAHL) \times 100$

   Where:
   L_{INF} = Current Average (Avg) influent loading in lb/day
   C_{POLL} = Avg concentration in µg/L of all influent samples collected during the pretreatment year.
   Q_{WWTP} = Annual average flow of the WWTP in MGD, defined as the arithmetic average of all daily flow determinations taken within the preceding 12 consecutive calendar months (or during the pretreatment year), and as described in the Definitions and Standard Permit Conditions section.
   $L_{\%}$ = % of the MAHL
   MAHL = Calculated MAHL in lb/day
   8.34 = Unit conversion factor

3. Daily average effluent limit (metal values are for total metals) as derived by the Texas Toxicity Modeling Program (TexTox). Effluent limits as calculated are designed to be protective of the Texas Surface Water Quality Standards. The permittee shall determine and indicate which effluent limit is the most stringent between the 30 TAC Chapter 319 (Hazardous Metal Rule), TexTox values, or any applicable TPDES permit limit in Effluent Limitations and Monitoring Requirements Section. Shaded blocks need not be filled in unless the permittee has received a permit requirement/limit for the particular parameter.

4. Minimum analytical levels (MALs) and analytical methods as suggested in Tables E-1 and E-2 of the *Procedures to Implement the Texas Surface Water Quality Standards* (June 2010), as amended and adopted by the TCEQ Commission. Pollutants that are not detectable above the MAL need to be reported as less than (<) the MAL numeric value.

5. Report result by subtracting Hexavalent Chromium from Total Chromium.

6. Either the method for Amenable to Chlorination or Weak-Acid Dissociable is authorized.

7. Hydrolyzes in water. Will not require permittee to analyze at this time.

8. EPA procedure not approved. Will not require permittee to analyze at this time.

9. Analyses are not required at this time for these pollutants unless there is reason to believe that these pollutants may be present.

CHRONIC BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this Section apply to Outfall 001 for whole effluent toxicity (WET) testing.

1. Scope, Frequency and Methodology

   a. The permittee shall test the effluent for toxicity in accordance with the provisions below. Such testing will determine if an appropriately dilute effluent sample adversely affects the survival, reproduction, or growth of the test organisms.

   b. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures and quality assurance requirements specified in this Part of the permit and in accordance with "Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, Fourth Edition" (EPA-821-R-02-013), or its most recent update:

      1) Chronic static renewal survival and reproduction test using the water flea (*Ceriodaphnia dubia*) (Method 1002.0). This test should be terminated when 60% of the surviving adults in the control produce three broods or at the end of eight days, whichever comes first. This test shall be conducted once per quarter.

      2) Chronic static renewal 7-day larval survival and growth test using the fathead minnow (*Pimephales promelas*) (Method 1000.0). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution. This test shall be conducted once per quarter.

      The permittee must perform and report a valid test for each test species during the prescribed reporting period. An invalid test must be repeated during the same reporting period. An invalid test is herein defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit. All test results, valid or invalid, must be submitted as described below.

   c. The permittee shall use five effluent dilution concentrations and a control in each toxicity test. These additional effluent concentrations are 21%, 28%, 38%, 50%, and 67% effluent. The critical dilution, defined as 50% effluent, is the effluent concentration representative of the proportion of effluent in the receiving water during critical low flow or critical mixing conditions.

   d. This permit may be amended to require a WET limit, Chemical-Specific (CS) effluent limits, a Best Management Practice (BMP), or other appropriate actions to address toxicity. The permittee may be required to conduct a Toxicity Reduction Evaluation after multiple toxic events.

   e. Testing Frequency Reduction

      1) If none of the first four consecutive quarterly tests demonstrates significant toxicity, the permittee may submit this information in writing and, upon approval, reduce the testing frequency to once per six months

for the invertebrate test species and once per year for the vertebrate test species.

2) If one or more of the first four consecutive quarterly tests demonstrates significant toxicity, the permittee shall continue quarterly testing for that species until the permit is reissued. If a testing frequency reduction had been previously granted and a subsequent test demonstrates significant toxicity, the permittee will resume a quarterly testing frequency for that species until the permit is reissued.

2. Required Toxicity Testing Conditions

a. Test Acceptance - The permittee shall repeat any toxicity test, including the control and all effluent dilutions, which fail to meet the following criteria:

1) a control mean survival of 80% or greater;

2) a control mean number of water flea neonates per surviving adult of 15 or greater;

3) a control mean dry weight of surviving fathead minnow larvae of 0.25 mg or greater;

4) a control Coefficient of Variation percent (CV%) of 40 or less in between replicates for the young of surviving females in the water flea test; and the growth and survival endpoints in the fathead minnow test.

5) a critical dilution CV% of 40 or less for young of surviving females in the water flea test; and the growth and survival endpoints for the fathead minnow test. However, if statistically significant lethal or nonlethal effects are exhibited at the critical dilution, a CV% greater than 40 shall not invalidate the test.

6) a Percent Minimum Significant Difference of 47 or less for water flea reproduction;

7) a Percent Minimum Significant Difference of 30 or less for fathead minnow growth.

b. Statistical Interpretation

1) For the water flea survival test, the statistical analyses used to determine if there is a significant difference between the control and an effluent dilution shall be Fisher's Exact Test as described in the manual referenced above, or its most recent update.

2) For the water flea reproduction test and the fathead minnow larval survival and growth tests, the statistical analyses used to determine if there is a significant difference between the control and an effluent dilution shall be in accordance with the manual referenced above, or its most recent update.

3) The permittee is responsible for reviewing test concentration-response relationships to ensure that calculated test-results are interpreted and reported correctly. The EPA manual, "Method Guidance and Recommendation for Whole Effluent Toxicity (WET) Testing (40 CFR Part 136)" (EPA 821-B-00-004), provides guidance on determining the validity of test results.

4) If significant lethality is demonstrated (that is, there is a statistically significant difference in survival at the critical dilution when compared to the control), the conditions of test acceptability are met, and the survival of the test organisms are equal to or greater than 80% in the critical dilution and all dilutions below that, then the permittee shall report a survival No Observed Effect Concentration (NOEC) of not less than the critical dilution for the reporting requirements.

5) The NOEC is defined as the greatest effluent dilution at which no significant effect is demonstrated. The Lowest Observed Effect Concentration (LOEC) is defined as the lowest effluent dilution at which a significant effect is demonstrated. A significant effect is herein defined as a statistically significant between the survival, reproduction, or growth of the test organism(s) in a specified effluent dilution compared to the survival, reproduction, or growth of the test organism(s) in the control (0% effluent).

6) The use of NOECs and LOECs assumes either a monotonic (continuous) concentration-response relationship or a threshold model of the concentration-response relationship. For any test result that demonstrates a non-monotonic (non-continuous) response, the NOEC should be determined based on the guidance manual referenced in Item 3 above.

7) Pursuant to the responsibility assigned to the permittee in Part 2.b.3), test results that demonstrate a non-monotonic (non-continuous) concentration-response relationship may be submitted, prior to the due date, for technical review. The above-referenced guidance manual will be used when making a determination of test acceptability.

8) Staff will review test results for consistency with rules, procedures, and permit requirements.

c. Dilution Water

1) Dilution water used in the toxicity tests shall be the receiving water collected at a point upstream of the discharge as close as possible to the discharge point, but unaffected by the discharge. Where the toxicity tests are conducted on effluent discharges to receiving waters that are classified as intermittent streams, or where the toxicity tests are conducted on effluent discharges where no receiving water is available due to zero flow conditions, the permittee shall; (a) substitute a synthetic dilution water that has a pH, hardness, and alkalinity similar to that of the closest

downstream perennial water unaffected by the discharge, or (b) utilize the closest downstream perennial water unaffected by the discharge.

2) Where the receiving water proves unsatisfactory as a result of pre-existing instream toxicity (i.e. fails to fulfill the test acceptance criteria of item 2.a.), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

   a) a synthetic lab water control was performed (in addition to the receiving water control) which fulfilled the test acceptance requirements of item 2.a;

   b) the test indicating receiving water toxicity was carried out to completion (i.e., 7 days);

   c) the permittee submitted all test results indicating receiving water toxicity with the reports and information required in Part 3 of this Section.

3) The synthetic dilution water shall consist of standard, moderately hard, reconstituted water. Upon approval, the permittee may substitute other appropriate dilution water with chemical and physical characteristics similar to that of the receiving water.

d. Samples and Composites

1) The permittee shall collect a minimum of three composite samples from Outfall 001. The second and third composite samples will be used for the renewal of the dilution concentrations for each toxicity test.

2) The permittee shall collect the composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the first composite sample. The holding time for any subsequent composite sample shall not exceed 72 hours. Samples shall be maintained at a temperature of 0-6 degrees Centigrade during collection, shipping, and storage.

4) If Outfall 001 ceases discharging during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum numbers of effluent portions, and the sample holding time, are waived during that sampling period. However, the permittee must have collected an effluent composite sample volume sufficient to complete the required toxicity tests with renewal of the effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report.

5) The effluent samples shall not be dechlorinated after sample collection.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Standards Implementation Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted in accordance with the manual referenced above, or its most recent update, for every valid and invalid toxicity test initiated whether carried to completion or not.

b. The permittee shall routinely report the results of each biomonitoring test on the Table 1 forms provided with this permit.

1) Annual biomonitoring test results are due on or before January 20th for biomonitoring conducted during the previous 12 month period.

2) Semiannual biomonitoring test results are due on or before July 20th and January 20th for biomonitoring conducted during the previous 6 month period.

3) Quarterly biomonitoring test results are due on or before April 20th, July 20th, October 20th, and January 20th, for biomonitoring conducted during the previous calendar quarter.

4) Monthly biomonitoring test results are due on or before the 20th day of the month following sampling.

c. Enter the following codes for the appropriate parameters for valid tests only:

1) For the water flea, Parameter TLP3B, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

2) For the water flea, Parameter TOP3B, report the NOEC for survival.

3) For the water flea, Parameter TXP3B, report the LOEC for survival.

4) For the water flea, Parameter TWP3B, enter a "1" if the NOEC for reproduction is less than the critical dilution; otherwise, enter a "0."

5) For the water flea, Parameter TPP3B, report the NOEC for reproduction.

6) For the water flea, Parameter TYP3B, report the LOEC for reproduction.

7) For the fathead minnow, Parameter TLP6C, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

8) For the fathead minnow, Parameter TOP6C, report the NOEC for survival.

9) For the fathead minnow, Parameter TXP6C, report the LOEC for survival.

10) For the fathead minnow, Parameter TWP6C, enter a "1" if the NOEC for growth is less than the critical dilution; otherwise, enter a "0."

11) For the fathead minnow, Parameter TPP6C, report the NOEC for growth.

12) For the fathead minnow, Parameter TYP6C, report the LOEC for growth

d. Enter the following codes for retests only:

1) For retest number 1, Parameter 22415, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

2) For retest number 2, Parameter 22416, enter a "1" if the NOEC for survival is less than the critical dilution; otherwise, enter a "0."

4. <u>Persistent Toxicity</u>

The requirements of this Part apply only when a test demonstrates a significant effect at the critical dilution. A significant effect is defined as a statistically significant difference between a specified endpoint (survival, growth, or reproduction) of the test organism in a specified effluent dilution when compared to the specified endpoint of the test organism in the control. Significant lethality is defined as a statistically significant difference in survival at the critical dilution when compared to the survival in the control. Significant sublethality is defined as a statistically significant difference in growth/reproduction at the critical dilution when compared to the growth/reproduction in the control.

a. The permittee shall conduct a total of 2 additional tests (retests) for any species that demonstrates a significant effect (lethal or sublethal) at the critical dilution. The two retests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two retests in lieu of routine toxicity testing. All reports shall be submitted within 20 days of test completion. Test completion is defined as the last day of the test.

b. If the retests are performed due to a demonstration of significant lethality, and one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5. The provisions of item 4.a. are suspended upon completion of the two retests and submittal of the TRE Action Plan and Schedule defined in Part 5.

If neither test demonstrates significant lethality and the permittee is testing under the reduced testing frequency provision of Part 1.e., the permittee shall return to a quarterly testing frequency for that species.

c. If the two retests are performed due to a demonstration of significant sublethality, and one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall again perform two retests as stipulated in item 4.a.

d. If the two retests are performed due to a demonstration of significant sublethality, and neither test demonstrates significant lethality, the permittee shall continue testing at the quarterly frequency.

e. Regardless of whether retesting for lethal or sublethal effects, or a combination of the two, no more than one retest per month is required for a species.

5. Toxicity Reduction Evaluation

a. Within 45 days of the retest that demonstrates significant lethality, or within 45 days of being so instructed due to multiple toxic events, the permittee shall submit a General Outline for initiating a Toxicity Reduction Evaluation (TRE). The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the retest that demonstrates significant lethality, or within 90 days of being so instructed due to multiple toxic events, the permittee shall submit a TRE Action Plan and Schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A TRE is a step-wise investigation combining toxicity testing with physical and chemical analysis to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE Action Plan shall lead to the successful elimination of significant lethality for both test species defined in item 1.b. As a minimum, the TRE Action Plan shall include the following:

1) Specific Activities - The TRE Action Plan shall specify the approach the permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled, "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA/600/6-91/005F), or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled, "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation

procedures, and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant(s) and source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and suspected pollutant(s) and source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and substantiating documentation which identifies the pollutant(s) and source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b.

f. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality for a period of 12 consecutive months with at least monthly testing. At the end of the 12 months, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b. The permittee may only apply the "cessation of lethality" provision once.

This provision accommodates situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality. This provision does not apply as a result of corrective actions taken by the permittee. "Corrective actions" are herein defined as proactive efforts which eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, the permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing and replacing the WET limit with an alternate toxicity control measure by identifying and confirming the toxicant and an appropriate control measure.

g. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than 28 months from the last test day of the retest that confirmed significant lethal effects at the critical dilution. The permittee may petition the Executive Director (in writing) for an extension of the 28-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE. The report shall provide information pertaining to the specific control mechanism(s) selected that will, when implemented, result in reduction of effluent toxicity to no significant lethality at the critical dilution. The report will also provide a specific corrective action schedule for implementing the selected control mechanism(s). A copy of the TRE Final Report shall also be submitted to the U.S. EPA Region 6 office.

h. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements, where necessary, to require a compliance schedule for implementation of corrective actions, to specify a WET limit, to specify a BMP, and to specify CS limits.

TABLE 1 (SHEET 1 OF 4)

BIOMONITORING REPORTING

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION

Date Time Date Time

Dates and Times Composites Collected

No. 1 FROM: ________________ TO: ________________________

No. 2 FROM: ________________ TO: ________________________

No. 3 FROM: ________________ TO: ________________________

Test initiated: ____________________________am/pm __________________________date

Dilution water used: ________ Receiving water _______ Synthetic Dilution water

NUMBER OF YOUNG PRODUCED PER ADULT AT END OF TEST

REP	Percent effluent					
	0%	21%	28%	38%	50%	67%
A						
B						
C						
D						
E						
F						
G						
H						
I						
J						
Survival Mean						
Total Mean						
CV%*						
PMSD						

*Coefficient of Variation = standard deviation x 100/mean (calculation based on young of the surviving adults)

Designate males (M), and dead females (D), along with number of neonates (x) released prior to death.

TABLE 1 (SHEET 2 OF 4)

CERIODAPHNIA DUBIA SURVIVAL AND REPRODUCTION TEST

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

Is the mean number of young produced per adult significantly less than the number of young per adult in the control for the % effluent corresponding to significant nonlethal effects?

CRITICAL DILUTION (50%): _______ YES _______ NO

PERCENT SURVIVAL

	Percent effluent					
Time of Reading	0%	21%	28%	38%	50%	67%
24h						
48h						
End of Test						

2. Fisher's Exact Test:

Is the mean survival at test end significantly less than the control survival for the % effluent corresponding to lethality?

CRITICAL DILUTION (50%): _______ YES _______ NO

3. Enter percent effluent corresponding to each NOEC\LOEC below:

a.) NOEC survival = ___________% effluent

b.) LOEC survival = ___________% effluent

c.) NOEC reproduction = ___________% effluent

d.) LOEC reproduction = ___________% effluent

TABLE 1 (SHEET 3 OF 4)

BIOMONITORING REPORTING

FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL

		Date Time		Date Time
Dates and Times Composites Collected	No. 1 FROM:	__________	TO:	__________
	No. 2 FROM:	__________	TO:	__________
	No. 3 FROM:	__________	TO:	__________

Test initiated: ______________________am/pm ______________________date

Dilution water used: _________ Receiving water _________ Synthetic dilution water

FATHEAD MINNOW GROWTH DATA

Effluent Concentration	Average Dry Weight in replicate chambers					Mean Dry Weight	CV%*
	A	B	C	D	E		
0%							
21%							
28%							
38%							
50%							
67%							
PMSD							

* Coefficient of Variation = standard deviation x 100/mean

1. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean dry weight (growth) at 7 days significantly less than the control's dry weight (growth) for the % effluent corresponding to significant nonlethal effects?

CRITICAL DILUTION (50%): _______ YES _______ NO

TABLE 1 (SHEET 4 OF 4)

BIOMONITORING REPORTING

FATHEAD MINNOW GROWTH AND SURVIVAL TEST

FATHEAD MINNOW SURVIVAL DATA

Effluent Concentration	Percent Survival in replicate chambers					Mean percent survival			CV%*
	A	B	C	D	E	24h	48h	7 day	
0%									
21%									
28%									
38%									
50%									
67%									

* Coefficient of Variation = standard deviation x 100/mean

2. Dunnett's Procedure or Steel's Many-One Rank Test or Wilcoxon Rank Sum Test (with Bonferroni adjustment) or t-test (with Bonferroni adjustment) as appropriate:

   Is the mean survival at 7 days significantly less than the control survival for the % effluent corresponding to lethality?

   CRITICAL DILUTION (50%): _______ YES _______ NO

3. Enter percent effluent corresponding to each NOEC\LOEC below:

   a.) NOEC survival = ___________% effluent

   b.) LOEC survival = ___________% effluent

   c.) NOEC growth = ___________% effluent

   d.) LOEC growth = ___________% effluent

24-HOUR ACUTE BIOMONITORING REQUIREMENTS: FRESHWATER

The provisions of this section apply to Outfall 001 for whole effluent toxicity (WET) testing.

1. Scope, Frequency and Methodology

   a. The permittee shall test the effluent for lethality in accordance with the provisions in this Section. Such testing will determine compliance with the Surface Water Quality Standard, 307.6(e)(2)(B), of greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

   b. The toxicity tests specified shall be conducted once per six months. The permittee shall conduct the following toxicity tests utilizing the test organisms, procedures, and quality assurance requirements specified in this section of the permit and in accordance with "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition" (EPA-821-R-02-012), or its most recent update:

      1) Acute 24-hour static toxicity test using the water flea (*Daphnia pulex* or *Ceriodaphnia dubia*). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution.

      2) Acute 24-hour static toxicity test using the fathead minnow (*Pimephales promelas*). A minimum of five replicates with eight organisms per replicate shall be used in the control and in each dilution.

      A valid test result must be submitted for each reporting period. The permittee must report, and then repeat, an invalid test during the same reporting period. The repeat test shall include the control and the 100% effluent dilution and use the appropriate number of organisms and replicates, as specified above. An invalid test is herein defined as any test failing to satisfy the test acceptability criteria, procedures, and quality assurance requirements specified in the test methods and permit.

   c. In addition to an appropriate control, a 100% effluent concentration shall be used in the toxicity tests. The control and dilution water shall consist of standard, synthetic, moderately hard, reconstituted water.

   d. This permit may be amended to require a WET limit, a Best Management Practice (BMP), Chemical-Specific (CS) limits, or other appropriate actions to address toxicity. The permittee may be required to conduct a Toxicity Reduction Evaluation after multiple toxic events.

2. Required Toxicity Testing Conditions

   a. Test Acceptance - The permittee shall repeat any toxicity test, including the control, if the control fails to meet a mean survival equal to or greater than 90%.

   b. Dilution Water - In accordance with item 1.c., the control and dilution water shall consist of standard, synthetic, moderately hard, reconstituted water.

c. Samples and Composites

1) The permittee shall collect one composite sample from Outfall 001.

2) The permittee shall collect the composite samples such that the samples are representative of any periodic episode of chlorination, biocide usage, or other potentially toxic substance discharged on an intermittent basis.

3) The permittee shall initiate the toxicity tests within 36 hours after collection of the last portion of the composite sample. Samples shall be maintained at a temperature of 0-6 degrees Centigrade during collection, shipping, and storage.

4) If Outfall 001 ceases discharging during the collection of the effluent composite sample, the requirements for the minimum number of effluent portions are waived. However, the permittee must have collected a composite sample volume sufficient for completion of the required test. The abbreviated sample collection, duration, and methodology must be documented in the full report.

5) The effluent samples shall not be dechlorinated after sample collection.

3. Reporting

All reports, tables, plans, summaries, and related correspondence required in any Part of this Section shall be submitted to the attention of the Standards Implementation Team (MC 150) of the Water Quality Division.

a. The permittee shall prepare a full report of the results of all tests conducted in accordance with the manual referenced above, or its most recent update thereof, for every valid and invalid toxicity test initiated.

b. The permittee shall routinely report the results of each biomonitoring test on the Table 2 forms provided with this permit.

1) Semiannual biomonitoring test results are due on or before January 20th and July 20th for biomonitoring conducted during the previous 6 month period.

2) Quarterly biomonitoring test results are due on or before January 20th, April 20th, July 20th, and October 20th, for biomonitoring conducted during the previous calendar quarter.

c. Enter the following codes on for the appropriate parameters for valid tests only:

1) For the water flea, Parameter TIE3D, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

2) For the fathead minnow, Parameter TIE6C, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if

the mean survival is less than or equal to 50%, enter a "1."

d. Enter the following codes for retests only:

  1) For retest number 1, Parameter 22415, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

  2) For retest number 2, Parameter 22416, enter a "0" if the mean survival at 24-hours is greater than 50% in the 100% effluent dilution; if the mean survival is less than or equal to 50%, enter a "1."

4. Persistent Mortality

The requirements of this Part apply when a toxicity test demonstrates significant lethality, here defined as a mean mortality of 50% or greater to organisms exposed to the 100% effluent concentration after 24-hours.

a. The permittee shall conduct 2 additional tests (retests) for each species that demonstrates significant lethality. The two retests shall be conducted once per week for 2 weeks. Five effluent dilution concentrations in addition to an appropriate control shall be used in the retests. These additional effluent concentrations are 6%, 13%, 25%, 50% and 100% effluent. The first retest shall be conducted within 15 days of the laboratory determination of significant lethality. All test results shall be submitted within 20 days of test completion of the second retest. Test completion is defined as the 24th hour.

b. If one or both of the two retests specified in item 4.a. demonstrates significant lethality, the permittee shall initiate the TRE requirements as specified in Part 5 of this Section.

5. Toxicity Reduction Evaluation

a. Within 45 days of the retest that demonstrates significant lethality, the permittee shall submit a General Outline for initiating a Toxicity Reduction Evaluation (TRE). The outline shall include, but not be limited to, a description of project personnel, a schedule for obtaining consultants (if needed), a discussion of influent and effluent data available for review, a sampling and analytical schedule, and a proposed TRE initiation date.

b. Within 90 days of the retest that demonstrates significant lethality, the permittee shall submit a TRE Action Plan and Schedule for conducting a TRE. The plan shall specify the approach and methodology to be used in performing the TRE. A TRE is a step-wise investigation combining toxicity testing with physical and chemical analysis to determine actions necessary to eliminate or reduce effluent toxicity to a level not effecting significant lethality at the critical dilution. The TRE Action Plan shall lead to the successful elimination of significant lethality for both test species defined in item 1.b. As a minimum, the TRE Action Plan shall include the following:

  1) Specific Activities - The TRE Action Plan shall specify the approach the

permittee intends to utilize in conducting the TRE, including toxicity characterizations, identifications, confirmations, source evaluations, treatability studies, and alternative approaches. When conducting characterization analyses, the permittee shall perform multiple characterizations and follow the procedures specified in the document entitled, "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA/600/6-91/003), or alternate procedures. The permittee shall perform multiple identifications and follow the methods specified in the documents entitled, "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081). All characterization, identification, and confirmation tests shall be conducted in an orderly and logical progression;

2) Sampling Plan - The TRE Action Plan should describe sampling locations, methods, holding times, chain of custody, and preservation techniques. The effluent sample volume collected for all tests shall be adequate to perform the toxicity characterization/ identification/ confirmation procedures, and chemical-specific analyses when the toxicity tests show significant lethality. Where the permittee has identified or suspects specific pollutant(s) and source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical-specific analyses for the identified and suspected pollutant(s) and source(s) of effluent toxicity;

3) Quality Assurance Plan - The TRE Action Plan should address record keeping and data evaluation, calibration and standardization, baseline tests, system blanks, controls, duplicates, spikes, toxicity persistence in the samples, randomization, reference toxicant control charts, as well as mechanisms to detect artifactual toxicity; and

4) Project Organization - The TRE Action Plan should describe the project staff, project manager, consulting engineering services (where applicable), consulting analytical and toxicological services, etc.

c. Within 30 days of submittal of the TRE Action Plan and Schedule, the permittee shall implement the TRE with due diligence.

d. The permittee shall submit quarterly TRE Activities Reports concerning the progress of the TRE. The quarterly TRE Activities Reports are due on or before April 20th, July 20th, October 20th, and January 20th. The report shall detail information regarding the TRE activities including:

1) results and interpretation of any chemical-specific analyses for the identified and suspected pollutant(s) performed during the quarter;

2) results and interpretation of any characterization, identification, and confirmation tests performed during the quarter;

3) any data and substantiating documentation which identifies the pollutant(s) and source(s) of effluent toxicity;

4) results of any studies/evaluations concerning the treatability of the facility's effluent toxicity;

5) any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to eliminate significant lethality; and

6) any changes to the initial TRE Plan and Schedule that are believed necessary as a result of the TRE findings.

Copies of the TRE Activities Report shall also be submitted to the U.S. EPA Region 6 office.

e. During the TRE, the permittee shall perform, at a minimum, quarterly testing using the more sensitive species; testing for the less sensitive species shall continue at the frequency specified in Part 1.b.

f. If the effluent ceases to effect significant lethality (herein as defined below) the permittee may end the TRE. A "cessation of lethality" is defined as no significant lethality for a period of 12 consecutive weeks with at least weekly testing. At the end of the 12 weeks, the permittee shall submit a statement of intent to cease the TRE and may then resume the testing frequency specified in Part 1.b. The permittee may only apply the "cessation of lethality" provision once.

This provision accommodates situations where operational errors and upsets, spills, or sampling errors triggered the TRE, in contrast to a situation where a single toxicant or group of toxicants cause lethality. This provision does not apply as a result of corrective actions taken by the permittee. "Corrective actions" are herein defined as proactive efforts which eliminate or reduce effluent toxicity. These include, but are not limited to, source reduction or elimination, improved housekeeping, changes in chemical usage, and modifications of influent streams and effluent treatment.

The permittee may only apply this cessation of lethality provision once. If the effluent again demonstrates significant lethality to the same species, the permit will be amended to add a WET limit with a compliance period, if appropriate. However, prior to the effective date of the WET limit, the permittee may apply for a permit amendment removing and replacing the WET limit with an alternate toxicity control measure by identifying and confirming the toxicant and an appropriate control measure.

g. The permittee shall complete the TRE and submit a Final Report on the TRE Activities no later than 18 months from the last test day of the retest that demonstrates significant lethality. The permittee may petition the Executive Director (in writing) for an extension of the 18-month limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE. The report shall specify the control mechanism(s) that will, when implemented, reduce effluent toxicity as specified in item 5.g. The report will also specify a corrective action schedule for implementing the selected control mechanism(s). A copy of the TRE Final Report shall also be submitted to the U.S. EPA Region 6 office.

h. Within 3 years of the last day of the test confirming toxicity, the permittee shall comply with 307.6(e)(2)(B), which requires greater than 50% survival of the test organism in 100% effluent at the end of 24-hours. The permittee may petition the Executive Director (in writing) for an extension of the 3-year limit. However, to warrant an extension the permittee must have demonstrated due diligence in their pursuit of the TIE/TRE and must prove that circumstances beyond their control stalled the TIE/TRE.

The requirement to comply with 307.6(e)(2)(B) may be exempted upon proof that toxicity is caused by an excess, imbalance, or deficiency of dissolved salts. This exemption excludes instances where individually toxic components (e.g. metals) form a salt compound. Following the exemption, the permit may be amended to include an ion-adjustment protocol, alternate species testing, or single species testing.

i. Based upon the results of the TRE and proposed corrective actions, this permit may be amended to modify the biomonitoring requirements where necessary, to require a compliance schedule for implementation of corrective actions, to specify a WET limit, to specify a BMP, and to specify a CS limit.

TABLE 2 (SHEET 1 OF 2)

WATER FLEA SURVIVAL

GENERAL INFORMATION

	Time	Date
Composite Sample Collected		
Test Initiated		

PERCENT SURVIVAL

Time	Rep	Percent effluent					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN						

Enter percent effluent corresponding to the LC50 below:

24 hour LC50 = _______% effluent

TABLE 2 (SHEET 2 OF 2)

FATHEAD MINNOW SURVIVAL

GENERAL INFORMATION

	Time	Date
Composite Sample Collected		
Test Initiated		

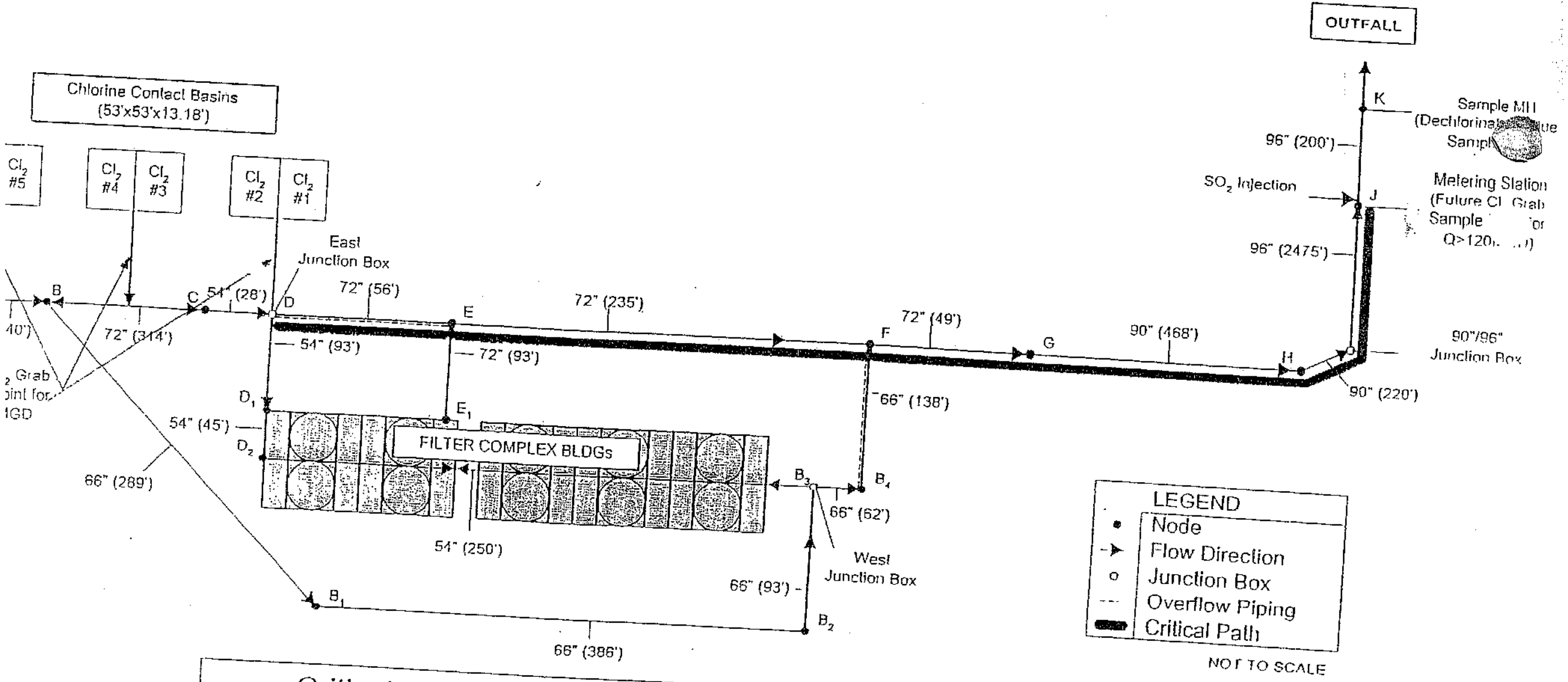
PERCENT SURVIVAL

Time	Rep	Percent effluent					
		0%	6%	13%	25%	50%	100%
24h	A						
	B						
	C						
	D						
	E						
	MEAN						

Enter percent effluent corresponding to the LC50 below:

24 hour LC50 = _______% effluent

Walnut Creek WWTP Disinfection Contact Basins and Piping Schematic



Critical Path Plan - Chlorine Contact to Metering Station

City of Austin
WQ0010543011
Attachment A

Austin SWIFT Loan Application

Part D, Item 64

ED-101
Revised 11/1/2011

STATE OF TEXAS §
§
COUNTY OF Travis §

SITE CERTIFICATE

Before me, the undersigned notary, on this day personally appeared Greg Meszaros, a person whose identify is known to me or who has presented to me a satisfactory proof of identity. After I administered an oath, this person swore to the following:

(1) My name is Greg Meszaros. I am over 18 years of age and I am of sound mind, and capable of swearing to the facts contained in this Site Certificate. The facts stated in this certificate are within my personal knowledge and are true and correct.

(2) I am an authorized representative of City of Austin, an entity that has filed an application for financial assistance with the Texas Water Development Board for a (water) (wastewater) project.

LEGAL CERTIFICATION – OWNERSHIP INTEREST

This is to certify that **City of Austin** (Legal Name of Applicant, i.e., City, District, etc.)

has acquired or is in the process of acquiring the necessary real property interest, as evidenced by fee simple purchase or fully executed earnest money contracts, firm option agreements to purchase the subject property or the initiation of eminent domain procedures, that such acquisition will guarantee access and egress and such interest will contain the necessary easements, rights of way or unrestricted use as is required for the project being financed by the Texas Water Development Board. The legal description is referenced below:

(Location and Description of Property Interests acquired for Project)

- See attachment for Montopolis Tank site location and legal description
- South Austin Regional WWTP Deed Recording: Vol 7644, Pg 652
- Walnut Creek WWTP Deed Recording: 2564/41, 2607/530, 2864/130, plus outfall parcel 13066/232

Any deeds or other instruments required to be recorded to protect the title(s) held by

City of Austin
(Legal Name of Applicant)

have been recorded or filed for the record in the County deed records or other required location.

LEGAL CERTIFICATION – LEASE/CONTRACT

In the alternative, I certify that ______________________
(Legal Name of Applicant, i.e., City, District, etc.)

has executed a written lease or other contractual agreement to use the property needed for this (water) (wastewater) project that extends through _____ the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. A copy of this lease or agreement is attached hereto.

LEGAL CERTIFICATION – PROPERTY EASEMENT

In the alternative, I certify that _____
(Legal Name of Applicant, i.e., City, District, etc.)

has executed an express easement to use the property needed for this (water) (wastewater) project that extends through _____, the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. A copy of the express easement agreement is attached hereto.

EXECUTED this 10 day of May, 2016.

(Signature)

Greg Meszaros
(Print Name)

Director
(Title)

Sworn to and subscribed before me by Greg Meszaros on May 10 2016.

FELICIA CANCINO
Notary Public, State of Texas
My Commission Expires
September 21, 2016

[SEAL]

Felicia Cancino
Notary Public in and for the State of Texas

My Commission expires: Sept. 21, 2016

Austin SWIFT Loan Application
Part D, Item 64
Site Certificate (ED-101)
Attachment 1 of 1 for Montopolis
Reuse Tank Project

RIGHT OF ENTRY AND POSSESSION

THE STATE OF TEXAS §
§
COUNTY OF TRAVIS §

1. Praxair Distribtion, Inc., a Delaware corporation (called "Grantors", whether one or more) whose mailing address is 39 Old Ridgebury Road, Danbury, CT 06810-5113, the fee simple owners of a certain tract of land in Austin, Travis, County, Texas, described in the attached and incorporated **Exhibits "A", "B", "C" and "D"** ("Property").

2. The City of Austin, Texas is going to acquire a 2.005 acre water tank site (fee simple), an Electric Distribution Utility Easement, a Water Line and Access Easement and a Temporary Working Space Easement in the Property.

3. The City of Austin must have possession of the Property by January 2, 2013 to construct a ground storage tank, pump and water lines improvements in, on, over, across, under, or upon the Property.

Agreement:

The parties agree that Grantors in consideration $1.00 and other good and valuable consideration paid by the City of Austin to Grantors, the receipt and sufficiency of which is acknowledged. Grantors have **GRANTED, SOLD** and **CONVEYED**, and by these premises do **GRANT, SELL** and **CONVEY**, unto the City of Austin, the right of entry in, on, over, across, under and upon, and the right of possession of the Property.

This grant of Right of Entry and Possession is conditioned upon the following:

1. The City of Austin, its agents, contractors, and assigns, have the right of entry upon, and the possession of the Property from and after January 2, 2013 to survey, conduct site review and analysis, and to construct, operate, maintain, repair, replace, upgrade, decommission, remove, and make connection with the project improvement using the water tank site, Electric Distribution Utility Easement, Water Line and Access Easement and Temporary Working Space Easement in, on, over, across, under and upon the Property as deemed appropriate by the City. The City and the Contractor have the full and non-exclusive right to control and use the Property.

2. Granting the Right of Entry and Possession does not in any way, prejudice Grantors' rights to receive full and just compensation for the interest to be

acquired by the City of Austin in the Property, nor the Grantors' right to donate or provide as a gift all or any part of the Property to the City if Grantor so elects.

3. It is expressly provided that if the City of Austin institutes condemnation proceedings against the Property, the City will not be liable to the Grantors for interest upon any award or judgment in such proceedings for any period of time prior to the deposit by the City of Austin in the condemnation proceedings as required by law. This conveyance is made for the mutual benefit of the Grantor and the City, and Grantor does not claim the right to interest for any period of time that the City might have had possession of the Property prior to the deposit by the City of the amount of the award.

4. This Right of Entry and Possession is irrevocable by Grantors and that the Grantors' retain only the right to be compensated for the interests and rights in the Property that will be permanently and temporarily utilized by the City of Austin and the Grantors will have no right to withdraw or rescind the rights in the Property herein conveyed.

TO HAVE AND TO HOLD the possession of the Property for the purposes and subject to the limitations above described, and the Grantors herein warrant that no person or corporation owns an interest in the fee title of the Property other than the Grantors herein.

Executed on DECEMBER 18, 2012.

GRANTORS:

Praxair Distribution, Inc., a Delaware corporation

By:
Name: Edward R. Durkin
Title: Director, Corporate Real Estate

CONNECTICUT
STATE OF ~~TEXAS~~ §
FAIRFIELD § DANBURY
COUNTY OF ~~TRAVIS~~ §

This instrument was acknowledged before me on December 18, 2012 by Edward R. Durkin, Director, Corporate Real Estate, of Praxair Distribution, Inc., a Delaware corporation, on behalf of said corporation.

[SEAL]

Renee M Bouteiller
Notary Public, State of Texas

RENEE M. BOUTEILLER
NOTARY PUBLIC
MY COMMISSION EXPIRES MAY 31, 2017

AFTER RECORDING, RETURN TO CITY OF AUSTIN PICK UP BOX:

City of Austin
Office of Real Estate Services
505 Barton Springs Rd. Ste. 1350
Austin, Texas 78704
ATTN: Betty Nguyen

File#: 4710.01
Project Name: Montopolis WRI Tank
TCAD#: 03-1413-0207

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS

EXHIBIT "A"

WILSON OXYGEN AND SUPPLY COMPANY,
A TEXAS CORPORATION NKA PRAXAIR
DISTRIBUTION SERVICES, INC., NKA
PRAXAIR DISTRIBUTION, INC.
TO
CITY OF AUSTIN
(WATER TANK SITE)

DESCRIPTION FOR PARCEL NO. 4710.01 TANK

LEGAL DESCRIPTION OF A 2.005 ACRE (87,347 SQUARE FOOT) TRACT OF LAND IN THE SANTIAGO DEL VALLE GRANT, ABSTRACT NO. 24, TRAVIS COUNTY, TEXAS, BEING A PORTION OF A 11.413 ACRE TRACT DESCRIBED IN A SPECIAL WARRANTY DEED TO WILSON OXYGEN AND SUPPLY COMPANY, EXECUTED ON AUGUST 21, 1994, AND RECORDED IN VOLUME 12257, PAGE 1837 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS, ALSO BEING A PORTION OF A 22.156 ACRE TRACT, DESCRIBED IN A PARTITION DEED TO RPC INVESTMENTS, INC., AND ROBERTA P. CRENSHAW AND CARTER INVESTMENTS, EXECUTED DECEMBER 23, 1988, AND RECORDED IN VOLUME 10793, PAGE 501 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS; SAID 2.005 ACRE TRACT AS SHOWN ON THE ACCOMPANYING SKETCH, BEING MORE PARTICULARLY DESCRIBED BY METES AND BOUNDS AS FOLLOWS:

BEGINNING at a 60d nail set in the northeast line of said 11.413 acre tract and the southwest line of Lot 2, Block A, Montopolis - Ben White Subdivision, a subdivision of record in Doc. No. 200100029 of the Official Public Records of Travis County, Texas, having Texas Coordinate System (Central Zone-4203, NAD83, U.S. Survey Feet) values of N=10,052,073.53, E=3,126,356.75, for the north corner and **POINT OF BEGINNING** of the herein described tract, from which a ½" iron rod found at an angle point in the southeast right-of-way line of Montopolis Drive (right-of-way width varies) and the northwest line of said 11.413 acre tract, bears N17°06'36"W, a distance of 30.81 feet, N52°07'56"W, a distance of 835.61 feet and S28°02'43"W, a distance of 117.50 feet;

THENCE, S17°06'36"E, with the northeast line of said 11.413 acre tract and the southwest line of said Lot 2, a distance of 295.80 feet to a ½" iron rod found at the east corner of said 11.413 acre tract, and the common north corner of Lot 2 and Lot 1 of said Montopolis – Ben White Subdivision, for the east corner of this tract;

THENCE, S76°15'23"W, with the southeast line of said 11.413 acre tract and the northwest line of said Lot 1, at a distance of 262.93 feet pass a ½" iron rod found at the common corner of said Lot 1, and Lot 1 Block "A", Circle "B" Homes Subdivision, a subdivision of record in Volume 100, Page 289 of the Plat Records of Travis County, Texas, continuing in all a distance of 295.80 feet to a 60d nail set for the south corner of this tract, from which a ½" iron rod found in the southeast line of a 4.15 acre tract described in Volume 12407, Page 2589 of the Real Property

Records of Travis County, Texas, at the south corner of said 11.413 acre tract and the northwest corner of said Lot 1, Block "A", of said Circle "B" Homes Subdivision, bears S76°15'23"W, a distance of 339.83 feet;

THENCE, over and across said 11.413 acre tract, the following two (2) courses:

1) N17°06'36"W, a distance of 295.80 feet to a 60d nail set for the west corner of this tract;

2) N76°15'23"E, a distance of 295.80 feet to the **POINT OF BEGINNING**, containing 2.005 acre (87,347 square feet) of land.

BEARING BASIS NOTE

The coordinates and bearings shown hereon are based on the Texas State Plane Coordinate System (Central Zone-4203, NAD83, Combined Scale Factor = 1.000023). All distances shown are surface distances.

THE STATE OF TEXAS §
§ KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF TRAVIS §

That I, Todd Blenden, a Registered Professional Land Surveyor, do hereby state that the above description is true and correct to the best of my knowledge and belief and that the property described herein was determined by a survey made on the ground under my direction and supervision.

WITNESS MY HAND AND SEAL at Austin, Travis County, Texas, this 22nd day of August, 2012, A.D.

TODD BLENDEN
6186

Todd Blenden

Macias & Associates, L.P.
5410 South 1st Street
Austin, Texas 78745
512-442-7875

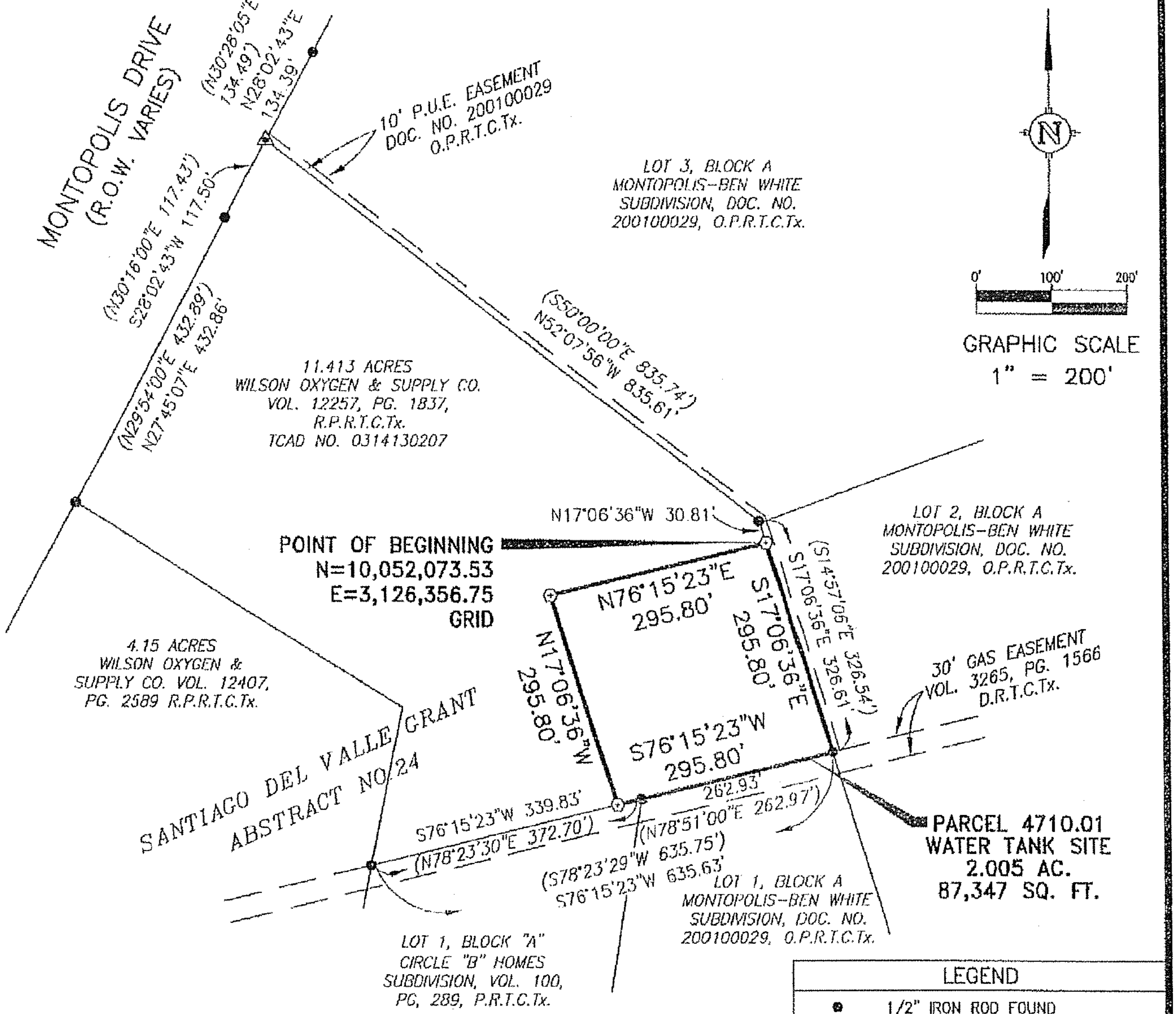
Todd Blenden
Registered Professional Land Surveyor
No. 6186 – State of Texas

REFERENCES

MAPSCO 2009, 646-E
AUSTIN GRID NO. L-18
TCAD PARCEL ID NO. 03-1413-0207
MACIAS & ASSOCIATES, L.P., PROJECT NO. 519-02-12

FIELD NOTES REVIEWED
By: Date 11/27/12
Engineering Support Section
Department of Public Works
and Transportation

SKETCH TO ACCOMPANY LEGAL DESCRIPTION



LEGEND

●	1/2" IRON ROD FOUND
⊙	1/2" IRON ROD SET WITH PLASTIC CAP STAMPED "MACIAS & ASSOC."
▲	60D NAIL SET
P.O.B.	POINT OF BEGINNING
VOL., PG.	VOLUME, PAGE
DOC. NO.	DOCUMENT NUMBER
P.R.T.C.Tx.	PLAT RECORDS OF TRAVIS COUNTY, TEXAS
R.P.R.T.C.Tx.	REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS
O.P.R.T.C.Tx.	OFFICIAL PUBLIC RECORDS OF TRAVIS COUNTY, TEXAS
D.R.T.C.Tx.	DEED RECORDS OF TRAVIS COUNTY, TEXAS
T.C.A.D.	TRAVIS COUNTY APPRAISAL DISTRICT
( )	RECORD INFORMATION

BEARING BASIS:
ALL BEARINGS SHOWN HEREON ARE BASED ON THE TEXAS COORDINATE SYSTEM, NAD83, CENTRAL ZONE. ALL DISTANCES SHOWN HEREON ARE SURFACE DISTANCES. SURFACE ADJUSTMENT SCALE FACTOR IS 1.000023.

The easements shown or noted and addressed on this subject tract are those listed in Schedule B of title commitment issued by Chicago Title Insurance Company of Austin, GF No. CTA-07-CTA11000255JP, effective date: June 14, 2011.

TODD BLENDEN
6186

Todd Blenden 8/22/2012

Todd Blenden Date:
Registered Professional Land Surveyor
No. 6186 – State of Texas

PAGE 3 OF 3

J:\JOBS\ZAMORA\519-02-12 11.413AC TR EASEMENTS\DWG\5190212TANK.DWG

DATE: 08-01-12
DRAWN BY: TB
MAI JOB NO.: 519-02-12
REFERENCE: 613/08

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS
5410 SOUTH 1ST STREET
AUSTIN, TEXAS 78745 PH. (512)442-7875
FAX (512)442-7876 EMAIL: WWW.MACIASWORLD.COM

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS

EXHIBIT " B "

WILSON OXYGEN AND SUPPLY COMPANY,
A TEXAS CORPORATION NKA PRAXAIR
DISTRIBUTION SERVICES, INC., NKA
PRAXAIR DISTRIBUTION, INC.
TO
CITY OF AUSTIN
(ELECTRIC EASEMENT)

DESCRIPTION FOR PARCEL NO. 4710.01 EE

LEGAL DESCRIPTION OF A 0.266 ACRE (11,582 SQUARE FOOT) TRACT OF LAND IN THE SANTIAGO DEL VALLE GRANT, ABSTRACT NO. 24, TRAVIS COUNTY, TEXAS, BEING A PORTION OF A 11.413 ACRE TRACT DESCRIBED IN A SPECIAL WARRANTY DEED TO WILSON OXYGEN AND SUPPLY COMPANY, EXECUTED ON AUGUST 21, 1994, AND RECORDED IN VOLUME 12257, PAGE 1837 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS, ALSO BEING A PORTION OF A 22.156 ACRE TRACT, DESCRIBED IN A PARTITION DEED TO RPC INVESTMENTS, INC., AND ROBERTA P. CRENSHAW AND CARTER INVESTMENTS, EXECUTED DECEMBER 23, 1988, AND RECORDED IN VOLUME 10793, PAGE 501 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS; SAID 0.266 ACRE TRACT AS SHOWN ON THE ACCOMPANYING SKETCH, BEING MORE PARTICULARLY DESCRIBED BY METES AND BOUNDS AS FOLLOWS:

BEGINNING at a 60d nail set in the southeast right-of-way line of Montopolis Drive (right-of-way width varies), at the north corner of said 11.413 acre tract and the west corner of Lot 3, Block A, Montopolis - Ben White Subdivision, a subdivision of record in Doc. No. 200100029 of the Official Public Records of Travis County, Texas, having Texas Coordinate System (Central Zone-4203, NAD83, U.S. Survey Feet) values of N=10,052,615.90, E=3,125,688.03, for the north corner and **POINT OF BEGINNING** of the herein described tract, from which a ½" iron rod found at an angle point in the said southeast right-of-way line of Montopolis Drive and the northwest line of said Lot 3, bears N28°02'43"E, a distance of 134.39 feet;

THENCE, S52°07'56"E, with the northeast line of said 11.413 acre tract and the southwest line of said Lot 3, a distance of 835.61 feet to a ½" iron rod found at an angle point in the northeast line of said 11.413 acre tract, at the southwest line of said Lot 3, for an angle point;

THENCE, S17°06'36"E, with the northeast line of said 11.413 acre tract and the southwest lines of said Lot 3 and Lot 2, Block A, of said Montopolis – Ben White Subdivision, a distance of 326.61 feet to a ½" iron rod found at the east corner of said 11.413 acre tract, and the common north corner of Lot 2 and Lot 1 of said Montopolis – Ben White Subdivision, for the east corner of this tract;

THENCE, S76°15'23"W, with the south line of said 11.413 acre tract and the north line of said Lot 1, a distance of 10.02 feet to a 60d nail set, for the southwest corner of this tract, from which a ½" iron rod found in the south line of said 11.413 acre tract at the common north corner of said Lot 1, Block A of said Montopolis – Ben White Subdivision and Lot 1, Block "A", Circle "B" Homes Subdivision, a subdivision of record in Volume 100, Page 289 of the Plat Records of Travis County, Texas, bears S76°15'23"W, a distance of 252.92 feet;

THENCE, over and across said 11.413 acre tract, the following two (2) courses:

1) N17°06'36"W, a distance of 322.86 feet to a 60d nail set for an angle point;

2) N52°07'56"W, a distance of 830.72 feet to a 60d nail set in the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, for the northwest corner of this tract, from which a ½" iron rod found at an angle point in the said southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, bears S28°02'43"W, a distance of 107.35 feet;

THENCE, N28°02'43"E, with the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, a distance of 10.15 feet, to the **POINT OF BEGINNING**, containing 0.266 acre (11,582 square feet) of land.

BEARING BASIS NOTE

The coordinates and bearings shown hereon are based on the Texas Coordinate System (Central Zone-4203, NAD83, Combined Scale Factor = 1.000023). All distances shown are surface distances.

THE STATE OF TEXAS §
§ KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF TRAVIS §

That I, Todd Blenden, a Registered Professional Land Surveyor, do hereby state that the above description is true and correct to the best of my knowledge and belief and that the property described herein was determined by a survey made on the ground under my direction and supervision.

WITNESS MY HAND AND SEAL at Austin, Travis County, Texas, this 22nd day of August, 2012, A.D.

Todd Blenden

Macias & Associates, L.P.
5410 South 1st Street
Austin, Texas 78745
512-442-7875

Todd Blenden
Registered Professional Land Surveyor
No. 6186 – State of Texas

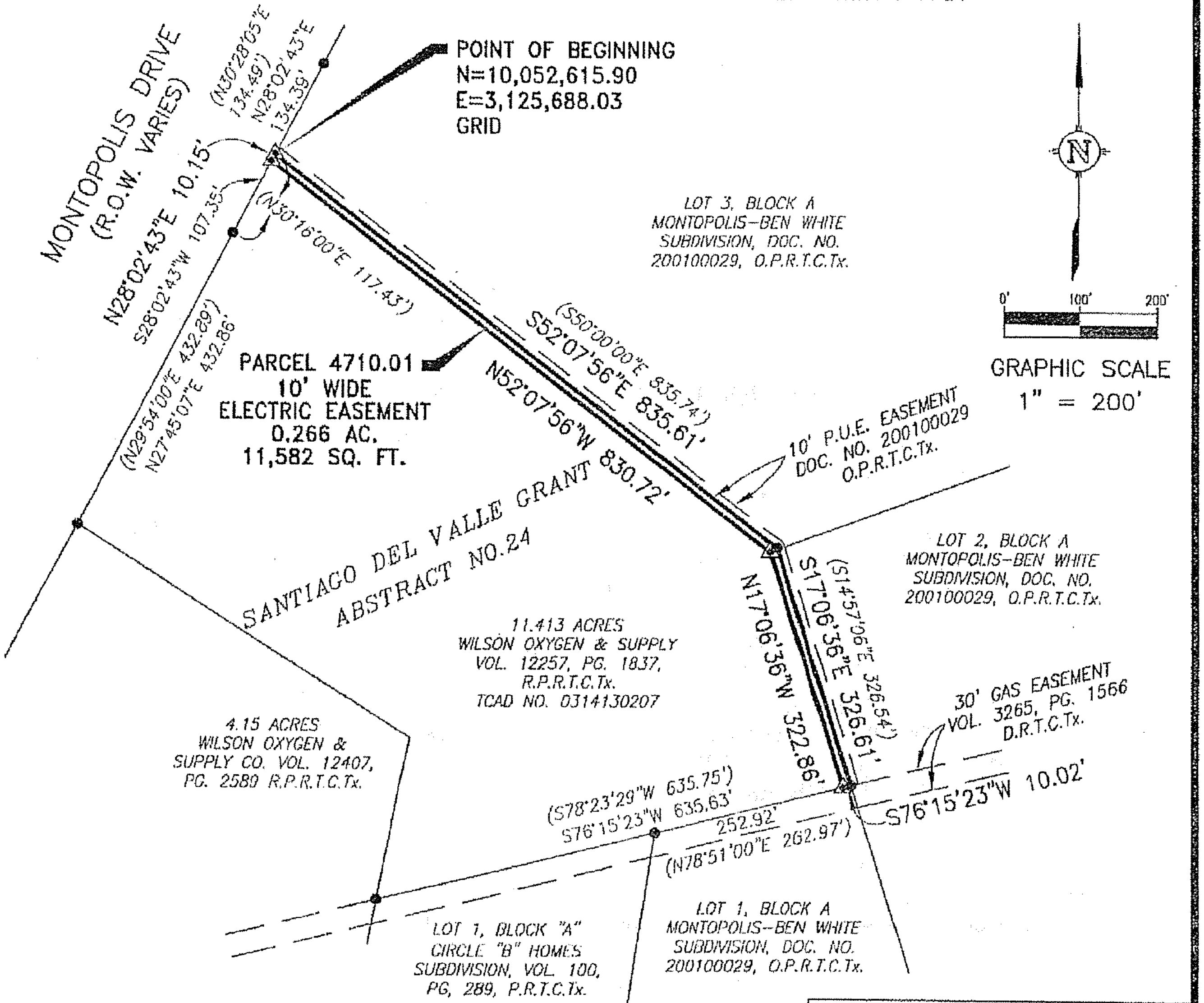
TODD BLENDEN
6186

REFERENCES

MAPSCO 2009, 646-E
AUSTIN GRID NO. L-18
TCAD PARCEL ID NO. 03-1413-0207
MACIAS & ASSOCIATES, L.P., PROJECT NO. 519-02-12

FIELD NOTES REVIEWED
By: Date 11/27/12
Engineering Support Section
Department of Public Works
and Transportation

SKETCH TO ACCOMPANY LEGAL DESCRIPTION



LEGEND

●	1/2" IRON ROD FOUND
▲	60D NAIL SET
P.O.B.	POINT OF BEGINNING
VOL., PG.	VOLUME, PAGE
DOC. NO.	DOCUMENT NUMBER
P.R.T.C.Tx.	PLAT RECORDS OF TRAVIS COUNTY, TEXAS
R.P.R.T.C.Tx.	REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS
O.P.R.T.C.Tx.	OFFICIAL PUBLIC RECORDS OF TRAVIS COUNTY, TEXAS
D.R.T.C.Tx.	DEED RECORDS OF TRAVIS COUNTY, TEXAS
T.C.A.D.	TRAVIS COUNTY APPRAISAL DISTRICT
( )	RECORD INFORMATION

BEARING BASIS:

ALL BEARINGS SHOWN HEREON ARE BASED ON THE TEXAS COORDINATE SYSTEM, NAD83, CENTRAL ZONE. ALL DISTANCES SHOWN HEREON ARE SURFACE DISTANCES. SURFACE ADJUSTMENT SCALE FACTOR IS 1.000023.

The easements shown or noted and addressed on this subject tract are those listed in Schedule B of title commitment issued by Chicago Title Insurance Company of Austin, GF No. CTA-07-CTA11000255JP, effective date: June 14, 2011.

TODD BLENDEN
6186

Todd Blenden 8/22/2012

Todd Blenden Date:
Registered Professional Land Surveyor
No. 6186 – State of Texas

PAGE 3 OF 3

DATE: 08-01-12
DRAWN BY: TB
MAI JOB NO.: 519-02-12
REFERENCE: 613/08

J:\JOBS\ZAMORA\519-02-12 11.413AC TR EASEMENTS\DWG\5190212EE.DWG

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS
★ ★ ★ ★ ★ ★
5410 SOUTH 1ST STREET
AUSTIN, TEXAS 78745 PH. (512)442-7875
FAX (512)442-7876 EMAIL: WWW.MACIASWORLD.COM

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS

EXHIBIT "C"

WILSON OXYGEN AND SUPPLY COMPANY,
A TEXAS CORPORATION NKA PRAXAIR
DISTRIBUTION SERVICES, INC., NKA
PRAXAIR DISTRIBUTION, INC.
TO
CITY OF AUSTIN
(WATER LINE, AND ACCESS EASEMENT)

DESCRIPTION FOR PARCEL NO. 4710.01 WLAE

LEGAL DESCRIPTION OF A 0.580 ACRE (25,255 SQUARE FOOT) TRACT OF LAND IN THE SANTIAGO DEL VALLE GRANT, ABSTRACT NO. 24, TRAVIS COUNTY, TEXAS, BEING A PORTION OF A 11.413 ACRE TRACT DESCRIBED IN A SPECIAL WARRANTY DEED TO WILSON OXYGEN AND SUPPLY COMPANY, EXECUTED ON AUGUST 21, 1994, AND RECORDED IN VOLUME 12257, PAGE 1837 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS, ALSO BEING A PORTION OF A 22.156 ACRE TRACT, DESCRIBED IN A PARTITION DEED TO RPC INVESTMENTS, INC., AND ROBERTA P. CRENSHAW AND CARTER INVESTMENTS, EXECUTED DECEMBER 23, 1988, AND RECORDED IN VOLUME 10793, PAGE 501 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS; SAID 0.580 ACRE TRACT AS SHOWN ON THE ACCOMPANYING SKETCH, BEING MORE PARTICULARLY DESCRIBED BY METES AND BOUNDS AS FOLLOWS:

BEGINNING at a 60d nail set in the southeast right-of-way line of Montopolis Drive (right-of-way width varies), on the northwest line of said 11.413 acre tract, having Texas Coordinate System (Central Zone-4203, NAD83, U.S. Survey Feet) values of N=10,052,606.95, E=3,125,683.26, for the north corner and **POINT OF BEGINNING** of the herein described tract, from which a ½" iron rod found at an angle point in the said southeast right-of-way line of Montopolis Drive and the northwest line of said Lot 3, Block A, Montopolis - Ben White Subdivision, a subdivision of record in Doc. No. 200100029 of the Official Public Records of Travis County, Texas, bears N28°02'43"E, a distance of 144.54 feet;

THENCE, over and across said 11.413 acre tract the following four (4) courses:

1) S52°07'56"E, 10 feet southwest and parallel to the northeast line of said 11.413 acre tract, a distance of 830.72 feet to a 60d nail set for an angle point, from which a ½" iron rod found at an angle point in the northeast line of said 11.413 acre tract, and the southwest line of said Lot 3, bears N55°22'44"E, a distance of 10.49 feet;

2) S17°06'36"E, a distance of 27.06 feet to a 60d nail set for the southeast corner of this tract;

3) S76°15'23"W, a distance of 18.46 feet to a 60d nail set for the southwest corner of this tract;

4) N52°07'56"W, a distance of 836.23 feet to a 60d nail set in the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, for the northwest corner of this tract, from which a ½" iron rod found at an angle point in the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, bears S28°02'43"W, a distance of 76.90 feet;

THENCE, N28°02'43"E, with the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, a distance of 30.45 feet, to the **POINT OF BEGINNING**, containing 0.580 acre (25,255 square feet) of land.

BEARING BASIS NOTE

The coordinates and bearings shown hereon are based on the Texas Coordinate System (Central Zone-4203, NAD83, Combined Scale Factor = 1.000023). All distances shown are surface distances.

THE STATE OF TEXAS §
§ KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF TRAVIS §

That I, Todd Blenden, a Registered Professional Land Surveyor, do hereby state that the above description is true and correct to the best of my knowledge and belief and that the property described herein was determined by a survey made on the ground under my direction and supervision.

WITNESS MY HAND AND SEAL at Austin, Travis County, Texas, this 22nd day of August, 2012, A.D.

TODD BLENDEN
6186

Todd Blenden

Macias & Associates, L.P.
5410 South 1st Street
Austin, Texas 78745
512-442-7875

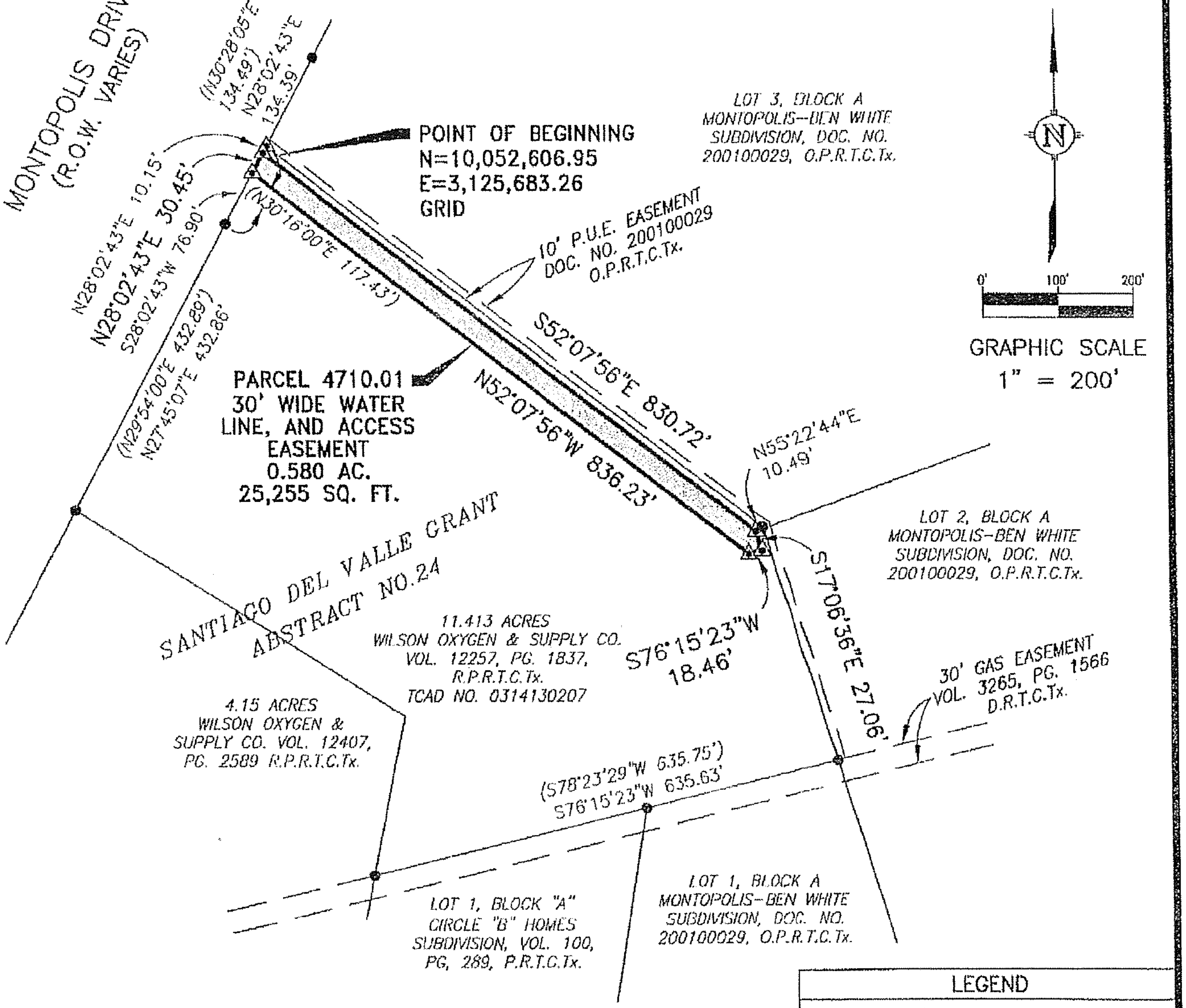
Todd Blenden
Registered Professional Land Surveyor
No. 6186 – State of Texas

REFERENCES

MAPSCO 2009, 646-E
AUSTIN GRID NO. L-18
TCAD PARCEL ID NO. 03-1413-0207
MACIAS & ASSOCIATES, L.P., PROJECT NO. 519-02-12

FIELD NOTES REVIEWED
By: Date 11/27/12
Engineering Support Section
Department of Public Works
and Transportation

SKETCH TO ACCOMPANY LEGAL DESCRIPTION



LEGEND

●	1/2" IRON ROD FOUND
▲	60D NAIL SET
P.O.B.	POINT OF BEGINNING
VOL., PG.	VOLUME, PAGE
DOC. NO.	DOCUMENT NUMBER
P.R.T.C.Tx.	PLAT RECORDS OF TRAVIS COUNTY, TEXAS
R.P.R.T.C.Tx.	REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS
O.P.R.T.C.Tx.	OFFICIAL PUBLIC RECORDS OF TRAVIS COUNTY, TEXAS
D.R.T.C.Tx.	DEED RECORDS OF TRAVIS COUNTY, TEXAS
T.C.A.D.	TRAVIS COUNTY APPRAISAL DISTRICT
( )	RECORD INFORMATION

BEARING BASIS:
ALL BEARINGS SHOWN HEREON ARE BASED ON THE TEXAS COORDINATE SYSTEM, NAD83, CENTRAL ZONE. ALL DISTANCES SHOWN HEREON ARE SURFACE DISTANCES. SURFACE ADJUSTMENT SCALE FACTOR IS 1.000023.

The easements shown or noted and addressed on this subject tract are those listed in Schedule B of title commitment issued by Chicago Title Insurance Company of Austin, GF No. CTA-07-CTA11000255JP, effective date: June 14, 2011.

TODD BLENDEN
6186

Todd Blenden 8/27/2012

Todd Blenden Date:
Registered Professional Land Surveyor
No. 6186 – State of Texas

DATE: 08-01-12
DRAWN BY: TB
MAI JOB NO.: 519-02-12
REFERENCE: 613/08

J:\JOBS\ZAMORA\519-02-12 11.413AC TR EASEMENTS\DWG\5190212WLE.DWG

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS
★ ★ ★ ★ ★ ★
5410 SOUTH 1ST STREET
AUSTIN, TEXAS 78745 PH. (512)442-7875
FAX (512)442-7876 EMAIL: WWW.MACIASWORLD.COM

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS

EXHIBIT "D"

WILSON OXYGEN AND SUPPLY COMPANY,
A TEXAS CORPORATION NKA PRAXAIR
DISTRIBUTION SERVICES, INC., NKA
PRAXAIR DISTRIBUTION, INC.
TO
CITY OF AUSTIN
(TEMPORARY WORKING SPACE
EASEMENT)

DESCRIPTION FOR PARCEL NO. 4710.01 TWSE

LEGAL DESCRIPTION OF A 0.380 ACRE (16,534 SQUARE FOOT) TRACT OF LAND IN THE SANTIAGO DEL VALLE GRANT, ABSTRACT NO. 24, TRAVIS COUNTY, TEXAS, BEING A PORTION OF A 11.413 ACRE TRACT DESCRIBED IN A SPECIAL WARRANTY DEED TO WILSON OXYGEN AND SUPPLY COMPANY, EXECUTED ON AUGUST 21, 1994, AND RECORDED IN VOLUME 12257, PAGE 1837 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS, ALSO BEING A PORTION OF A 22.156 ACRE TRACT, DESCRIBED IN A PARTITION DEED TO RPC INVESTMENTS, INC., AND ROBERTA P. CRENSHAW AND CARTER INVESTMENTS, EXECUTED DECEMBER 23, 1988, AND RECORDED IN VOLUME 10793, PAGE 501 OF THE REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS; SAID 0.380 ACRE TRACT AS SHOWN ON THE ACCOMPANYING SKETCH, BEING MORE PARTICULARLY DESCRIBED BY METES AND BOUNDS AS FOLLOWS:

BEGINNING at a 60d nail set in the southeast right-of-way line of Montopolis Drive (right-of-way width varies), on the northwest line of said 11.413 acre tract, having Texas Coordinate System (Central Zone-4203, NAD83, U.S. Survey Feet) values of N=10,052,580.07, E=3,125,668.95, for the north corner and **POINT OF BEGINNING** of the herein described tract, from which a ½" iron rod found at an angle point in the said southeast right-of-way line of Montopolis Drive and the northwest line of said Lot 3, Block A, Montopolis - Ben White Subdivision, a subdivision of record in Doc. No. 200100029 of the Official Public Records of Travis County, Texas, bears N28°02'43"E, a distance of 174.99 feet;

THENCE, over and across said 11.413 acre tract, the following three (3) courses:

1) S52°07'56"E, 40 feet southwest and parallel to the northeast line of said 11.413 acre tract, a distance of 836.23 feet to a 60d nail set for the southeast corner of this tract, from which a ½" iron rod found at an angle point in the northeast line of said 11.413 acre tract, and the southwest line of said Lot 3, bears N27°11'20"E, a distance of 40.70 feet;

2) S76°15'23"W, a distance of 25.52 feet to a 60d nail set for the southwest corner of this tract;

3) N52°07'56"W, a distance of 816.92 feet to a 60d nail set in the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, for the northwest corner of this tract, from which a ½" iron rod found at an angle point in the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, bears S28°02'43"W, a distance of 56.60 feet;

THENCE, N28°02'43"E, with the southeast right-of-way line of said Montopolis Drive and the northwest line of said 11.413 acre tract, a distance of 20.30 feet, to the **POINT OF BEGINNING**, containing 0.380 acre (16,534 square feet) of land.

BEARING BASIS NOTE

The coordinates and bearings shown hereon are based on the Texas State Coordinate System (Central Zone-4203, NAD83, Combined Scale Factor = 1.000023). All distances shown are surface distances.

THE STATE OF TEXAS §
§ KNOW ALL MEN BY THESE PRESENTS:
COUNTY OF TRAVIS §

That I, Todd Blenden, a Registered Professional Land Surveyor, do hereby state that the above description is true and correct to the best of my knowledge and belief and that the property described herein was determined by a survey made on the ground under my direction and supervision.

WITNESS MY HAND AND SEAL at Austin, Travis County, Texas, this 22nd day of August, 2012, A.D.

TODD BLENDEN
6186

Todd Blenden

Macias & Associates, L.P.
5410 South 1st Street
Austin, Texas 78745
512-442-7875

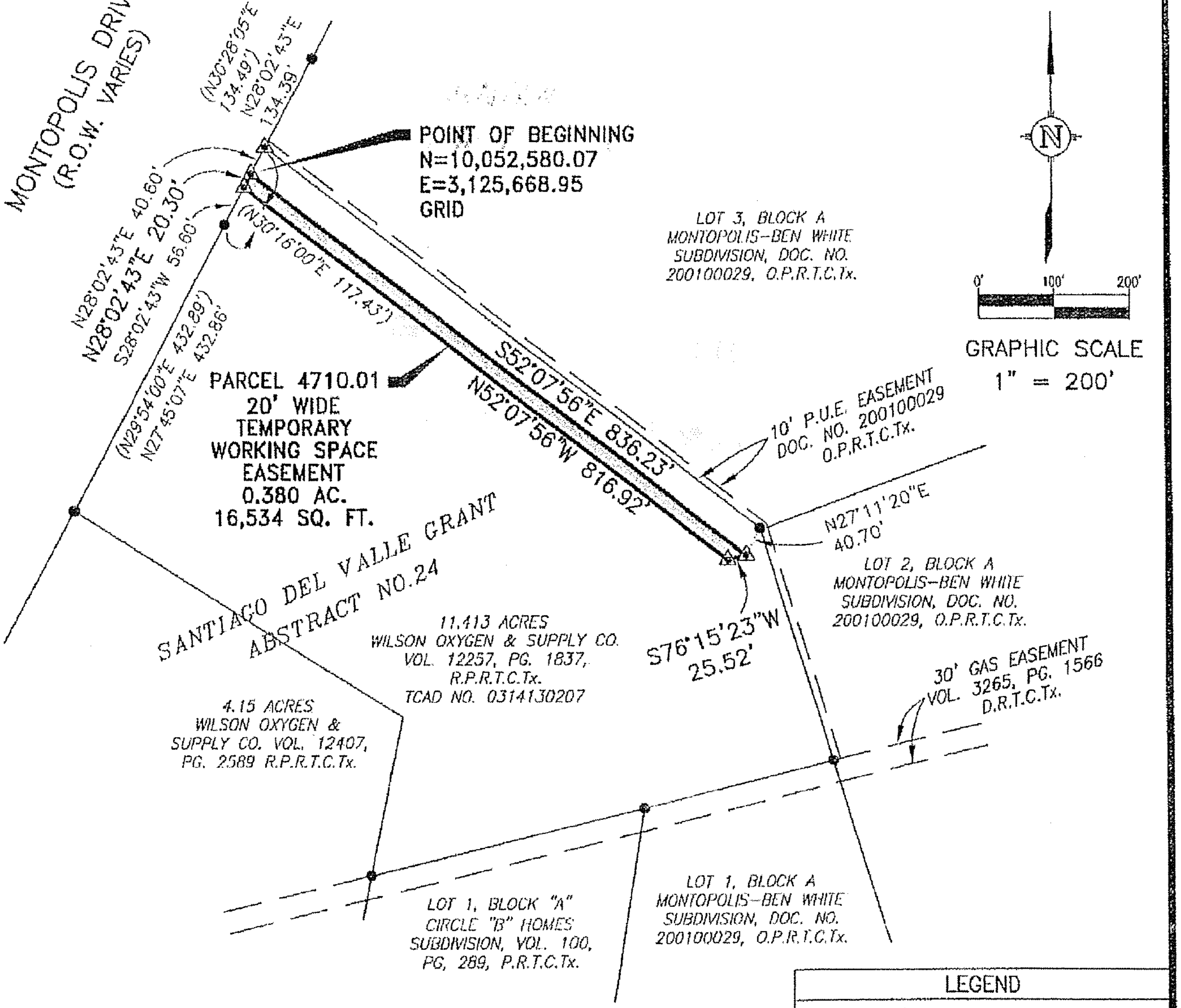
Todd Blenden
Registered Professional Land Surveyor
No. 6186 – State of Texas

REFERENCES

MAPSCO 2009, 646-E
AUSTIN GRID NO. L-18
TCAD PARCEL ID NO. 03-1413-0207
MACIAS & ASSOCIATES, L.P., PROJECT NO. 519-02-12

FIELD NOTES REVIEWED
By: Date 11/27/12
Engineering Support Section
Department of Public Works
and Transportation

SKETCH TO ACCOMPANY LEGAL DESCRIPTION



LEGEND

●	1/2" IRON ROD FOUND
△	60D NAIL SET
P.O.B.	POINT OF BEGINNING
VOL., PG.	VOLUME, PAGE
DOC. NO.	DOCUMENT NUMBER
P.R.T.C.Tx.	PLAT RECORDS OF TRAVIS COUNTY, TEXAS
R.P.R.T.C.Tx.	REAL PROPERTY RECORDS OF TRAVIS COUNTY, TEXAS
O.P.R.T.C.Tx.	OFFICIAL PUBLIC RECORDS OF TRAVIS COUNTY, TEXAS
D.R.T.C.Tx.	DEED RECORDS OF TRAVIS COUNTY, TEXAS
T.C.A.D.	TRAVIS COUNTY APPRAISAL DISTRICT
( )	RECORD INFORMATION

BEARING BASIS:

ALL BEARINGS SHOWN HEREON ARE BASED ON THE TEXAS COORDINATE SYSTEM, NAD83, CENTRAL ZONE. ALL DISTANCES SHOWN HEREON ARE SURFACE DISTANCES. SURFACE ADJUSTMENT SCALE FACTOR IS 1.000023.

The easements shown or noted and addressed on this subject tract are those listed in Schedule B of title commitment issued by Chicago Title Insurance Company of Austin, GF No. CTA-07-CTA11000255JP, effective date: June 14, 2011.

TODD BLENDEN
6186

Todd Blenden 8/22/2012

Todd Blenden Date:
Registered Professional Land Surveyor
No. 6186 — State of Texas

DATE: 08-01-12
DRAWN BY: TB
MAI JOB NO.: 519-02-12
REFERENCE: 613/08

J:\JOBS\ZAMORA\519-02-12 11.413AC TR EASEMENTS\DWG\5190212TWSE.DWG

MACIAS & ASSOCIATES, L.P.
LAND SURVEYORS
★ ★ ★ ★ ★ ★
5410 SOUTH 1ST STREET
AUSTIN, TEXAS 78745 PH. (512)442-7875
FAX (512)442-7876 EMAIL: WWW.MACIASWORLD.COM

ORIGINAL
FILED FOR RECORD

FILED AND RECORDED
OFFICIAL PUBLIC RECORDS
Dana DeBeauvoir
Jan 03, 2013 02:45 PM 2013002151
BENAVIDESV: $76.00
Dana DeBeauvoir, County Clerk
Travis County TEXAS

Austin SWIFT Loan Application
Reuse Water Main Projects

Part D, Item 64

ED-101
Revised 11/1/2011

STATE OF TEXAS §
§
COUNTY OF **Travis** §

SITE CERTIFICATE

Before me, the undersigned notary, on this day personally appeared **Greg Meszaros**, a person whose identify is known to me or who has presented to me a satisfactory proof of identity. After I administered an oath, this person swore to the following:

(1) My name is **Greg Meszaros**. I am over 18 years of age and I am of sound mind, and capable of swearing to the facts contained in this Site Certificate. The facts stated in this certificate are within my personal knowledge and are true and correct.

(2) I am an authorized representative of City of Austin, an entity that has filed an application for financial assistance with the Texas Water Development Board for a (water) (wastewater) project.

LEGAL CERTIFICATION – OWNERSHIP INTEREST

This is to certify that **City of Austin** (Legal Name of Applicant, i.e., City, District, etc.)

has acquired or is in the process of acquiring the necessary real property interest, as evidenced by fee simple purchase or fully executed earnest money contracts, firm option agreements to purchase the subject property or the initiation of eminent domain procedures, that such acquisition will guarantee access and egress and such interest will contain the necessary easements, rights of way or unrestricted use as is required for the project being financed by the Texas Water Development Board. The legal description is referenced below:

(Location and Description of Property Interests acquired for Project)

See attached maps for proposed alignments for the following reuse water main projects that will generally be constructed along City of Austin streets, in City right of way:

- **Burleson Reuse Main**
- **Cemetery Reuse Main**
- **Decker Lane Reuse Main**
- **Onion Creek Reuse Main**

Any deeds or other instruments required to be recorded to protect the title(s) held by

City of Austin
(Legal Name of Applicant)

have been recorded or filed for the record in the County deed records or other required location.

ED-101
Revised 11/1/2011

LEGAL CERTIFICATION – LEASE/CONTRACT

In the alternative, I certify that ______________________
(Legal Name of Applicant, i.e., City, District, etc.)

has executed a written lease or other contractual agreement to use the property needed for this (water) (wastewater) project that extends through _____ the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. A copy of this lease or agreement is attached hereto.

LEGAL CERTIFICATION – PROPERTY EASEMENT

In the alternative, I certify that _____
(Legal Name of Applicant, i.e., City, District, etc.)

has executed an express easement to use the property needed for this (water) (wastewater) project that extends through _____, the life of the Texas Water Development Board loan or grant that will be used to finance this project, either in whole or in part. A copy of the express easement agreement is attached hereto.

EXECUTED this 18 day of May, 2016.

(Signature)

Greg Meszaros
(Print Name)

Director, Austin Water
(Title)

Sworn to and subscribed before me by Greg Meszaros on May 18th 2016.

Felicia Cancino
Notary Public in and for the State of Texas

[SEAL]

FELICIA CANCINO
Notary Public, State of Texas
My Commission Expires
September 21, 2016

My Commission expires: Sept. 21, 2016

Austin SWIFT Loan Application
Part D, Item 64
Site Certificate Attachment
Burleson Reuse Water Main
Proposed Alignment

LEGEND
- EXISTING WASTEWATER LINE
- EXISTING WATER LINE
- EXISTING REUSE WATER LINE
- PROPOSED ALIGNMENT
- PROPOSED ALIGNMENT "A"
- 🟧 PROPERTIES SERVED BY BASE ALIGNMENT
- 🟪 PROPERTIES SERVED BY ALIGNEMNT "A"

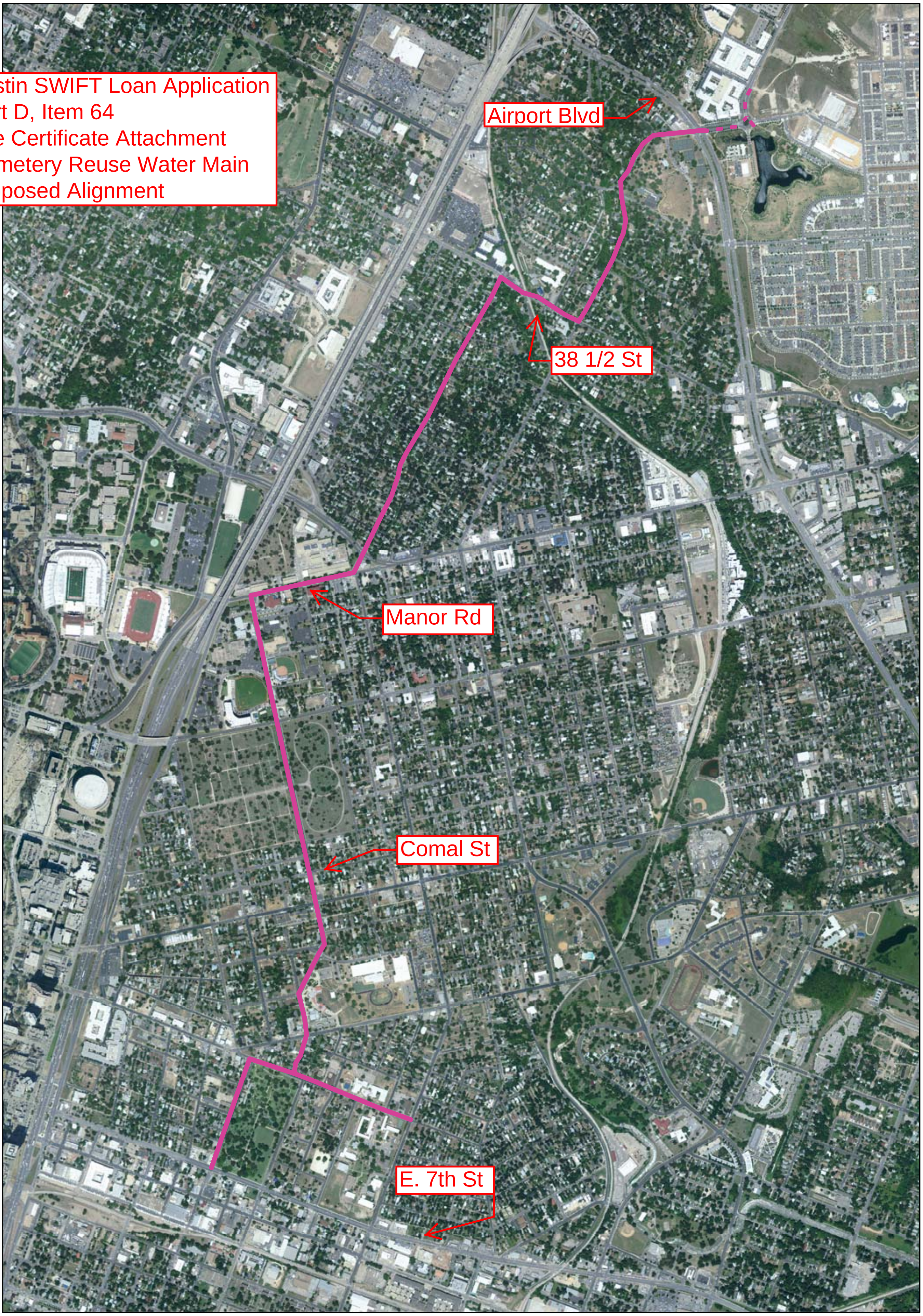
CITY OF AUSTIN
BURLESON WRI PRESSURE CONVERSION

EXHIBIT 1: ROUTE OPTION "A"

K•FRIESE
+ ASSOCIATES
PUBLIC PROJECT ENGINEERING

1120 S. Capital of Texas Highway
CityView 2, Suite 100
Austin, Texas 78746
P – 512.338.1704 F – 512.338.1784
TBPE Firm Number 6535
www.kfriese.com

Austin SWIFT Loan Application
Part D, Item 64
Site Certificate Attachment
Cemetery Reuse Water Main
Proposed Alignment



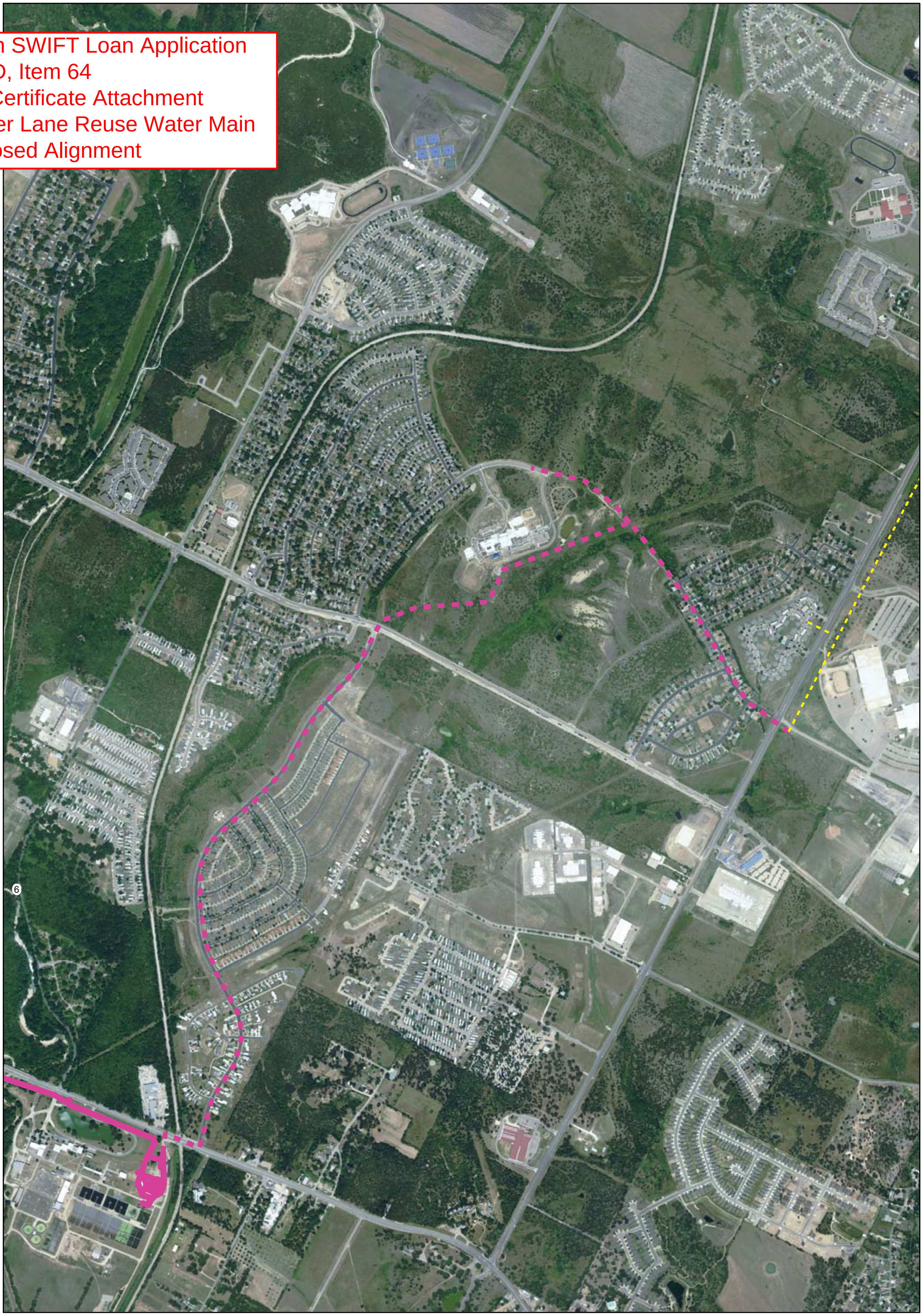
Legend

- - - Existing Reclaimed Mains
— Proposed Reclaimed Mains

"Using purple to keep Austin green"

Proposed Alignment for Cemetery Main

Austin SWIFT Loan Application
Part D, Item 64
Site Certificate Attachment
Decker Lane Reuse Water Main
Proposed Alignment



Legend

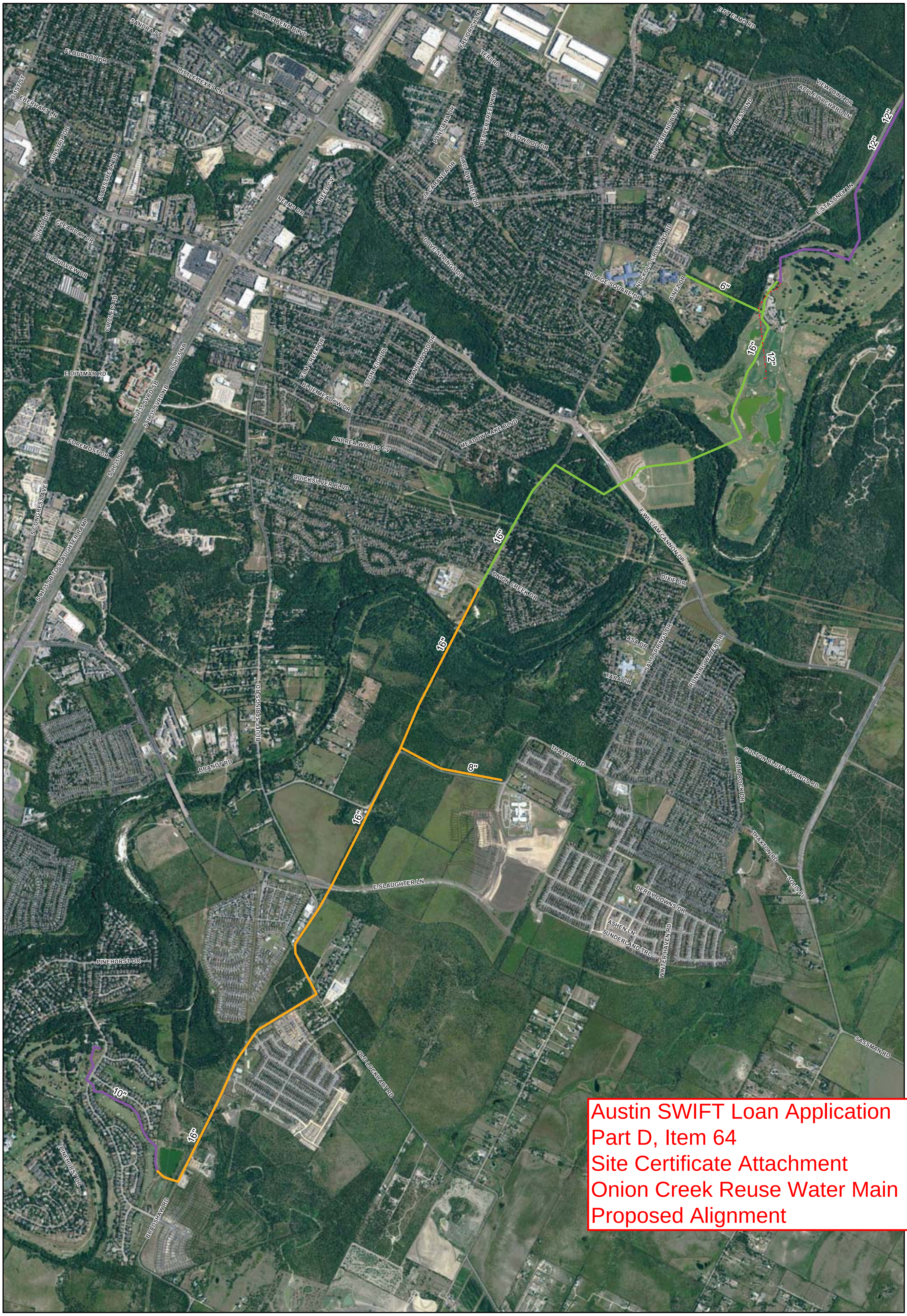
- - - - Proposed Reclaimed Main
—— Existing Reclaimed Main

"Using purple to keep Austin green"

N

0 500 1,000 2,000 Feet

Proposed Reclaimed Main to Decker Lane



Austin SWIFT Loan Application
Part D, Item 64
Site Certificate Attachment
Onion Creek Reuse Water Main
Proposed Alignment

Reclaimed Water Mains

- 🟪 Existing
- 🟩 Phase 1
- 🟧 Phase 2
- - - - Private

N

0 1,250 2,500
Feet

City of Austin
Austin Water
Reclaimed Water Program

Onion Creek
Reclaimed Water Main

Produced by the Reclaimed Water Program
2/1/2016

Austin SWIFT Loan Application
Part D, Item 65
Categorical Exclusion Determination
South Austin Regional WWTP

Texas Water Development Board
P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

March 3, 2016

TO: ALL POTENTIALLY INTERESTED PARTIES:

RE: City of Austin (SWIRFT PIF# 11826) – Direct Reuse Strategy-South Austin Regional WWTP Filtration Project

The attached document is being provided for your information. This is not a permit application. No action is being requested from your agency and no response is required. This project does not involve federal funds.

The attached document is an environmental determination issued by the Texas Water Development Board (TWDB) for a project that may seek funding through the TWDB. Pursuant to the environmental assessment requirements of 31 Texas Administrative Code (TAC) 363.14 of the TWDB rules, the Executive Administrator of the TWDB has determined that the proposed action described in the attached documents may be exempted from formal environmental review requirements. A review by TWDB staff included a consideration of potential environmental impacts and permitting requirements. If there were any concerns about particular regulations or permits, the appropriate regulatory agency would have been contacted for clarification, and this would be described in the attached environmental determination.

Comments regarding this determination may be submitted to the Director of Regional Water Planning and Development, TWDB, P.O. Box 13231, Austin, Texas 78711-3231.

Texas Water Development Board

P.O. Box 13231, 1700 N. Congress Ave.
Austin, TX 78711-3231, www.twdb.texas.gov
Phone (512) 463-7847, Fax (512) 475-2053

March 3, 2016

DETERMINATION OF NO EFFECT

TO ALL INTERESTED AGENCIES AND PUBLIC GROUPS:

Pursuant to the environmental assessment requirements of 31 Texas Administrative Code (TAC) Section 363.14 of the Texas Water Development Board (TWDB) rules, the Executive Administrator of the TWDB has determined that the proposed action identified below may be exempted from formal environmental review requirements:

City of Austin, Travis County
Direct Reuse Strategy
South Austin Regional WWTP Filtration Project
SWIRFT PIF# 11826

The City of Austin (City) is proposing to seek funding from the State Water Implementation Revenue Fund for Texas (SWIRFT) for the planning, design and construction phases required to rehabilitate and expand the tertiary filtration system at South Austin Regional Wastewater Treatment Plant (WWTP). Specifically, the City plans to: (1) replace the existing aging granular media filters with cloth disk filters; 2) perform piping size modifications to increase treatment capacity; 3) remove blowers; 4) replace the existing 42-inch filter influent pipe with a 54-inch filter influent pipe; 5) demolish the existing concrete floor and installation of a new concrete floor to accommodate the increased filter capacity; and, 6) replace existing mud well pumps including replacement of the discharge piping and installation of a new concrete splitter box. The project will also include erosion control plans, removal of debris and revegetation within the limits of construction. All proposed components would occur within the existing treatment plant facilities.

The final filtration stage, or tertiary filtration, is required in order to comply with Texas Commission on Environmental Quality (TCEQ) wastewater discharge and water reuse requirements. The effluent filters at the South Austin Regional Wastewater Treatment Plant (WWTP) serve as the final step in the wastewater treatment process before the effluent is discharged to the Colorado River or reused through the City's water reuse initiative. The proposed project will extend the useful life of the filtration treatment facility at the WWTP and should help the City provide reliable and high quality reclaimed water to meet need of the City's reuse strategy and its growing customer base.

No impacts to state or federally listed protected species or critical habitat, waters of the United States, including wetlands, or cultural resources are expected because the project would occur entirely within the footprint of the existing wastewater treatment plant site.

A desktop review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) (Map Panel ID# 48453C0630K) found that the existing wastewater treatment facilities and proposed improvements are located in Zone X, which are areas determined to be outside of the 100-year floodplain.

TWDB staff concurs that the proposed project qualifies for a categorical exclusion because the work is functional replacement of the existing filtration system with a minor capacity increase in the existing service area. No permit modifications will be required for this project. All proposed work will be performed on previously disturbed sites. Therefore, environmental impacts should be similar to rehabilitation activities and limited to those associated with excavation and pipe installation.

This decision is allowed because the specified project elements should not entail significant adverse impacts to the quality of the human environment. Documentation supporting this determination is on file at the TWDB. This determination may be rescinded if it is found that:

(1) because of changes in the project the proposed actions no longer correspond to the description provided above;
(2) the project may have significant adverse environmental effects; or
(3) Federal, State, or local laws are being or may be violated by implementation of this project.

The project also must comply with the following standard emergency conditions:

- Standard emergency conditions for the discovery of cultural resources; and,
- Standard emergency conditions for the discovery of threatened and endangered species.

Comments regarding this determination may be submitted to the Director, Regional Water Planning & Development, Texas Water Development Board, P.O. Box 13231, Austin, Texas 78711-3231.

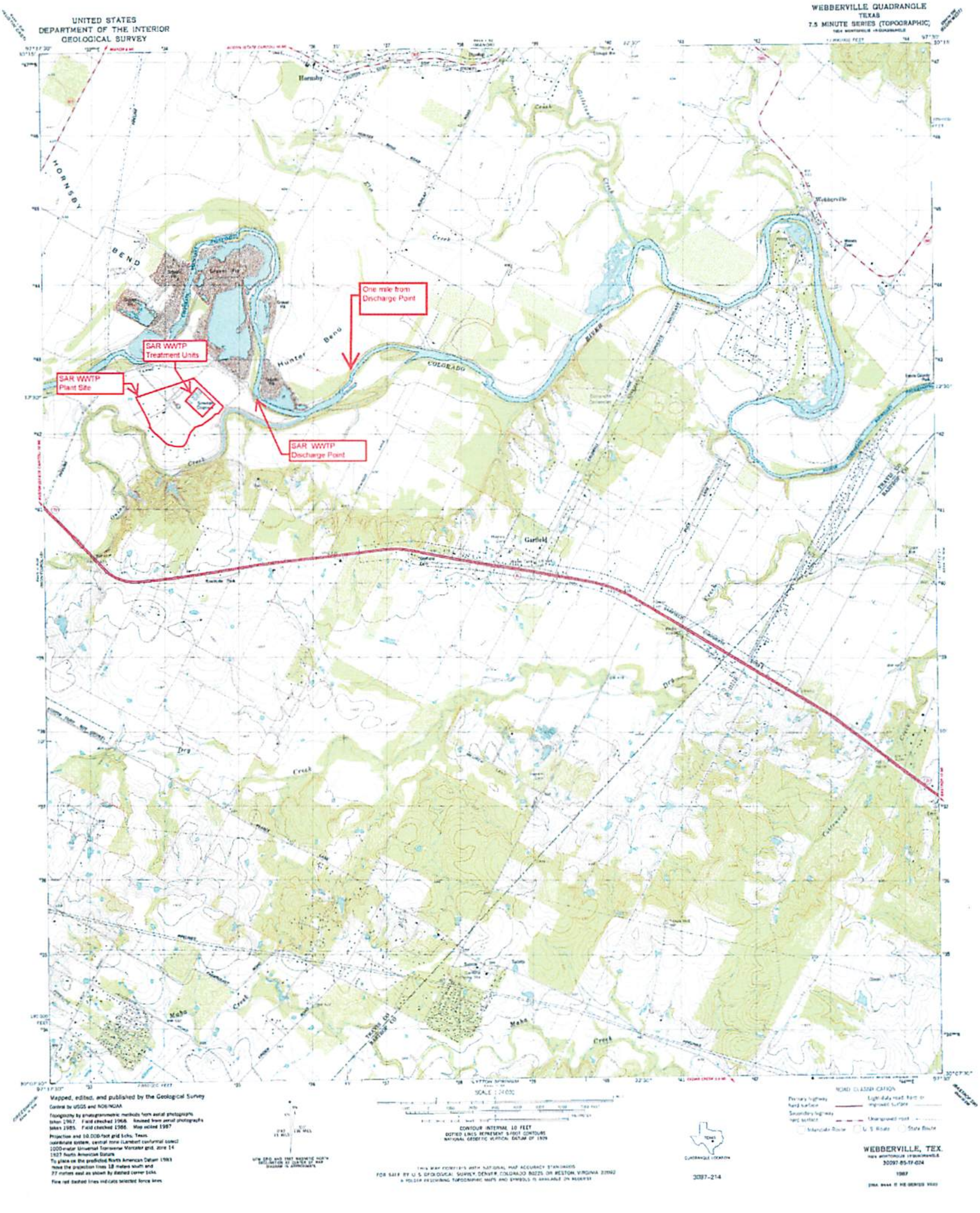
Sincerely,

Jessica Zuba, Director
Regional Water Planning and Development

WA:JZ: du

Attachment

City of Austin – SWIFT Loan Application for Direct Reuse Strategy
Submitted February 4, 2016
South Austin Regional WWTP Filtration Project – Environmental Review - USGS Map



Texas Parks & Wildlife Department
Wildlife Habitat Assessment Program,
Wildlife Division
4200 Smith School Rd., Mail Room
INTER-AGENCY

Texas Historical Commission
1511 Colorado, Mail Room
INTER-AGENCY

U.S. Fish & Wildlife Service
Austin Ecological Services Field Office
10711 Burnet Rd., Suite 200
Austin, TX 78758

U.S. Army Corps of Engineers
Fort Worth District
P.O. Box 17300
Fort Worth, TX 76102-0300

Heather Cooke
Legislative Coordinator
625 E. 10th Street, Suite 300
Austin, Texas 78701

Kevin Shunk, PE, CFM
Floodplain Administrator
505 Barton Springs Rd, 12th Floor
Austin, TX 78704

RECLAMATION
Managing Water in the West

Austin SWIFT Loan Application
Part D, Item 65

Draft Environmental Assessment

Title XVI Wastewater Reuse Initiative, Austin, Texas

U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office
Austin, Texas

February 2008

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Draft Environmental Assessment

Title XVI Wastewater Reuse Initiative, Austin, Texas
Great Plains Region

U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office
Austin, Texas

February 2008

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Introduction

Proposed Action

The City of Austin (City) is proposing to expand its existing wastewater reuse infrastructure in order to provide a continuous and dependable alternative water supply for the future. The Bureau of Reclamation (Reclamation) is assisting the City in the development of a feasibility report to evaluate reuse alternatives, and Reclamation may provide a portion of funds for construction of associated facilities if Congress provides the necessary authorization and appropriations. The *Reclamation Wastewater and Groundwater Study and Facilities Act,* Public Law 102-575, Title XVI as amended in 1992, directs the Secretary of the Interior (Secretary) to "*undertake a program to investigate and identify opportunities for reclamation and reuse of municipal, industrial, domestic, and agricultural wastewater, and naturally impaired ground and surface waters, for the design and construction of demonstration and permanent facilities to reclaim and reuse wastewater….*" Section 1604 further authorizes the Secretary to work with federal, state, regional, and local authorities to determine the feasibility of water reclamation and reuse projects that are identified in appraisal level reports. An Appraisal Report was completed in 2003 by the City and Reclamation, which concluded that there is a Federal interest in pursuing water reclamation and reuse investigations in Austin. Before Reclamation may participate in the financing or construction of the proposed project, compliance with the National Environmental Policy Act (NEPA) is required, and it was determined that an Environmental Assessment (EA) must be prepared to identify impacts resulting from the City's wastewater reuse initiative.

Purpose and Need

Growth and development of the City has placed a strain on water supply resources. Water demand is projected to exceed water supply by 2043[1], resulting in a water deficit. The City is expected to incur large water diversion costs by 2018[1] to meet these demands based on the payment structure of their water storage contract. This would limit funding for much needed capital improvements, including the expansion of existing water treatment facilities. The City's goal is to maximize the use of local water supplies, and provide a continuous and dependable source of supplemental water for the area. To meet this goal, there is a need to expand the City's existing recycled water program to serve additional areas in the central and southern part of the City.

Background

City Water System

The current water system for the City of Austin services approximately 770,000 residents over 274 square miles. The City owns and operates the Austin Water Utility (Utility), with approximately 180,000 residential, multifamily,

---

[1] This is based on the City's most recent modeling efforts.

commercial, industrial, and wholesale connections. The Utility is comprised of three potable water treatment plants with a production capacity of 291,238 acre-feet/year (af/yr)[1]. The potable water treatment plants draw water from the Colorado River (River) at Lake Austin and Town Lake. The Utility also operates two Waste Water Treatment Plants (WWTPs) with a capacity of 145,619 af/yr (Walnut Creek, and South Austin Regional). The three plants release (2004 statistics) a combined 96,340 af/yr of highly treated effluent into the Colorado River. This is approximately 65-70% of the total water withdrawn from the River (170,049 af/yr) for all purposes.

Capital Improvements

A 1999 Administrative Order (Order) from the Environmental Protection Agency (EPA) mandates the elimination of sanitary sewer overflows (SSOs; unplanned discharges) from wastewater collection facilities by 2007. Following the Order, the City of Austin instituted the Austin Clean Water Program to eliminate and prevent SSOs. The Program consists of structural improvements and enhanced collection system maintenance. Failure to meet the 2007 deadline will result in monetary penalties imposed by the EPA.

Water treatment plant upgrades are also needed to meet projected water demands. This includes the reconstruction, renovation, and improvements of the existing potable treatment plants, as well as the construction of the new plant within the next 5 years. In addition, two large WWTPs will be expanded significantly by 2050.

Water Supply, Demand, and Conservation

The City currently holds 292,703 acre-feet per year of permitted Colorado run-of-river water rights granted by the State of Texas for municipal use. The City holds a water supply contract with the Lower Colorado River Authority (LCRA). Under the contract, the City can purchase additional water for a total available water supply of 325,000 af/yr. Under the contract with LCRA, the first 201,000 af/yr are prepaid, whereby the City would incur additional expenses for water use beyond that quantity. Currently, the City withdraws approximately 170,049 af/yr of water for all purposes. By 2018, the City is expected to exceed the 201,000 af/yr threshold resulting in an estimated $8-14 million/yr in additional costs that would otherwise assist in procuring capital improvements to meet the needs of City residents.

Furthermore, the City’s withdrawal is projected to exceed the 325,000 af/yr maximum by 2043, and withdrawals of 367,096 af/yr by 2050 would result in a municipal water supply deficit of 42,096 af/yr. Wastewater reuse would make up for approximately half of this deficit, leaving water conservation measures to make up for the rest.

---

[1] An acre-foot of water is equivalent to the amount of water taken to cover one acre of land in 1 foot deep water.

The City of Austin implemented a Sustainability Initiative in 1990 to protect and conserve water resources. This initiative included the pursuit of beneficial use of reclaimed water. Reclaimed water, for the purposes of this document, is treated wastewater effluent that is normally discharged to the Colorado River for nonpotable purposes (i.e., irrigation, cooling tower makeup, ornamental ponds, and manufacturing) to decrease demand on potable water. The City of Austin Reclaimed Water Program currently reuses approximately 2,108 acre-feet of water per year. The program consists of two large WWTPs (excludes the Govalle plant which is planned for decommissioning), four smaller satellite plants, two plant storage tanks, one system pump station, six plant pump stations, and 19 miles of transmission main pipeline (Figure 1). All pump stations and storage tanks are located at the six treatment plants.

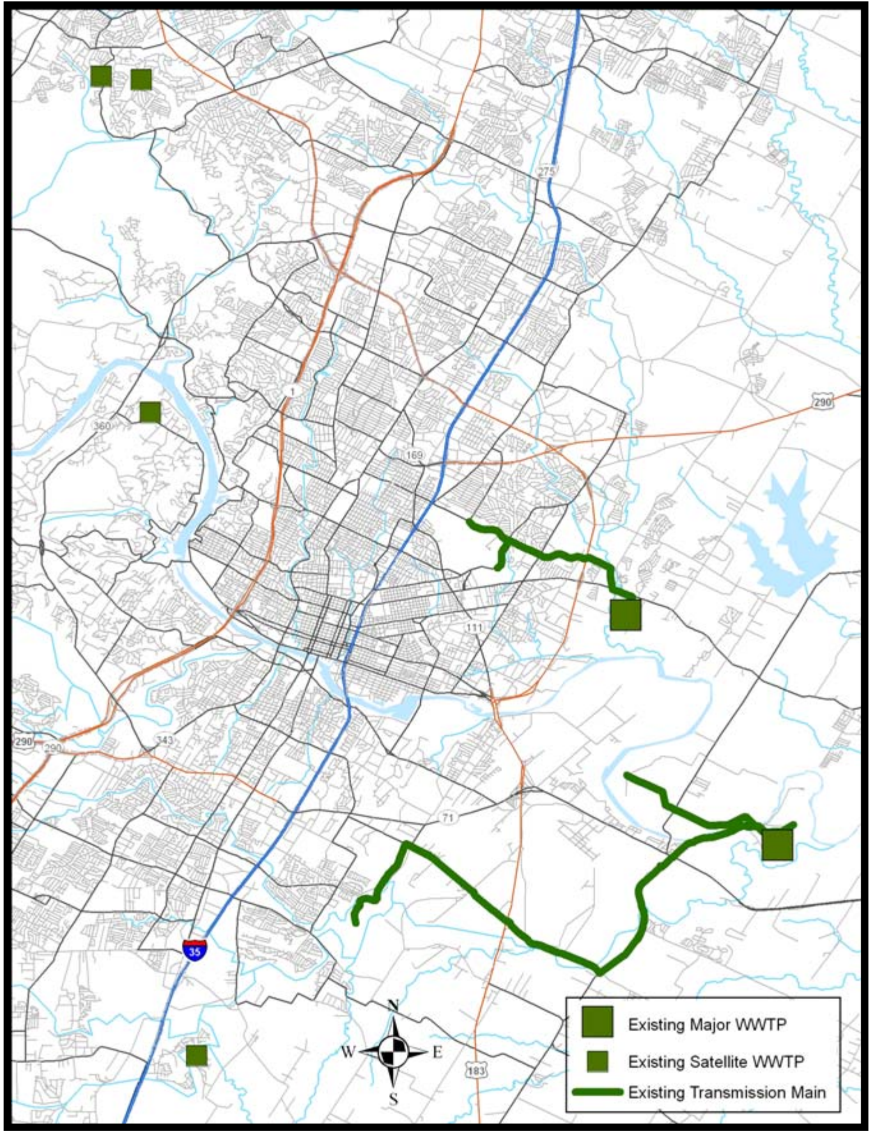

Figure 1. City of Austin's existing reclaimed water infrastructure.

The City's reclaimed water program is governed by the State of Texas Administrative Code (30 TAC 210) regulations, as adopted by the Texas Commission on Environmental Quality (TCEQ). The program has been determined to be of no risk to human or environmental health by the Austin/Travis County Health and Human Services Department.

Alternatives

Two alternatives are evaluated in this document, along with a No Federal Action Alternative, that explore different opportunities for direct reuse of treated effluent. Alternative 1: No Federal Action, is used as the baseline for comparing Alternatives 2 and 3. The No Federal Action Alternative is considered to be the future condition without either of the other two action alternatives. It is important to note that the components included in the No Federal Action Alternative are also common to both Alternatives 2 and 3. For instance, the miles of transmission main proposed under Alternatives 2 and 3 includes the one mile proposed under the No Federal Action Alternative (see below). A brief narrative of the three alternatives is provided below. A more detailed description of the alternatives can be found in the City of Austin’s Feasibility Report. Following the description of all alternatives is Table 1, which summarizes the differences in reclaimed system infrastructure under each alternative.

Alternative 1: No Federal Action

Alternative 1 would expand the current capacity of the City's reclaimed water system by 1,219 af/yr (Table 1). The distribution of reuse water by beneficial use and month is shown in Table 2.

This alternative would expand the existing Central Reclaimed Water System's transmission main, which is supported by the Walnut Creek WWTP, by only one mile; one additional system storage tank would also be installed (Figure 2). Construction would be completed in 2008, with the system reaching full capacity in 2012.

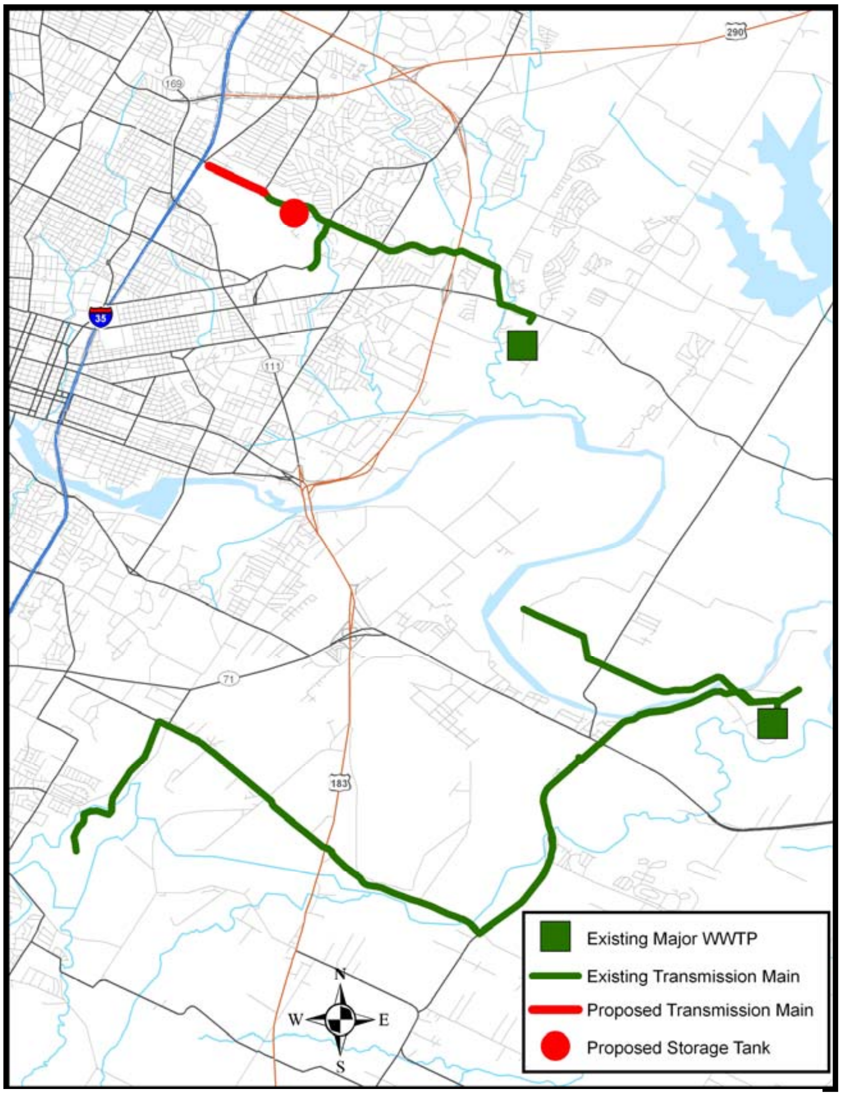

Figure 2. Existing and proposed reclaimed water system infrastructure under the No Federal Action Alternative.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

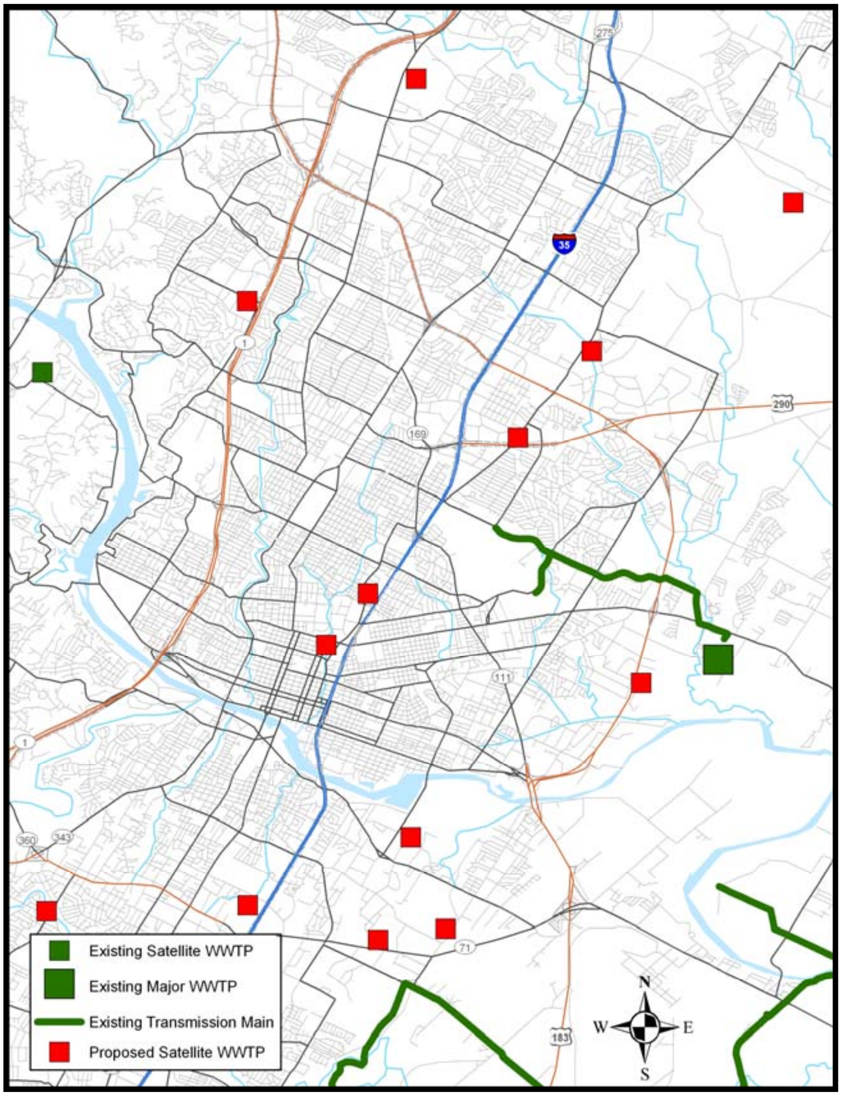

Figure 3. Existing and proposed reclaimed water system infrastructure under Alternative 2.

Under this alternative, the City proposes to reuse 7,427 af/yr of wastewater by 2050. This would be an increase of 6,208 af/yr from the No Federal Action Alternative reuse amount of 1,219 af/yr (Table 1). The distribution of reuse water by beneficial use and month is shown in Table 2.

Instead of utilizing the existing WWTPs for reclaimed water production, 13 satellite treatment plants would be installed throughout the City near potential reuse customers (Figure 3; Table 1). Each satellite plant would possess the full range of treatment processes (i.e., screening, aeration, clarification, filtration, and chlorination), including a small storage tank and pump station. An estimated 44 miles[1] of additional transmission main would also be installed in order to convey water to nearby customers. Each satellite facility would have nominal office, control, and maintenance space within a small building enclosed in a security fence. Installation of all 13 plants would be completed within 25 years, with the system reaching full capacity within 29 years. The Alternative is described in detail in the City's Feasibility Report. All project components would be installed in previously developed areas within the City, and reuse customers would be located within the city limits adjacent to reuse infrastructure.

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[1] Assumes 5,000 ft. of transmission main per satellite plant plus 500 ft. per customer (341), for a total of 44 miles

Alternative 3 (Preferred Alternative): Wastewater Facility Reuse Expansion via Transmission Main Extension

Under this alternative, the City proposes to reuse 24,005 af/yr of wastewater by 2050. This would be an increase of 22,786 af/yr from the No Action Alternative reuse amount of 1,219 af/yr (Table 1). The distribution of reuse water by beneficial use and month is shown in Table 2.

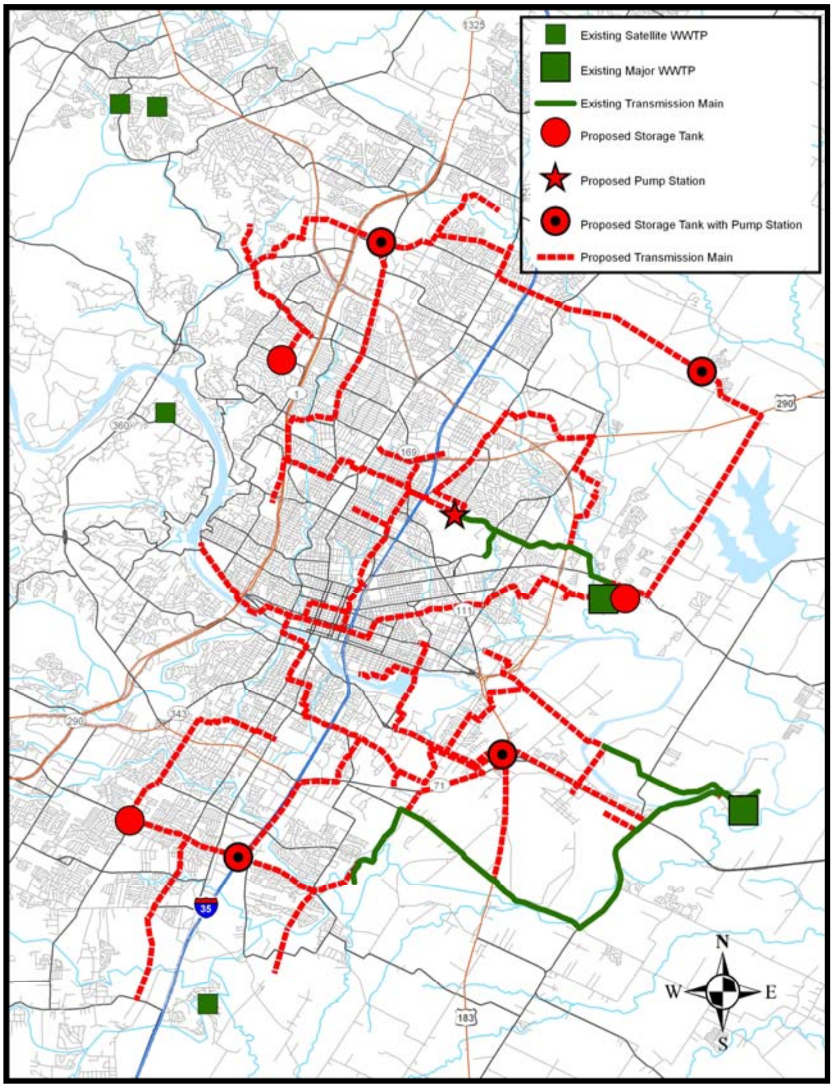

Figure 4. Existing and proposed reclaimed water system infrastructure under Alternative 3.

The City would expand its Central Reclaimed Water System from the Walnut Creek WWTP as well as develop a South Reclaimed Water System from the South Austin Regional Wastewater Treatment Plant (SAR WWTP). With both systems combined, the transmission main would be extended an additional 117 miles, and one plant storage tank, six system storage tanks, and five pump stations would be installed throughout the City (Figure 4; Table 1). This would be accomplished over the next 27 years, with the system reaching full capacity in 31 years. All project components would be installed in previously developed areas within the City, and reuse customers would be located within the city limits adjacent to reuse infrastructure.

Alternatives Considered but Eliminated

Additional Supply Alternative

- This alternative was evaluated in the 2003 Appraisal Report in order to determine its compatibility with federal cost-sharing eligibility criteria outlined in Title XVI of Public Law 102-575. Under this alternative, flows in the Colorado River downstream of Bastrop would be augmented with groundwater pumped from the Carrizo-Wilcox Aquifer. This would reduce releases of water from the Highland Lakes and result in an increase in water availability to the City of Austin. The Appraisal Report concluded that this alternative did not meet at least two critical criteria. This alternative did not, "*reduce, postpone, or eliminate development of new or expanded water supplies*" or "*reduce or eliminate the use of existing diversions from natural watercourses*". For these reasons, the Appraisal Report recommended that the Feasibility Study focus on aggressive wastewater reuse, which did meet all necessary criteria.

Table 1. A comparison of three alternatives proposed under the City of Austin's Wastewater Reuse Initiative.

	Alternative 1: No Federal Action	**Alternative 2: Satellite Systems**		**Preferred Alternative**	
	Proposed	Net Increase	Proposed[1]	Net Increase	Proposed[2]
Reuse Capacity (af/yr)	1,219	6,208	7,427	22,786	24,005
# of Large WWTPs[3]	0	0	0	0	0
Satellite WWTPs	0	13	13	0	0
Transmission Mains (miles)	1	44	45	117	118
# of Plant Storage Tanks	0	13	13	1	1
# of System Storage Tanks	1	0	1	6	7
# Plant Pump Stations	0	13	13	0	0
# of System Pump Stations	0	0	0	5	5
Years to Construct	2	23	25	25	27

[1, 2] These values represent the total proposed reuse amount, which includes the reuse amount proposed under the No Federal Action Alternative plus the net increase in reuse.

[3] Wastewater Treatment Plants

Table 2. Amount of reuse (acre-feet) proposed per beneficial use per month under each of the three alternatives proposed by the City of Austin's Wastewater Reuse Initiative.

	Alternative 1: No Federal Action				**Alternative 2: Satellite Systems**				**Preferred Alternative**			
Month	Irrigation	Cooling	Manuf.	Total	Irrigation	Cooling	Manuf.	Total	Irrigation	Cooling	Manuf.	Total
JAN	39	12	16	67	94	68	244	406	565	286	463	1,314
FEB	42	13	16	71	102	73	244	419	608	308	463	1,380
MAR	46	14	16	76	112	80	244	436	670	340	463	1,473
APR	62	20	16	98	152	109	244	504	908	460	463	1,831
MAY	86	27	16	129	210	151	244	605	1,260	639	463	2,363
JUN	70	22	16	108	171	122	244	538	1,024	519	463	2,007
JUL	105	33	16	154	257	184	244	685	1,539	781	463	2,783
AUG	117	37	16	170	286	205	244	735	1,713	868	463	3,044
SEP	79	25	16	120	193	138	244	575	1,155	586	463	2,203
OCT	56	18	16	90	137	98	244	479	819	415	463	1,697
NOV	45	14	16	75	110	79	244	433	659	334	463	1,456
DEC	35	11	16	62	85	61	244	391	511	259	463	1,233
ALL	***781***	***246***	***192***	***1,219***	***1,908***	***1,367***	***2,933***	***6,208***	***11,431***	***5,797***	***5,558***	***22,786***

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Executive Summary of Environmental Impacts

Resource			No Federal Action Alternative	Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction	Preferred Alternative: Wastewater Reuse Facility Expansion via Transmission Main Extension	Cumulative Impacts of Preferred Alternative Combined with Draft Water Rights Permits
Surface Water	Direct Impacts		None	Minor sedimentation resulting from stream crossings during construction	Minor sedimentation resulting from stream crossings during construction	None
	Indirect Impacts	Colorado River Instream Flows	Critical flows are always met. During the POR, target flow frequency is mostly 100% and is always greater than 81%. During the DOR, target frequency is mostly 100% and is always 50% or greater.	Critical flows remain unchanged. The only decrease in target flow frequency is 4.4% (November) during the POR.	Critical flows remain unchanged. Target flow frequency decreases by 2.2% in October and 4.4% (November) during the POR; the average decrease is less than 0.5%.	The addition of three draft permits has some cumulative impacts on median and average regulated flows, but these do not affect critical and target flow frequency.
		Freshwater Inflows into Matagorda Bay	Critical and target flow frequency averages around 37% during the POR and between 10% and 15% during the DOR. Critical flows are never met in August. Both critical and target flow frequencies are lowest in the summer.	During the POR, the only decrease in critical flow frequency foccurs in November (5.7%) and December (1.5%). Target flow frequency decreases across most months, but never by more than 1.7%. The average decrease is under 1%. Critical and target flow frequency never decrease during the DOR.	During the POR, critical flow frequency decreases by 5.7% in November and 5.2% in December and by less than 2% in January. Target flow frequency decreases across most months, but never by more than 4.4%. The average decrease is under 2%. Critical and target flow frequency never decreases during the DOR.	The addition of the three draft permits results in cumulative decreases in average regulated flow across all months during the POR. However, critical and target flows remain primarily unchanged.
		Lakes Travis and Buchanan	The combined firm yield of both lakes is 599,402 af/yr	The combined firm yield of both lakes is 598,203 af/yr	The combined firm yield of both lakes is 589,916 af/yr	The combined firm yield of both lakes is 589,916 af/yr
		Water Quality	Potential improvement in quality of Colorado River immdediatly downstream of Austin; potential minor impacts from surface run-off from lands irrigated with reclaimed water	Potential improvement in quality of Colorado River immdediatly downstream of Austin; potential minor impacts from surface run-off from lands irrigated with reclaimed water	Potential improvement in quality of Colorado River immdediatly downstream of Austin; potential minor impacts from surface run-off from lands irrigated with reclaimed water	None

Resource		No Federal Action Alternative	Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction	Preferred Alternative: Wastewater Reuse Facility Expansion via Transmission Main Extension	Cumulative Impacts of Preferred Alternative Combined with Draft Water Rights Permits
Ground Water	Direct Impacts	None	None	Potential minor sedimentation resulting from ~1 mile of transmission main constructed over Recharge Zone of Edwards Aquifer; ~6 miles over installed over Transition zone	None
	Indirect Impacts	None	Some reuse customers over Transition Zone of the Edwards Aquifer; little, if any risk of aquifer contamination	Some reuse customers over Transition Zone of the Edwards Aquifer; little, if any risk of aquifer contamination	None
Floodplains and Wetlands	Direct and Indirect Impacts	None	None	None	None
Wildlife	Direct Impacts	6 acres of disturbed land impacted; minor impacts to urban wildlife	567 acres of disturbed land impacted; minor impacts to urban wildlife	715 acres of disturbed land impacted; minor impacts to urban wildlife	None
	Indirect Impacts	None	None	None	None
Endangered Species	Direct and Indirect Impacts	No effect on nine federally listed species; May affect, but not likely to adversely affect 12 species	No effect on nine federally listed species; May affect, but not likely to adversely affect 12 species	No effect on nine federally listed species; May affect, but not likely to adversely affect 12 species	No effect on nine federally listed species; May affect, but not likely to adversely affect 12 species
Migratory Birds	Direct and Indirect Impacts	Some woody vegetation may be lost during construction; surveys for nesting birds required	Some woody vegetation may be lost during construction; surveys for nesting birds required	Some woody vegetation may be lost during construction; surveys for nesting birds required	None
Invasive Species	Direct Impacts	None: most areas previously disturbed; reseeding of previously undisturbed lands required	None: most areas previously disturbed; reseeding of previously undisturbed lands required	None: most areas previously disturbed; reseeding of previously undisturbed lands required	None
	Indirect Impacts	None; flow reduction in Colorado River too small for any impact	None; flow reduction in Colorado River too small for any impact	None; flow reduction in Colorado River too small for any impact	None; flow reduction in Colorado River too small for any impact

Resource		No Federal Action Alternative	Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction	Preferred Alternative: Wastewater Reuse Facility Expansion via Transmission Main Extension	Cumulative Impacts of Preferred Alternative Combined with Draft Water Rights Permits
Air and Noise Quality	Direct and Indirect Impacts	Short-term decrease from construction activities	Short-term decrease from construction activities; pump stations subject to City ordinance	Short-term decrease from construction activities; pump stations subject to City ordinance	None
Human Health and Safety	Direct and Indirect Impacts	None; effluent is treated to a standard allowing some contact; measures taken to limit that contact	None; effluent is treated to a standard allowing some contact; measures taken to limit that contact	None; effluent is treated to a standard allowing some contact; measures taken to limit that contact	None
Aesthetics/Visual	Direct and Indirect Impacts	None; all infrastructure placed in developed areas; City ordinance would minimize impacts	None; all infrastructure placed in developed areas; City ordinance would minimize impacts	None; all infrastructure placed in developed areas; City ordinance would minimize impacts	None
Socioeconomic Conditions	Direct and Indirect Impacts	3.36% annual increase in customer water bill	3.36% annual increase in customer water bill	3.35% annual increase in customer water bill	None
Cultural	Direct and Indirect Impacts	No effect	May affect cultural resources; Antiquities Code of Texas would minimize potential impacts	May affect cultural resources; Antiquities Code of Texas would minimize potential impacts	None
Native American Trust Assets	Direct and Indirect Impacts	No effect; No Trust assets occur within the project area	No effect; No Trust assets occur within the project area	No effect; No Trust assets occur within the project area	None
Environmental Justice	Direct and Indirect Impacts	Only one census tract impacted; it is a minority tract; impacts very minor; no disproportionate impacts	52% of census tracts impacted minority; < 1% low-income; impacts would be minor and consistent throughout entire project area; no disproportionate impact	45% of census tracts impacted minority; 1% low-income; impacts would be minor and consistent throughout entire project area; no disproportionate impact	None

Affected Environment and Environmental Consequences

The following section describes the existing environmental conditions within the proposed project area and the direct, indirect, and cumulative impacts of different alternatives on those conditions. Direct impacts are defined as those that occur at the same time and place of the action while indirect impacts occur later in time or are farther removed in distance, but are still reasonably foreseeable. The subsections below reflect environmental resources that must be considered by law under the NEPA. Some resources were excluded from review because they were not found to be present within the project area. These include: floodplains and wetlands; park, recreation or refuge lands; wilderness areas; wild or scenic rivers; national natural landmarks; prime farmlands; and national monuments.

Climate Change

Secretarial Order 3226 (2001), Evaluating Climate Change Impacts in Management Planning, states that, "each bureau and office of the Department will consider and analyze potential climate change impacts when undertaking long-range planning exercises, when setting priorities for scientific research and investigations, when developing multi-year management plans, and/or when making major decisions regarding the potential utilization of resources under the Department's purview. Departmental activities covered by this Order include, but are not limited to, programmatic and long-term environmental reviews undertaken by the Department…"

The Intergovernmental Panel on Climate Change (2007), which was established in 1988 by the World Meteorological Organization and the United Nations Environment Program, predicts that the earth's climate is changing due to atmospheric buildup of greenhouse gases including carbon dioxide, methane, nitrous oxide, and chlorofluorocarbons (IPCC 2007). Although uncertainty exists about exactly how the earth's climate will respond to enhanced concentrations of greenhouse gases, observations indicate that detectable changes will occur. Most models predict increases in temperature and changes in rainfall, evaporation, groundwater recharge rates, soil moisture, and runoff patterns. Based on this information, it is likely that differences between historic and future (i.e., 2050) hydroclimatic conditions in the proposed study area will exist.

The Council on Environmental Quality (CEQ) 1997 draft guidance on climate change states that Federal agencies must determine whether and to what extent (1) their actions may affect climate change, and (2) climate change may affect their actions. The CEQ asserts that the first question is perhaps better answered at the Federal program level because project-level emissions are likely of such insignificance that meaningful information may not be discerned. This approach recognizes that individual projects such as the City's proposed wastewater reuse project may increase greenhouse emissions by only marginal amounts compared to those emitted by the City or even the county or state as a whole. For instance, approximately 11,975 megawatt hours (MWh) of energy is required to treat and pump one million gallons of reclaimed water per day[1]. This would emit a total of about 6,310 tons of carbon dioxide (CO_2) per year[2] when the project is fully built out in 2050. For comparison purposes, a detailed inventory revealed that 1990 CO_2 emissions in Travis County, Texas totaled 9.6 million tons, with emission estimations for 2010 exceeding 16 million tons (City of Austin 1997). The magnitude of difference in CO_2 emission estimations between the City's proposed reuse project and that of Travis County likely pales in comparison to differences associated with state or even nationwide CO_2 emissions. These points illustrate the need to focus on Federal actions at the program level, not the project level, in order to disclose meaningful information about the impacts of Federal actions on climate change.

The second and perhaps more difficult question posed by CEQ pertains to evaluating the extent to which climate change may affect the City's proposed wastewater reuse project. In order to do this, one must first be able to accurately make predictions about climate change impacts on a scale relevant to that of the proposed study area. However, current climate modeling projections focus primarily on future global hydroclimatic conditions, leaving a gap in much needed climate data at the "basin" or "local study area" scale necessary for this analysis or that of most other small-scale Federal actions.

Numerous "downscaling" techniques have subsequently emerged as a means of reconciling global climate change data with the requirements of climate change impact assessments that evaluate smaller areas (Giorgi et al. 1994; Semenov and Barrow 1997; Conway and Jones 1998; Prudhomme et al. 2002; Wurbs et al. 2005). However, to our knowledge, no technique has gained wide acceptance for impact analyses in the proposed project's impact area in Texas. One recent study performed spatial downscaling to evaluate the impacts of climate change on Water Availability Modeling (WAM) estimates of water reliability in the Brazos River Basin, which is immediately adjacent to the Lower Colorado River Basin (Wurbs et al. 2005). The study concluded that the greatest uncertainty in performing this downscaling is the utilization of "coarse-scale" Global Circulation Models to predict future climate change on small scales. A similar study by Muttiah and Wurbs (2002) on the San Jacinto River Basin concluded that its downscaling methodology provided only a general framework for evaluating impacts of climate change on water resources management and that other alternative models could be used to make climate impact predictions. The LCRA and San Antonio Water Systems (2007) recommended that regional downscaling research should be continuously monitored, and that development of

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[1] Calculated using EPAnet model 2.0 developed by Environmental Protection Agency.

[2] This assumes Austin Energy's 0.527 metric tons of CO2-eq per megawatts per hour.

downscaling models capable of transferring global-scale climate results into local-scale hydrologic variables should be considered a long-term strategy. These findings make it difficult and even arbitrary to choose a downscaling methodology considered as providing the best available data, especially when such methodologies have not been incorporated future statewide planning efforts (i.e., 2007 State Water Plan) or in the administration of water rights by the TCEQ.

Although climatic change might be considered reasonably foreseeable, there is no accepted science for transforming variations in global temperature into incremental, quantifiable changes in stream flow within the Colorado River, and better predictions of future climate change at the basin scale are needed in order to accurately revise input data sets into existing WAMs.   Therefore, the following water resource impact assessments on instream flows of the Colorado River and freshwater inflows into Matagorda Bay do not consider a quantitative assessment of climate change as part of the baseline future condition established by the Colorado River WAM.

Surface and Groundwater Resources

The City of Austin depends on the Colorado River as its primary water source for municipal and industrial uses. The Colorado River is extremely important to the State of Texas, providing water for numerous municipalities, manufacturing, steam electric uses, mining operations, livestock, agricultural irrigation, wildlife habitat, and recreation. The headwaters of the Colorado River are located in Dawson County and flow about 900 miles southeast to Matagorda Bay in the Gulf of Mexico. The basin of the River includes 55 counties and covers about 40,000 square miles from eastern New Mexico to the Gulf of Mexico. It flows from an elevation of 3,000 ft in the semi-arid west, through the rugged canyons of the Texas Hill Country in San Saba County, and into the Balcones Escarpment of Austin. The reach of the Colorado River in and around Austin contains water flow that is controlled exclusively by the series of Highland Lakes located upstream. The Highland Lakes represent a unique series of reservoirs consisting of Lake Buchanan, Inks Lake, Lake Marble Falls, Lake Travis, Lake Austin, and Town Lake. From the eastern edges of Austin, the Colorado River broadens out and meanders through the Blackland Prairie, and flows through the Coastal Plains before draining into Matagorda Bay in the Gulf of Mexico.

The Colorado River has long been an excellent fisheries resource. Numerous game and nongame fishes can be encountered in the River including large mouth, striped, and white bass; crappie; blue, yellow, and channel catfish; gar; bowfin; sunfish; carp; shad; and numerous minnow species. Many macroinvertebrates, including caddisflies, stoneflies, mayflies, dragonflies, mussels and snails are a valuable food source to fishes of the River.

Almost all instream and riparian habitat of the Colorado River has been greatly altered by land-use practices, channelization, impoundments, and diversions. Even so, the Colorado River has both state and federal regulatory protection. The

River section from the Bastrop-Fayette County boundary upstream to Longhorn Dam is categorized by the U.S. Corps of Engineers as a “navigable water of the U.S.”

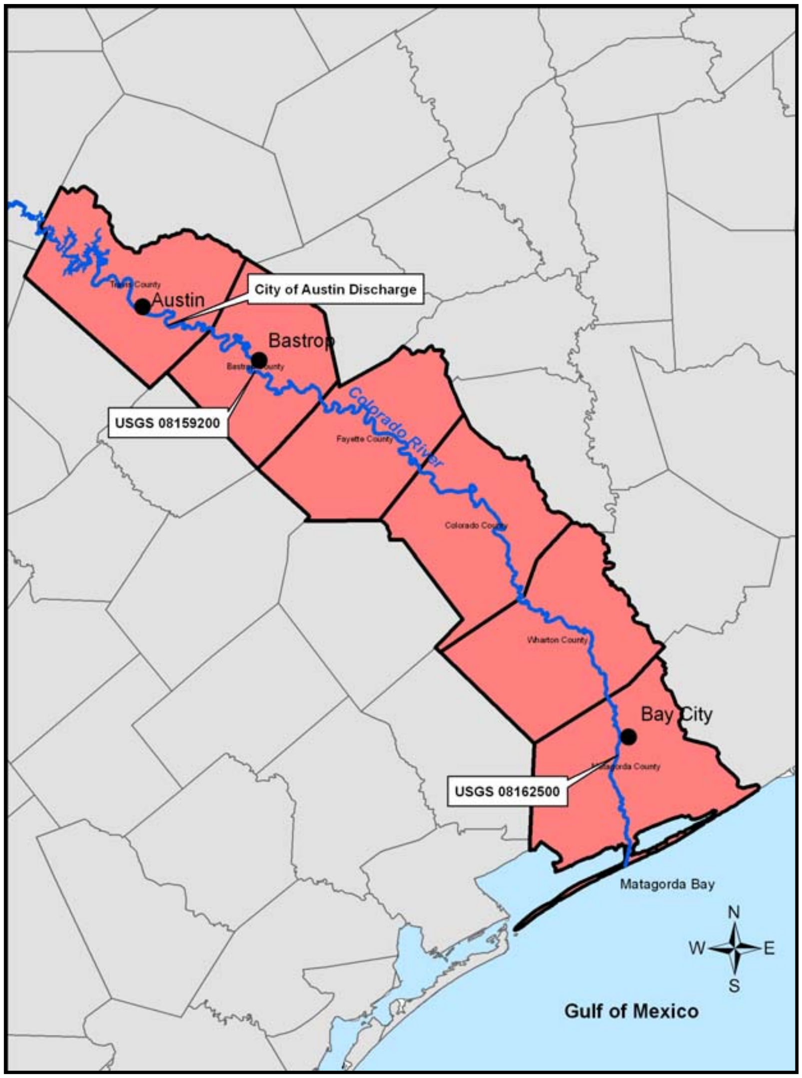

Figure 5. Locations of two USGS flow gages relative to the City of Austin’s discharge locations into the Colorado River.

The Colorado River basin contains more than 20 distinct watersheds throughout the City of Austin. The project area includes Barton Creek, Onion Creek, Slaughter Creek, and Williamson Creek in the south and Bull Creek, Decker Creek, Walnut Creek, and Shoal Creek to the north.

Instream Flow below Austin

Existing Condition

Two WWTPs currently release approximately 101,835 af/yr of highly treated effluent into the Colorado River. This represents about 68% of the total water withdrawn from the River by the City of Austin. Because wastewater discharge plants discharge into the Colorado River below Highway 183, return flows of treated effluent bypass the U.S. Geological Survey (USGS) Austin gage. Therefore, the USGS gage at Bastrop (USGS 08159200) is the nearest instream flow measuring device that is downstream from effluent discharge locations on the River (Figure 5). These gage data would reveal the nearest changes to instream flow following possible removal of treated effluent from the Colorado River.

According to the LCRA *Water Management Plan for the Lower Colorado River Basin* (1999; WMP), a range of target flows from 14,481 - 62,146 af would provide the optimal range of habitat complexity to support a healthy aquatic community. In addition, a mean critical flow of at least 7,266 acre-feet is required at the Bastrop gage to provide adequate water quality conditions in the Colorado River, except in late spring, when critical flows should be maintained above 30,275 af to facilitate spawning of the Blue Sucker (*Cycleptus elongatus*), a state threatened species (Table 3).

Table 3. Mean Monthly Target and Critical Flow Needs at the Bastrop Gage

Month	Target Flows (af)	Critical Flows (af)
Jan	22,324	7,266
Feb	25,944	7,266
Mar	33,788	30,275
Apr	36,202	30,275
May	62,146	30,275
Jun	50,079	7,266
Jul	22,324	7,266
Aug	14,481	7,266
Sep	24,134	7,266
Oct	28,358	7,266
Nov	22,324	7,266
Dec	20,514	7,266

Freshwater Inflows at Matagorda Bay

Existing Condition

The Colorado River drains into Matagorda Bay, which is the second largest estuary on the Texas Gulf Coast. It covers approximately 352 square miles and produces large quantities of fin and shell fish, making it a valuable ecological and economic resource. Freshwater inflows from the Colorado River are vital to the health of the bay system. The USGS gage at Bay City (USGS 08162500) is the nearest flow measuring device that is upstream from the confluence of the Colorado River with Matagorda Bay (Figure 5). These gage data would reveal the nearest changes in Colorado River freshwater inflows into the Bay following possible removal of treated effluent from the Colorado River. A study by the LCRA, Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD) and Texas Water Development Board (TWDB) estimated freshwater inflow needs for the Matagorda Bay system from both the Lavaca and Colorado Rivers (LCRA, et al. 2006). According to the study, target inflow needs are freshwater flows needed to optimize selected species productivity, while critical inflow needs are freshwater flows needed to provide fishery sanctuary habitat from which species are expected to recover and repopulate once conditions are suitable for productivity. Target flows range from about 60,000 af in March to 250,000 af in May; critical flow is 36,000 af for all months. (Table 4).

Table 4. Monthly Target and Critical Flow Needs for Matagorda Bay from the Colorado River.

Month	Target Flows (af)	Critical Flows (af)
Jan	205,600	36,000
Feb	194,500	36,000
Mar	63,200	36,000
Apr	60,400	36,000
May	255,400	36,000
Jun	210,500	36,000
Jul	108,400	36,000
Aug	62,000	36,000
Sep	61,900	36,000
Oct	71,300	36,000
Nov	66,500	36,000
Dec	68,000	36,000

Impacts on Instream Flows of the Colorado River and Freshwater Inflows into Matagorda Bay

According to the City's modeling efforts, the City would discharge less water into the Colorado River under each alternative (Table 5). However, the City would also withdraw less water from the River under these alternatives. Because both withdrawals and discharges would approximately equal the amount of water reused under each alternative, thus creating a balance, the City's model predicts no instream flow reduction in the Colorado River.

The model's withdrawal and discharge amounts, however, are based on quantitative assumptions regarding potable and wastewater usage, as well as water conservation[1] in 2050; and the model may underestimate water usage and overestimate water conservation, forcing the City to utilize all of its existing water right. Without decreased withdrawals to counterbalance water leaving the River from wastewater reuse, an instream flow reduction could occur. Subsequently, as a worst case scenario, this analysis assumes the possibility of a resulting instream flow reduction that is equivalent to the amount of wastewater reuse proposed under each of the three alternatives. Furthermore, the proceeding analysis does not assume implementation of any "demand-side" drought management strategies, such as the curtailment or elimination of irrigation using treated wastewater effluent currently proposed by the City. Such strategies would likely result in a decrease in demand on effluent, thereby lessening the impacts on instream flows.

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[1] The City estimates water conservation to be 21,000 af/yr in 2050 under each of the three alternatives.

Table 5. The proposed wastewater reuse amount and estimated amount of water withdrawn and discharged into the Colorado River under three alternatives proposed by the City of Austin.

	Alternative 1: No Federal Action	**Alternative 2: Satellite Systems**	**Preferred Alternative**
2050 Wastewater Reuse Amount (af/yr)	1,219	7,427	24,005
2050 Withdrawal From Colorado River (af/yr)	344,878	338,669	322,091
2050 Discharge Into Colorado River (af/yr)	227,367	221,158	204,581

It should be noted that usage of the Bastrop gage to assess the nearest instream flow impacts downstream from Austin may actually underestimate the impacts occurring at the immediate vicinity of the City's wastewater discharge points. This is because tributary streams and ground water contributions downstream from the City's wastewater discharge points create additional flows in the Colorado River before the Bastrop gage. However, these additional flows cannot be measurably calculated, and the baseline condition immediately downstream from the City's discharge points cannot be established. A comparison of the No Federal Action alternative with the two action alternatives cannot subsequently be made.

The nearest location where flow data *are* collected is at the Bastrop gage. In fact, the gage data allows integration into the water availability model being used to analyze instream and freshwater inflow impacts to the Colorado River (see next section). Furthermore, unlike the area immediately downstream from the City's discharge points, critical and target flows have been established at the Bastrop gage. Critical and target flows provide a standard of comparison that allows conclusions to be drawn regarding the significance of instream flow impacts.

Water Availability Modeling

A future reduction in instream flows of the Colorado River and freshwater inflows into Matagorda Bay must be evaluated in the context of anticipated future conditions in order to make a determination on its significance. In this analysis, the TCEQ Water Availability Model (WAM) was adopted for projecting the future condition and assessing environmental impacts in 2050. The TCEQ uses this computer-simulated model in its administration of water rights applications by determining how often or whether enough water would be available for a newly requested water right or amendment. The WAM also provides data on the frequency of meeting specified environmental flow requirements, such as critical and target flows, at particular locations (control points).

The WAM simulates water rights on a monthly time step[1] through a repetition of the naturalized hydrology for the 1940-1998 period of record. Regulated flow data from WAM Run 1 were selected to represent the future condition, which depicts conditions in the Colorado River that would be expected in 2050 if full water right utilization and reservoir storage are exercised and return flows are at 100 percent. All simulations were conducted with the December 2005 version of Water Rights Analysis Package Simulation (WRAP-SIM).

The Run 1 model simulation, created from Run 3 with the addition of return flows, was further modified to reflect demand and return flow factors proposed under each of the three direct reuse alternatives: No Federal Action, Satellite Systems, and Transmission Main. This was conducted under a repetition of the 1940-1998 period of record and the 1947-1957 drought of record. As previously mentioned, the WAM provides data on the frequency of meeting environmental flow requirements at specified control points. The WAM first calculates the combined storage of Lakes Travis and Buchanan at the beginning of each year and then determines whether the combined storage warrants engagement of specified environmental flow criteria. If the criteria are engaged, then regulated stream flow outputs (also obtained from the model) can be used to compute the percentage of months for which those criteria are met across the period (or drought) of record. At the Bastrop gaging station control point, environmental flow requirements established in the WAM reflect critical and target flows identified in LCRA's 1999 WMP[2]. At the Bay City gaging station control point, environmental flow requirements reflect critical and target flows identified in the recently drafted 2006 Matagorda Freshwater Inflow Needs Study (FINS)[3].

The WAM was utilized to simulate environmental impacts based on two sets of future conditions: baseline impact condition and cumulative impact condition. The baseline impact condition predicts the instream and freshwater inflow impacts that would result only from implementation of the City's proposed reuse alternatives. Under the baseline condition, the WAM scenarios for full water rights utilization incorporated only water right permits that have been granted as of October 2007, and it excluded draft permits. The cumulative impact condition predicts the instream and freshwater inflow impacts that would result from implementation of the City's proposed reuse alternatives, in combination with other Federal or non-Federal future actions on the Colorado River that are

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[1] The TCEQ has not developed WAM input data sets for a daily time step.

[2] The 1999 WMP incorporates a 1.1 million af storage trigger for determination of the annual instream flow criteria. However, this analysis incorporates the recommended trigger of 1.4 million af contained in the draft 2003 WMP revisions.

[3] This required a modification of the current WAM, which utilizes outdated Matagorda Bay environmental flow requirements established in Martin et al. 1997.

considered reasonably foreseeable[1]. Under the cumulative impact condition, the WAM scenarios for full water rights utilization incorporated water right permits granted to date, as well as draft or pending water right permits[2].

It is important to note that although the direct reuse alternatives reduce the amount of return flow discharged into the Colorado River below Austin, the reduction does not result in an equivalent reduction from the environmental flow criteria. The WAM algorithms compensate for this reduction by passing storable inflows or allocating firm water stored in the Highland Lakes to help meet the environmental criteria. For instance, during years when the combined storage of Lakes Travis and Buchanan warrants critical instream flow criteria engagement (the release of flows to meet critical flow criteria), shortages in the criteria are met with firm water stored in the lakes specifically for that purpose. Occasionally, the model algorithms result in a net increase in regulated flows and criteria frequency. Similarly, during years when target flow criteria are engaged, the Lakes are simulated as passing storable inflows to meet those needs. An analogous algorithm is used to meet critical and target bay and estuary needs.

Tables 6 and 8 summarize the median and average regulated flows at the Bastrop and Bay City gages, respectively that result from discharge decreases associated with implementation of each of the proposed reuse alternatives. Tables 7 and 9 summarize the subsequent impact on the frequency of meeting critical and target environmental flow criteria.

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[1] The term “reasonably foreseeable” is defined under a certain set of criteria established under the “Cumulative Impacts” section of this document.

[2] Results of the cumulative impact condition are presented in the “Cumulative Impacts” section of this document.

Bastrop Gage: Impacts on Instream Flows of the Colorado River (Tables 6 and 7.)

No Federal Action Alternative

Summary: Critical flows are always met. During the Period of Record (POR), target flow frequency is mostly 100% and is always greater than 81%. During the Drought of Record (DOR), target frequency is mostly 100% and is always 50% or greater.

During the POR:

- Median flows range from 32,743 af (November) to 112,073 af (June).
- Average flows range from 31,137 af (November) to 113,156 af (June).
- Critical flows are met 100% of the time.
- Target flow frequency is 81.8% in March; over 90% in January, February, April, May, November, and December; and 100% from June to October.

During the DOR:

- Median flows range from 23,775 af (December) to 114,057 (June).
- Average flows range from 25,409 af (January) to 103,508 af (June).
- Critical flows are met 100% of the time.
- Target flow frequency is 100% in January and April, and from June to October. Target flow frequency is 66.7% in May, November, and December; and 50% in February and March.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Summary: Critical flows remain unchanged. The only decrease from the No Federal Action Alternative in target flow frequency is 4.4% (November) during the POR.

During the POR:

- The maximum decrease in median flows is 2,259 af (July).
- The maximum decrease in average flows is 511 af (November).
- Critical flow frequency remains unchanged.
- Target flow frequency increases from December to May, remains unchanged at 100% from June to October, and decreases 4.4% in November.

During the DOR:

- The maximum decrease in median flows is 560 af (April).
- The maximum decrease in average flows is 531 af (August).
- Critical flows remain unchanged.
- Target flow frequency remains unchanged, except for February, when it increases from 50% to 100%.

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

Summary: Critical flows remain unchanged. Target flow frequency decreases by 2.2% in October and 4.4% (November) during the POR; the average decrease is less than 0.5%.

During the POR:

- The maximum decrease in median flows is 1,827 af (October).
- The maximum decrease in average flows is 1,447 af (November).
- Critical flow frequency remains unchanged.
- Target flow frequency increases from December to May, remains unchanged at 100% from June to September, and decreases 2.2% in October and 4.4% in November.

During the DOR:

- The maximum decrease in median flows is 443 af (September).
- The maximum decrease in average flows is 1,233 af (October).
- Critical and target flow frequency remains unchanged.

Table 6. Results of WAM Run 1 showing median and average regulated flows at the Bastrop gage in 2050 that result from discharge decreases associated with implementation of each of the proposed reuse alternatives. Red font represents decreases in flow; blue font represents increases in flow.

PERIOD OF RECORD		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
Median	No Federal Action	44,129	50,649	43,420	57,462	101,555	112,073	109,823	87,396	68,024	41,603	32,743	39,255	68,422
	Satellite Alt.	43,801	51,632	49,594	57,802	103,079	113,274	107,564	87,130	68,024	41,386	32,220	38,899	68,402
	Net Difference[12]	***328***	***983***	***6,174***	***340***	***1,524***	***1,201***	***2,259***	***266***	***0***	***217***	***523***	***356***	***21***
	Preferred Alt.	42,958	51,212	48,626	57,576	103,079	113,156	109,823	87,138	66,827	39,776	31,137	38,887	67,363
	Net Difference[13]	***1,171***	***563***	***5,206***	***114***	***1,524***	***1,083***	***0***	***258***	***1,197***	***1,827***	***1,606***	***368***	***1,060***
Average	No Federal Action	79,738	106,963	93,767	100,303	155,288	206,919	109,449	85,098	69,176	95,443	56,442	75,284	102,823
	Satellite Alt.	80,150	107,604	94,609	100,403	156,460	208,067	109,918	85,208	69,088	94,958	55,931	75,460	103,155
	Net Difference	***412***	***641***	***842***	***100***	***1,172***	***1,147***	***468***	***110***	***88***	***486***	***511***	***175***	***332***
	Preferred Alt.	79,565	107,117	94,489	99,718	156,705	207,054	109,768	84,866	68,388	94,165	54,995	74,631	102,622
	Net Difference	***173***	***155***	***722***	***586***	***1,417***	***134***	***319***	***232***	***788***	***1,278***	***1,447***	***653***	***201***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Median	No Federal Action	23,810	27,580	34,567	56,371	87,860	114,057	110,609	90,151	66,065	40,194	25,270	23,775	43,852
	Satellite Alt.	23,482	28,330	34,515	55,811	93,080	114,612	111,150	90,151	65,786	40,201	25,153	23,415	43,147
	Net Difference	***328***	***750***	***52***	***560***	***5,220***	***555***	***541***	***0***	***280***	***7***	***117***	***361***	***705***
	Preferred Alt.	22,639	27,664	34,748	54,769	93,118	114,607	111,097	90,151	65,904	39,350	23,936	22,592	42,089
	Net Difference	***1,171***	***84***	***181***	***1,602***	***5,258***	***550***	***488***	***0***	***162***	***845***	***1,334***	***1,183***	***1,763***
Average	No Federal Action	25,409	28,293	35,362	78,297	78,455	103,508	102,351	83,987	62,515	45,859	25,847	32,086	58,661
	Satellite Alt.	25,098	28,173	35,237	77,883	81,930	106,700	105,028	83,455	62,072	45,554	25,780	32,026	59,233
	Net Difference	***312***	***120***	***126***	***414***	***3,476***	***3,192***	***2,677***	***531***	***443***	***306***	***67***	***60***	***572***
	Preferred Alt.	24,341	27,345	35,049	77,372	81,856	106,089	104,816	83,290	61,646	44,627	24,646	31,057	58,667
	Net Difference	***1,068***	***948***	***313***	***925***	***3,402***	***2,582***	***2,465***	***697***	***869***	***1,233***	***1,200***	***1,029***	***6***

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[12] Represents the difference between Alternative 2: Satellite Systems and Alternative 1: No Federal Action.

[13] Represents the difference between Alternative 3: Preferred Alternative and Alternative 1: No Federal Action.

Table 7. Results of WAM Run 1 showing the percentage of time critical and target environmental flow criteria are met at the Bastrop gage in 2050 after implementation of each of the proposed reuse alternatives. Red font represents frequency decreases; blue font represents frequency increases.

PERIOD OF RECORD		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
Critical	No Federal Action	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Satellite Alt.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Net Difference[14]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Preferred Alt.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Net Difference[15]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
Target	No Federal Action	95.5%	95.5%	81.8%	90.9%	93.2%	100%	100%	100%	100%	100%	95.5%	95.5%	95.6%
	Satellite Alt.	95.6%	97.8%	82.2%	91.1%	93.3%	100%	100%	100%	100%	100%	91.1%	95.6%	95.6%
	Net Difference	***0.1%***	***2.3%***	***0.4%***	***0.2%***	***0.2%***	***0%***	***0%***	***0%***	***0%***	***0%***	***-4.4%***	***0.1%***	***-0.1%***
	Preferred Alt.	95.6%	95.6%	82.2%	91.1%	93.3%	100%	100%	100%	100%	97.8%	91.1%	95.6%	95.2%
	Net Difference	***0.1%***	***0.1%***	***0.4%***	***0.2%***	***0.2%***	***0%***	***0%***	***0%***	***0%***	***-2.2%***	***-4.4%***	***0.1%***	***-0.5%***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Satellite Alt.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Net Difference	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Preferred Alt.	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Net Difference	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
Target	No Federal Action	100%	50.0%	50.0%	100%	66.7%	100%	100%	100%	100%	100%	66.7%	66.7%	84.8%
	Satellite Alt.	100%	100%	50.0%	100%	66.7%	100%	100%	100%	100%	100%	66.7%	66.7%	87.9%
	Net Difference	***0%***	***50.0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***3.0%***
	Preferred Alt.	100%	50.0%	50.0%	100%	66.7%	100%	100%	100.0%	100%	100%	66.7%	66.7%	84.8%
	Net Difference	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***

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[14] Represents the difference between Alternative 2: Satellite Systems and Alternative 1: No Federal Action.
[15] Represents the difference between Alternative 3: Preferred Alternative and Alternative 1: No Federal Action.

Bay City Gage: Impacts on Freshwater Inflows into Matagorda Bay (Tables 8 and 9.)

No Federal Action Alternative

Summary: Critical and target flow frequency averages around 37% during the POR and between 10% and 15% during the DOR. Critical flows are never met in August. Both critical and target flow frequencies are lowest in the summer.

During the POR:

- Median flows range from 242 af (August) to 69,506 af (January).
- Average flows range from 7,598 af (August) to 184,233 af (June).
- Critical flow frequency ranges from 0% (August) to 57.1% (December-February).
- Target flow frequency ranges from 9.7% (August) to 54.8% (April, December).

During the DOR:

- Median flows range from 54 af (June) to 19,490 af (February).
- Average flows range from 84 af (July) to 56,376 af (April).
- Critical flow frequency ranges from 0% (July-September) to 33.3% (December).
- Target flow frequency ranges from 0% (May-December) to 11% (April).

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Summary: During the POR, the only decrease in critical flow frequency from the No Federal Action Alternative occurs in November (5.7%) and December (1.5%). Target flow frequency decreases across most months, but never by more than 1.7%. The average decrease is under 1%. Critical and target flow frequency never decrease during the DOR.

During the POR:

- The maximum decrease in median flows is 474 af (November).
- The maximum decrease in average flows is 634 af (November).
- Critical flow frequency increases across most months.
- The maximum flow decrease is 5.7% (November).
- Target flow frequency decreases across all months, except March; the maximum decrease is 1.7% (December).

During the DOR:

- The maximum decrease in median flows is 437 af (October).
- The maximum decrease in average flows is 256 af (October).
- Critical and target flow frequencies remain unchanged.

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

Summary: During the POR, critical flow frequency decreases by 5.7% in November and 5.2% in December and by less than 2% in January. Target flow frequency decreases across most months, but never by more than 4.4%. The average decrease is under 2%. Critical and target flow frequency never decreases during the DOR.

During the POR:

- The maximum decrease in median flows is 2,139 af (November).
- The maximum decrease in average flows is 1,515 af (November).
- Critical flow frequency increases across most months.
- The maximum critical flow decrease is 5.7% (November).
- Target flow frequency decreases across all months, except March; the maximum decrease is 4.4% (October).

During the DOR:

- The maximum decrease in median flows is 443 af (September).
- The maximum decrease in average flows is 1,233 af (October).
- Critical and target flow frequency remains unchanged.

Table 8. Results of WAM Run 1 showing median and average regulated flows at the confluence with Matagorda Bay in 2050, as extrapolated from the Bay City Gage, that result from discharge decreases associated with implementation of each of the proposed reuse alternatives. Red font represents decreases in flow; blue font represents increases in flow.

PERIOD OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Median	No Federal Action	69,506	65,669	36,000	36,259	34,370	4,046	306	242	1,930	28,319	50,989	68,000	30,706
	Satellite Alt.	69,452	66,032	36,000	36,259	35,383	4,908	418	242	1,647	27,866	50,515	68,000	30,553
	Net Difference[16]	***54***	***363***	***0***	***0***	***1,013***	***862***	***112***	***0***	***283***	***453***	***474***	***0***	***153***
	Preferred Alt.	68,694	66,167	36,000	36,259	36,000	4,908	418	242	1,409	26,395	48,850	68,000	29,613
	Net Difference[17]	***812***	***498***	***0***	***0***	***1,630***	***862***	***112***	***0***	***521***	***1,924***	***2,139***	***0***	***1,093***
Average	No Federal Action	118,691	151,694	117,603	115,848	138,696	184,233	37,801	7,598	38,061	120,054	111,479	123,660	105,452
	Satellite Alt.	119,287	152,071	118,430	115,930	139,747	185,527	38,428	7,640	38,046	119,567	110,845	123,929	105,787
	Net Difference	***595***	***376***	***828***	***82***	***1,050***	***1,294***	***627***	***42***	***16***	***487***	***634***	***269***	***336***
	Preferred Alt.	118,556	151,364	118,121	115,192	140,475	184,554	38,288	7,314	37,508	118,980	109,965	123,048	105,280
	Net Difference	***135***	***330***	***518***	***656***	***1,779***	***321***	***487***	***284***	***554***	***1,074***	***1,515***	***613***	***171***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Median	No Federal Action	17,810	19,490	17,479	17,722	141	54	60	60	55	4,240	17,862	18,052	10,046
	Satellite Alt.	17,572	19,414	17,479	17,361	454	60	60	60	55	3,803	19,095	18,606	10,883
	Net Difference	***239***	***77***	***0***	***361***	***313***	***6***	***0***	***0***	***0***	***437***	***1,234***	***555***	***837***
	Preferred Alt.	16,946	19,001	17,479	16,324	140	60	60	60	55	2,808	18,691	18,095	9,962
	Net Difference	***864***	***490***	***0***	***1,398***	***1***	***6***	***0***	***0***	***0***	***1,432***	***830***	***43***	***84***
Average	No Federal Action	21,684	35,045	18,991	56,376	12,154	7,854	84	2,666	3,905	30,534	21,297	42,751	21,403
	Satellite Alt.	21,432	35,011	18,896	56,171	15,713	11,401	3,678	2,613	3,755	30,278	21,313	42,683	22,195
	Net Difference	***252***	***34***	***95***	***205***	***3,559***	***3,548***	***3,594***	***53***	***151***	***256***	***16***	***68***	***792***
	Preferred Alt.	20,796	34,334	18,707	55,606	15,644	11,217	3,678	2,403	3,196	29,406	20,327	41,592	21,691
	Net Difference	***888***	***711***	***284***	***770***	***3,491***	***3,364***	***3,594***	***263***	***709***	***1,128***	***971***	***1,159***	***288***

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[16] Represents the difference between Alternative 2: Satellite Systems and Alternative 1: No Federal Action.

[17] Represents the difference between Alternative 3: Preferred Alternative and Alternative 1: No Federal Action.

Table 9. Results of WAM Run 1 showing the percentage of time critical and target environmental flow criteria are met at the confluence with Matagorda Bay in 2050, as extrapolated from the Bay City Gage, after implementation of each of the proposed reuse alternatives. Red font represents frequency decreases; blue font represents frequency increases in flow.

PERIOD OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	57.1%	57.1%	42.9%	42.9%	42.9%	28.6%	14.3%	0%	14.3%	28.6%	46.4%	57.1%	36.0%
	Satellite Alt.	59.3%	59.3%	48.1%	44.4%	44.4%	33.3%	18.5%	0%	14.8%	29.6%	40.7%	55.6%	37.3%
	Net Difference[18]	***2.1%***	***2.1%***	***5.3%***	***1.6%***	***1.6%***	***4.8%***	***4.2%***	***0%***	***0.5%***	***1.1%***	***-5.7%***	***-1.5%***	***1.3%***
	Preferred Alt.	55.6%	59.3%	44.4%	40.7%	48.1%	33.3%	18.5%	0%	14.8%	29.6%	40.7%	51.9%	36.4%
	Net Difference[19]	***-1.6%***	***2.1%***	***1.6%***	***-2.1%***	***5.3%***	***4.8%***	***4.2%***	***0%***	***0.5%***	***1.1%***	***-5.7%***	***-5.2%***	***0.4%***
Target	No Federal Action	32.3%	35.5%	48.4%	54.8%	32.3%	32.3%	22.6%	9.7%	29.0%	41.9%	51.6%	54.8%	37.1%
	Satellite Alt.	31.3%	34.4%	50.0%	53.1%	31.3%	31.3%	21.9%	9.4%	28.1%	40.6%	50.0%	53.1%	36.2%
	Net Difference	***-1.0%***	***-1.1%***	***1.6%***	***-1.7%***	***-1.0%***	***-1.0%***	***-0.7%***	***-0.3%***	***-0.9%***	***-1.3%***	***-1.6%***	***-1.7%***	***-0.9%***
	Preferred Alt.	31.3%	34.4%	50.0%	53.1%	31.3%	31.3%	21.9%	9.4%	25.0%	37.5%	50.0%	53.1%	35.7%
	Net Difference	***-1.0%***	***-1.1%***	***1.6%***	***-1.7%***	***-1.0%***	***-1.0%***	***-0.7%***	***-0.3%***	***-4.0%***	***-4.4%***	***-1.6%***	***-1.7%***	***-1.4%***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	10.0%	20.0%	10.0%	30.0%	22.2%	11.1%	0%	0%	0%	22.2%	11.1%	33.3%	14.3%
	Satellite Alt.	10.0%	20.0%	10.0%	30.0%	33.3%	22.2%	11.1%	0%	0%	22.2%	11.1%	33.3%	17.0%
	Net Difference	***0%***	***0%***	***0%***	***0%***	***11.1%***	***11.1%***	***11.1%***	***0%***	***0%***	***0%***	***0%***	***0%***	***2.7%***
	Preferred Alt.	10.0%	20.0%	10.0%	30.0%	33.3%	22.2%	11.1%	0%	0%	22.2%	11.1%	33.3%	17.0%
	Net Difference	***0%***	***0%***	***0%***	***0%***	***11.1%***	***11.1%***	***11.1%***	***0%***	***0%***	***0%***	***0%***	***0%***	***2.7%***
Target	No Federal Action	n/a[20]	n/a	n/a	100.0%	0%	0%	0%	0%	0%	0%	0%	0%	11.1%
	Satellite Alt.	n/a	n/a	n/a	100.0%	0%	0%	0%	0%	0%	0%	0%	0%	11.1%
	Net Difference	n/a	n/a	n/a	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Preferred Alt.	n/a	n/a	n/a	100.0%	0%	0%	0%	0%	0%	0%	0%	0%	11.1%
	Net Difference	n/a	n/a	n/a	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***

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[18] Represents the difference between Alternative 2: Satellite Systems and Alternative 1: No Federal Action.

[19] Represents the difference between Alternative 3: Preferred Alternative and Alternative 1: No Federal Action.

[20] Target flow criteria were established only for April through December of 1947 during the drought of record.

Impacts on Lakes Travis and Buchanan Reservoir Yield

As previously mentioned, the WAM algorithms compensate for stream discharge reductions by passing storable inflows or allocating firm water stored in Lakes Travis and Buchanan to help meet environmental criteria. Lakes Travis and Buchanan, therefore, would experience a reduction in combined storage/remaining water yield in 2050.

Alternative 1: No Federal Action

Under the No Federal Action Alternative, the combined firm yield of Lakes Travis and Buchanan would be 599,402 af/yr.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Under Alternative 2, the combined firm yield of Lakes Travis and Buchanan would decline by 1,299 af/yr. The resulting combined firm yield of both lakes would be 598,203 af.

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

Under the Preferred Alternative, the combined firm yield of Lakes Travis and Buchanan would decline by 9,486 af/yr. The resulting combined firm yield of both lakes would be 589,916 af/yr.

Under Alternatives 2 and 3, a simulated reduction in reservoir yield[21] in 2050 may require LCRA to plan for alternative sources of water in order to meet the future water demands of LCRA's firm water customers. One such source that is already being planned by the LCRA, independent of the City's direct reuse plans, includes the utilization of unused irrigation water rights[22] to back up supplies to LCRA's customers in lieu of stored water deliveries from Lakes Travis and Buchanan. Such plans, however, are in their infancy, and it is difficult to ascertain their impact on reservoir yield without speculation.

It is important to note that, similar to instream flow and freshwater inflows, the simulated decrease in reservoir yield represents a worst case scenario for two reasons. First, such a reduction may not materialize as a result of Austin's municipal wastewater reuse if, as predicted by the City's models, a decrease in return flow discharge results in a corresponding decrease in the City's municipal water right demand. Second, the WAM does not simulate "demand-side" drought management strategies, which may curtail water demand as reservoir levels drop below specific storage triggers outlined in the LCRA's Water Management Plan.

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[21] This assumes the simulated reduction in firm yield might result in drought of record shortage for LCRA firm water customers.

[22] According to the 2006 Region K Plan, unused irrigation water rights are expected to occur as a result of a projected decrease in future water demand from 620,930 af/yr in 2000 to 468,763 af/yr in 2060. This would result from irrigation efficiency and reductions in irrigated acres (Lower Colorado Regional Water Planning Group, 2006).

One such drought management strategy may include the curtailment or elimination of irrigation using treated wastewater effluent currently proposed by the City. Overall, such strategies would likely result in a decrease in the demand for reservoir yield, thereby alleviating pressures on LCRA to utilize alternative water sources to meet customer demands in 2050.

Water Quality

Existing Condition

Reclaimed water must undergo significant levels of treatment and disinfection to eliminate odors and destroy pathogens. Its usage is governed by the state of Texas Administrative Code (30 TAC 210) regulations, as adopted by the TCEQ. The rules were developed for the protection of both public health and the environment. The reclaimed water used for the purposes of the proposed project is categorized as Type I effluent by the TCEQ. Type I effluent is defined by its increased likelihood of coming into contact with humans and is subsequently imposed with the most stringent water quality guidelines. This enables it to be used, among other purposes, for irrigation. Existing wastewater facilities for the City have continually met state guidelines in order to hold a National Pollutant Discharge Elimination System (NPDES) permit for discharge into the Colorado River.

Surface water quality standards for the Colorado River are also governed by TCEQ regulations (30 TAC 307). Naturally saline soils and oil-field related activities, coupled with several years of drought have created high levels of dissolved solids in the upper portion of the basin. Some elevated nutrient levels and fecal coliform densities exist in tributary streams in the Austin area, but their origination is unidentified non-point source run-off. Town Lake and the Colorado River below Town Lake contain good water quality and fully support designated uses (TCEQ 2004).

Water quality standards for reclaimed water exclude many constituents that are included in surface water standards because these constituents are assumed to be at similar post-treatment levels. Type I effluent standards do impose a lower fecal coliform density than contact recreation surface water standards [20 Colony Forming Units (CFU) vs. 200 CFU/100 ml]. Because Type I effluent is chlorinated before conveyance into the reclaimed system, it maintains fecal coliform levels lower than water normally released into the Colorado River.

Impacts on Water Quality

All Three Alternatives

Direct impacts on surface water resources could result from sedimentation due to installation of satellite plants and transmission mains. In order to cross the Colorado River, the City would utilize abandoned pipelines or directional boring.

The City would obtain Section 404 and Section 401 permits from the U.S. Army Corp of Engineers and TCEQ, respectively, along with NPDES stormwater permits. These permits mandate avoidance and minimization of impacts to aquatic resources, and would require specific conditions for the protection of water quality and sediment reduction. Sedimentation also may occur into waterways adjacent to construction activities. These impacts would be minimized by erosion control measures outlined in state and local permits covered under TCEQ 30 TAC 308 and Title 25 of Austin's City ordinance, respectively.

Indirect impacts on water quality could occur in the Colorado River downstream of Austin under all three alternatives. During low flow periods, the Colorado River downstream of Austin may consist of 70-80% effluent on a given day (LCRA 1999). A reduction in effluent, therefore, could reduce these percentages and improve water quality by reducing the concentration of certain constituents typically found in effluent. These include toxicological components, microbes, nutrients, Total Dissolved Solids, salts, and heavy metals (TCEQ 30 TAC 210.33, CH2M Hill 2004, Graves 2004). Other water quality parameters, including carbonaceous biochemical oxygen demand ($CBOD_5$) or biochemical oxygen demand (BOD_5), temperature, dissolved oxygen, conductivity, pH, and turbidity could be beneficially impacted in a similar manner.

Another potential impact pertains to surface run-off into nearby waterways from lands irrigated with reclaimed water. Run-off, however, would not likely impact the waterways beyond what would normally occur from WWTP releases into the Colorado River. Much of the water would infiltrate into the ground, and buffers would further reduce impacts to surface water resources. As well, all customers must follow the terms and conditions of the Austin Water Utility's General Requirements for Reclaimed Water Users (Appendix A) and Operations and Maintenance Plan (Appendix B). These guidelines encourage, among other things, *"the efficient use of reclaimed water and avoidance of excess application of reclaimed water that results in surface run-off or excessive percolation below the root zone"*. The City will also continue to conduct routine water quality monitoring prior to distribution (30 TAC 210.34). These requirements would minimize any potential impacts from surface run-off.

The City is funding a two-year study on the irrigation impacts of reclaimed water on soils and turf at a local golf course. This may provide valuable information on overall turf management and watering efficiency, including information on irrigation rates, application rates of fertilizers, soil amendments, and pesticides. Results from this study should assist in the development of the required nutrient management plans for golf course customers and would minimize potential impacts to local waterways through run-off.

Groundwater Resources

Existing Condition

The Edwards Aquifer is one of the most valuable water resources in Central Texas, providing water for municipal, industrial, and agricultural uses. A number of cities rely on the aquifer as their only source of drinking water. The Edwards Aquifer covers 4,350 square miles in parts of 11 counties and is the sole source of drinking water for over 1.7 million people in Central Texas.

The Edwards Aquifer is particularly susceptible to pollution from surface activities because of rapid and direct recharge through percolation and infiltration of surface water through streambeds, or through sinkholes, caves, and faults. Despite this susceptibility, the Aquifer has excellent water quality with intermittent signs of contamination (Edwards Aquifer Authority 2004a).

The Edwards Aquifer is divided into three zones: Contributing, Recharge, and Transition (Figure 6). The Contributing Zone encompasses the drainage area or watershed where runoff from precipitation flows down gradient into the Recharge Zone. The Recharge Zone is the area where water infiltrates into the ground and eventually reaches the zone of saturation, adding water to the aquifer. The Transition Zone, or Artesian Zone, is the area south and southeast of the recharge zone where the aquifer is confined by a relatively impermeable clay layer. In the Transition Zone, the water level stands above the top of the strata in which the aquifer is located (Edwards Aquifer Authority 2005).

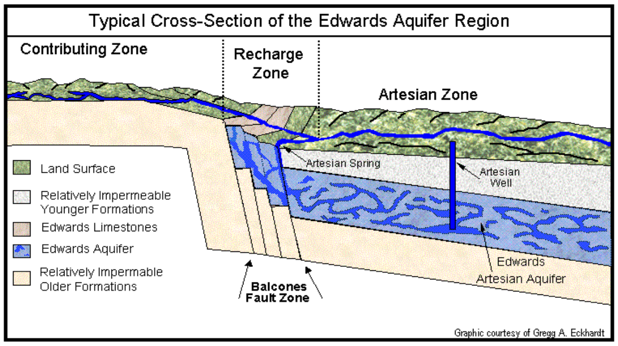

Figure 6. Three hydraulic zones associated with the Edwards Aquifer.

The Edwards Aquifer is divided from south to north into three segments: San Antonio, Barton Springs, and Northern. The southern hydrologic divide between the Barton Springs Segment and the San Antonio Segment occurs between Onion Creek and the Blanco River (LBG-Guyton Associates 1994). The San Antonio Segment is not included in the study area, so it is excluded from further discussion.

The Barton Springs Segment is located in Hays and Travis Counties, and supplies water to about 50,000 people in the area. It is bound to the north by the Colorado River and to the south by the groundwater divide near the City of Kyle. The Barton Springs Segment is recharged by precipitation and run-off in the Contributing and Recharge Zones, and from baseflow in springs and seeps. Groundwater circulation decreases from west to east along geochemical gradients (Scanlon et al. 2001). In the Transition Zone, some interconnection between the aquifer and overlying karst features may exist in unconfined portions, but the clay content and plasticity of overlying layers generally provides an effective barrier to vertical flow (Scanlon et al. 2001).

The Northern Segment is used primarily as a source of water for the cities of Round Rock, Georgetown, Salado, and Pflugerville. The Northern Segment is bisected by the hydrologic divide between the Colorado and Brazos River basins and coincides approximately with the boundary between Travis and Williamson Counties. Surface water and groundwater in Travis County flows towards the Colorado River, while water in Williamson County flows towards the Brazos River (Jones 2003). Similar to the Barton Springs Segment, the Northern Segment is composed of confined and unconfined portions that differ in the amount of faulting, geochemical composition, groundwater circulation, and recharge capability (Jones 2003).

The Edwards Aquifer was designated as a Sole Source Aquifer in 1975 by the Environmental Protection Agency. This designation was authorized under Section 1424(e) of the Safe Drinking Water Act, which mandates the EPA's evaluation of the water quality effects of federally funded projects on Sole Source Aquifers. At the state level, the Edwards Aquifer is protected under TCEQ rules contained in 30 TAC 213, Edwards Aquifer Protection. The rules regulate certain activities that may pollute surface water contributing to aquifer recharge.

Impacts on Groundwater Resources

Alternative 1: No Federal Action

Under the No Federal Action Alternative, no construction activities or reuse customers would exist over the Edwards Aquifer, and no impact would occur on groundwater resources.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Under Alternative 2, minor direct impacts would occur to the Edwards Aquifer from construction activities. Two out of the 13 satellite packaging plants, and about 6 miles of transmission main, would be installed over the Edwards Aquifer Transition Zone (Figure 7). Although this zone is not as prone to contamination as the Recharge Zone, the area can still contain fractured limestone in some places, and potential erosion/sedimentation impacts could occur to the aquifer from surface run-off related to construction activities. These impacts would be temporary and occur within previously developed areas. All activities would need to meet NPDES stormwater permitting requirements, as well as those contained in 30 TAC 210 and 213, which are administered by the TCEQ. These include preparation of a geologic assessment and implementation of best management practices to minimize erosion and sedimentation.

Indirect impacts would also occur to the Edwards Aquifer. Under Alternative 2, irrigation with reclaimed water would occur over the Transition Zone within an approximate one mile radius around two of the proposed satellite treatment plants (Figure 7). In the Northern Segment of the aquifer, the service area overlays Austin Chalk, which is a young and relatively impermeable layer that typifies a confined aquifer with little groundwater circulation (Scanlon et al. 2001, Jones 2003). In the Barton Springs Segment, the geology underlying the reuse service area is more complex, and contains some small localized, permeable layers. These layers, however, represent a very minor area of those underlying the City's reuse area, and the overall potential for infiltration of reclaimed water into the aquifer is very low. All conveyance of effluent would be subject to state regulation, including the mandate of routine water quality monitoring prior to distribution (30 TAC 210.34). Moreover, reuse customers would follow the terms and conditions of the City's requirements for reclaimed water users which specify that reclaimed water, *"shall not be utilized in a way that degrades groundwater quality to a degree adversely affecting its actual or potential uses"* (Appendix A). Finally, the City of Austin's study on the irrigation impacts of reclaimed water on soils and turf should provide valuable information on overall turf management and watering efficiency, including information on irrigation rates, application rates of fertilizers, soil amendments, and pesticides. This should assist in the development of nutrient management plans that would minimize potential impacts to local waterways through run-off, and hence into the aquifer.

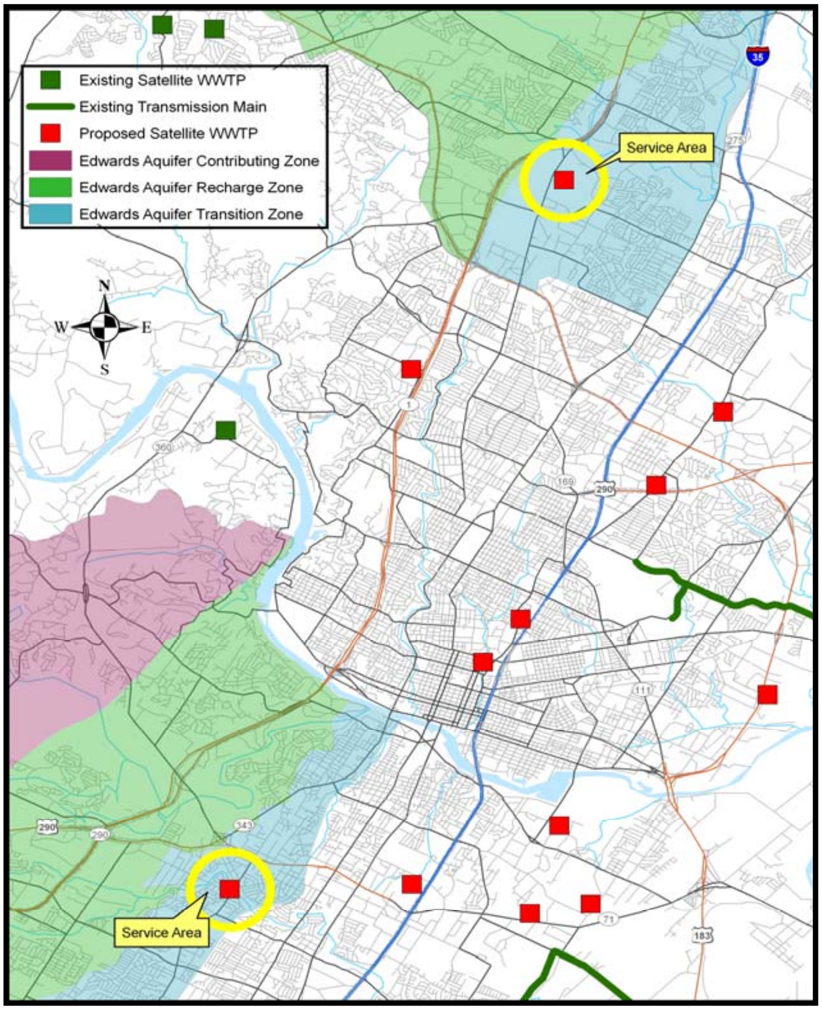

Figure 7. Construction activities and service area under Alternative 2 that would occur over the Edwards Aquifer.

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

Under the Preferred Alternative, minor direct impacts would occur to the Edwards Aquifer from construction activities. Impacts to the Northern Segment's Recharge Zone could result from sedimentation during installation of approximately 1.2 miles of 24 inch transmission main along Braker Lane in North Austin (Figure 8). With a 50 foot wide disturbance, the total surface area impacted over the Recharge Zone would be about 7.3 acres. Impacts to the Transition Zone would result from the installation of approximately 5.7 miles of transmission main along Burnet and Braker Roads, totaling 35 acres, as well as installation of a system storage tank and pump station (Figure 8). The nearest creek is approximately 1,000 feet from the proposed alignment, so run-off impacts would likely be buffered by the distance between construction activities and the creek. Direct sedimentation impacts could also occur to the Transition Zone of the Edwards Aquifer's Barton Creek Segment. These could occur through the installation of approximately 3.5 miles of transmission main along Manchaca and William Cannon Drive (Figure 8), totaling 21 acres. All of the above construction activities would occur within the City's existing right of way (ROW) in previously disturbed areas. As well, they would be subject to Edwards Aquifer protection rules outline in 30 TAC 213, reclaimed water rules outlined in 30 TAC 210, and NPDES stormwater protection. This would include pollution abatement plans and sedimentation/erosion control measures. Construction would be completed over a several month time frame and impacts would be temporary.

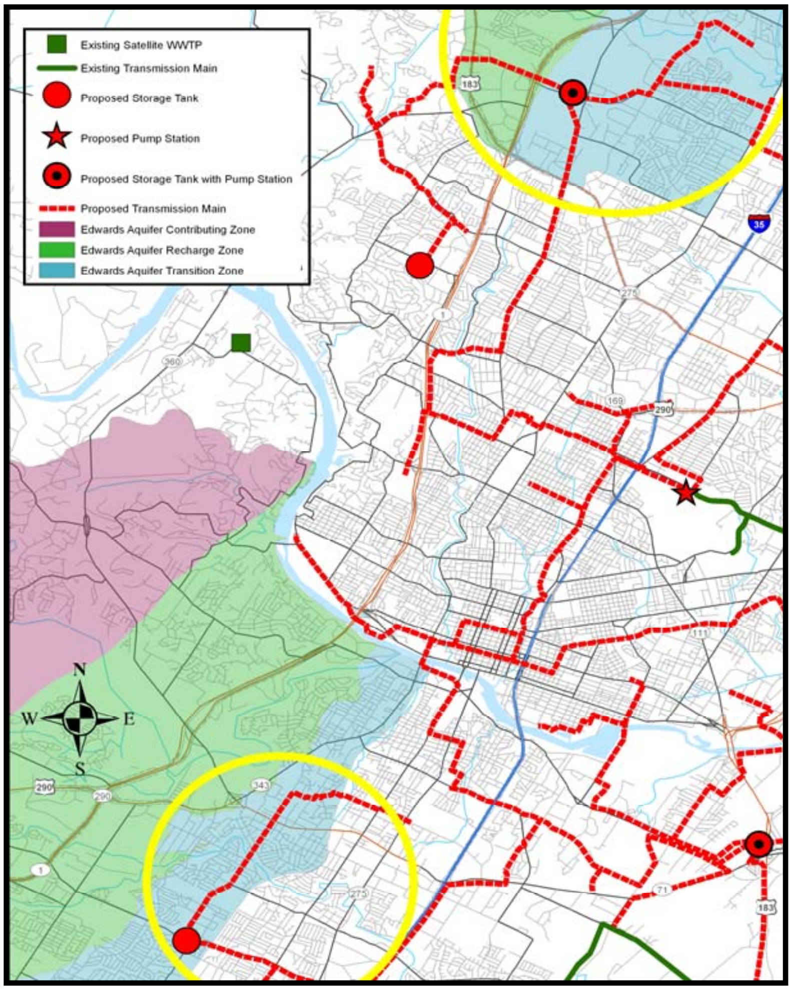

Figure 8. Construction activities under Alternative 3 that would occur over the Edwards Aquifer

Indirect impacts would also occur to the Edwards Aquifer. Customers would irrigate over the Transition Zone in both the Northern and Barton Springs segments (Figure 9). However, in those areas, groundwater circulation is low, recharge to the aquifer is much less pronounced, and the risk of contamination is minimized due to impermeable geologic barriers. In addition, reuse customers in the Northern Segment are located in the Walnut, Little Walnut, and Shoal Creek watersheds, where surface and groundwater directionally flow away from the Recharge Zone and towards the Colorado River (Jones 2003). Reuse customers in the Barton Springs Segment are located within the West Bouldin and Williamson Creek watersheds. The West Bouldin watershed does not contribute recharge water to the Barton Springs Segment, and portions of the Williamson Creek watershed within the recharge zone contribute only six percent of recharge water. This is the smallest of six watershed contributions to the Barton Springs Segment (Naismith Engineering 2005).

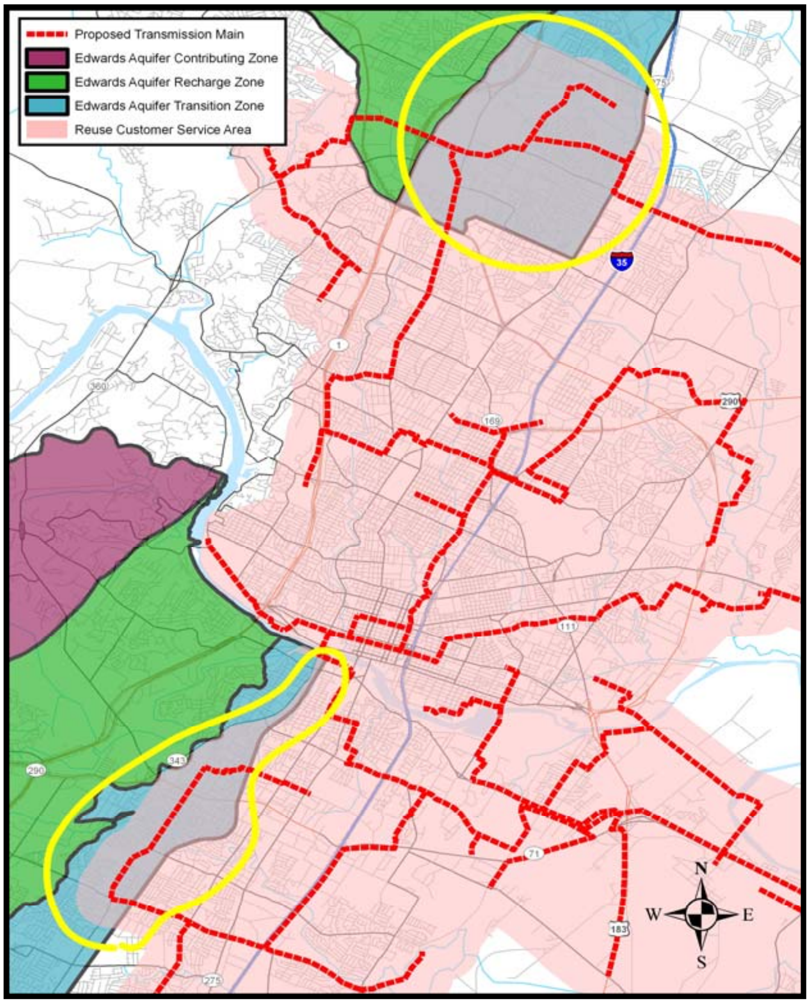

Figure 9. Reuse service area under Alternative 3 that would occur over the Edwards Aquifer

All conveyance of reclaimed water would be subject to state rules, including the mandate of routine water quality monitoring by the City prior to distribution into the system (30 TAC 210.34). Moreover, reuse customers would obey terms and conditions of the City’s requirements for reclaimed water users (Appendices A and B). Finally, the City’s study on the irrigation impacts of reclaimed water on soils and turf should provide valuable information on overall turf management and watering efficiency, including information on irrigation rates, application rates of fertilizers, soil amendments, and pesticides. This should assist in the development of nutrient management plans that would minimize potential impacts to local waterways through run-off, and hence into the aquifer.

Wildlife Resources

General Wildlife Resources

Existing Conditions

The proposed project area lies within the Edwards Plateau Ecoregion of south-central Texas, commonly referred to as the "hill country". Elevations range from about 100 to 3,000 ft., and several river systems dissect the surface, creating a rough and well-drained landscape. Average annual rainfall increases from west to east, ranging from 15 to 33 inches, with seasonal rainfall peaking in May/June and in September. Soils of the Edwards Plateau Ecoregion are usually shallow with a variety of surface textures, and the area is typified by limestone bedrock, making it unique among other ecoregions in Texas. The bedrock is very conducive to the development of large caves, which are home to some of the largest populations of bats in the world. The high number of endemic salamander and invertebrate cave species qualify this ecoregion as a global hotspot for cave-dwelling species. This ecoregion also ranks among the top ten ecoregions for reptiles and birds in the world (Olson et al. 2001). Common mammals include numerous bat species, raccoon, skunk, opossum, fox squirrel, nine-banded armadillo, cottontail rabbit, white-tailed deer, coyote, and bobcat.

Savannas were once common in this region, characterized by open plains with scattered tree growth among native grasslands, but almost all of this ecoregion has been converted to urban areas, pasture, and farmland. In fact, only about two percent of the original habitat survives, and only in fragmented pieces (Olson et al. 2001). Overgrazing and the suppression of natural fires have caused woody vegetation to replace the once abundant native grasslands in most areas. Urban and suburban development around Austin and San Antonio continues to threaten the few remaining habitat fragments that remain.

Across the range of the Colorado River stretching between Austin and Matagorda Bay lies an abundance of riparian habitat that is utilized by numerous wildlife species. Riparian habitat is defined as transitional zones between wet and dry areas that are located immediately adjacent, and thus related, to natural waterways. Boundaries of riparian habitat associated with the Colorado River are determined by the River's hydrologic regime. Because riparian areas share characteristics of both wetlands and uplands, they are extremely productive and provide excellent wildlife habitat. Since European settlement, changes in land use have destroyed numerous riparian corridors of all types; many remaining pieces have suffered degradation in structure, function, and composition.

Impacts

All Alternatives

Transmission mains would range from 12 to 48 in. diameter, with most being about 12 to 24 in. Mains would be placed in trenches that are 3 to 7 ft wide and 5 ft to 9 ft deep. The average total width of disturbance for pipeline installations would be 50 ft. Alternatives 1, 2, and 3, therefore, would impact six acres, 567 acres, and 715 acres, respectively during installation of transmission mains.

Under Alternative 2, each satellite treatment plant would impact approximately 0.5 acres of land, totaling about 7 acres. Under the No Federal Action and Preferred Alternative, each system storage tank would impact approximately 3 acres of land, so 3 acres and 18 acres would be impacted, respectively.

The project area for all three alternatives would be located entirely within an urban setting and almost exclusively impact previously disturbed areas. Transmission mains would be installed in existing City rights-of way, which are primarily paved, with adjacent areas containing some trees and shrubs. Construction activities may have an impact on diurnal urban wildlife species such as fox squirrel and northern mockingbird, but these species adjust well to disturbance and impacts would be temporary. Woody vegetation, including trees, would be avoided during construction and minimal loss would occur. Any noise associated with project construction may displace some wildlife from nearby areas, but impacts would be localized and temporary.

Based on results from instream flow analyses, the hydrologic regime of the Colorado River would remain primarily unchanged by Alternatives 2 and 3, with critical and target flow frequency remaining primarily unchanged. Subsequent alterations to riparian habitat and respective wildlife resources relative to the No Federal Action Alternative would be minimal.

Threatened and Endangered Species

Existing Condition

The Endangered Species Act of 1973 gives the U.S. Fish and Wildlife Service federal legislative authority for the protection of threatened and endangered species. This protection includes a prohibition of direct take (i.e., killing, harassing) and indirect take (i.e., destruction of critical habitat). Texas Parks and Wildlife Code established a state regulatory mandate for protection of state listed threatened and endangered species by prohibiting the take of such species.

Thirty-five state and federally listed threatened and endangered species occur within eight counties where potential construction and operational impacts of the proposed project would occur. Species and habitat descriptions for Llano, Burnet, Travis, Bastrop, Fayette, Colorado, Wharton, and Matagorda Counties are provided in Appendix C.

Impacts

All Alternatives

Twenty-one Federally listed threatened or endangered species were identified as occurring within eight counties where potential construction and operational impacts of the proposed project would occur. Reclamation determined that nine of these species would not be affected by the proposed project because each species and its habitat are located outside the project area and that twelve species could be potentially impacted by the project (Table 10).

Table 10. Federally threatened and endangered species identified as occurring in eight counties where impacts from the City of Austin's wastewater reuse initiative would occur.

Common Name	Status[1]	County	Potentially Impacted
Attwater's prairie chicken	E	Colorado	
Bald eagle	DM	Llano, Burnet, Bastrop, Fayette, Colorado, Wharton, Matagorda	*
Barton Springs salamander	E	Travis	*
Bee Creek Cave harvestman	E	Burnet, Travis	*
Black-capped Vireo	E	Llano, Burnet, Travis	
Bone Cave harvestman	E	Travis	
Brown pelican	DM, E	Matagorda	*
Golden-cheeked warbler	E	Llano, Burnet, Travis	
Green sea turtle	E, T, CH	Matagorda	*
Hawksbill sea turtle	E	Matagorda	*
Houston toad	E, CH	Bastrop, Fayette, Colorado	*
Kemp's ridley sea turtle	E	Matagorda	*
Kretschmarr Cave mold beetle	E	Travis	
Leatherback sea turtle	E, CH	Matagorda	*
Loggerhead sea turtle	T	Matagorda	*
Navasota ladies'-tresses	E	Bastrop	
Piping plover	E, T, CH	Matagorda	*
Tooth Cave ground beetle	E	Travis	
Tooth Cave pseudoscorpion	E	Travis	
Tooth Cave spider	E	Travis	
Whooping crane	E, EXPN	Travis, Matagorda	*

[1]E = Endangered; T = Threatened; DM = Delisted/Recovered/Monitored;
CH = Designated Critical Habitat; EXPN = Experimental Population, Nonessential
Listing information by County was obtained from the U.S. Fish and Wildlife Service.

Reclamation determined, with the concurrence from the U.S. Fish and Wildlife Service (dated ?), that the construction and operation of the City's wastewater reuse initiative would not likely adversely affect all twelve species because direct and indirect impacts related to construction activities, irrigation with reclaimed water, and instream flow reductions in the Colorado River would be minimal (Reclamation 2008). Construction impacts would be temporary, localized, and subject to best management practices outlined in state rules that minimize impacts to the Edwards Aquifer; and the geology of the Transition Zone where landscape irrigation would occur is such that the chances of reclaimed water entering the aquifer and actually impacting the species of concern are remote. Mandates on the conveyance and distribution of reclaimed water would further minimize any potential impacts.

A potential reduction of instream flows in the Colorado River would be considered insignificant, with critical and target flow frequency remaining primarily unchanged. Subsequent impacts to downstream riparian and floodplain habitats would be minimal and could not be meaningfully measured, detected, or evaluated. This rationale would also apply to Matagorda Bay, where a reduction in freshwater inflows would have minimal impacts, especially in light of the overriding influence of tides on sandbars, sandflats, or other offshore habitats used by Federally listed species.

Additionally, no subsequent effect would occur on the state threatened blue sucker, or any other state threatened or endangered species associated with the Colorado River or Matagorda Bay.

Migratory Birds

Existing Condition

The Migratory Bird Treaty Act of 1918 in conjunction with Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds directs federal agencies to ensure that environmental analyses of proposed actions, as required by NEPA or other established environmental review processes, evaluate the potential impacts on migratory birds.

Numerous species of waterbirds, waterfowl, raptors, warblers, orioles, hummingbirds, flycatchers, swallows, and sparrows have been known to breed or winter in central Texas. Of the 338 species that are listed as Nearctic-Neotropical migrants in North America (north of Mexico), 333 of them have been recorded in Texas. Because Texas occurs directly in the center of the central flyway for migratory birds, many additional species may be encountered as they pass through central Texas to their final destination. Most migratory birds breed in Texas from March to August, selecting a variety of tree, shrub, and grassland habitats.

Impacts

All Alternatives

Despite the anticipated loss of some trees during construction activities, migratory bird habitat would remain primarily unaltered. If construction does occur within the migratory bird breeding season and potential migratory bird habitat exists, surveys for nests would be required and avoidance of impacts would be mandated by federal law. Instream flow reductions in the Colorado River are not expected to impact migratory bird habitat along riparian corridors.

Non-native Invasive Species

Existing Condition

Executive Order 13112: Invasive Species states that federal agencies shall not, "*authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States*." Invasive species are defined as non-native species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

At least 67 terrestrial plants, 12 aquatic/wetland plants, 10 mammals, 4 birds, 7 fishes, 11 insects, and 11 mollusks and crustaceans are invasive in Texas (Rauschuber 2002). A few invasive species that inhabit the Lower Colorado River in Texas include blue tilapia (*Oreochromis aureus*), common carp (*Cyprinus carpio*), hydrilla (*Hydrilla verticilata*), and giant salvinia (*Salvinia molesta*). The latter two have created enormous problems on the Colorado River.

Impacts

All Alternatives

Construction activities could create disturbed environments that are favorable for the spread of non-native invasive species. These impacts would be mitigated by reseeding areas to their original vegetative composition in order to prevent both the spread of existing invasive species and the establishment of pioneer invasives.

Indirect impacts would not be expected to occur to non-native, invasive species. Water depth, temperature, and nutrient availability, which affect the abundance and distribution of hydrilla and giant salvinia, for instance, would not be impacted by any of the alternatives to a point that would facilitate establishment or spread of these species.

Air and Noise Quality

Existing Condition

The proposed project area lies within the EPA designated Austin-Waco Intrastate Air Quality Control Region (40 CFR 81.134), which extends from Caldwell County in the south, through Travis and Williamson Counties, to Hill County in the north. The EPA has designated all areas within the Region as meeting attainment for all six control pollutants (ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead). The Austin area, however, which includes Travis, Hays, Williamson, Bastrop, and Caldwell Counties, has been designated by the TCEQ as holding a “near nonattainment” status for ozone. Nevertheless, Travis County received an Air Quality Index rating of < 50, indicating “good” air quality.

The City of Austin, under Title 10-5 of the City Ordinance, defines noise[23] as a sound which disturbs a reasonable person of normal sensibilities. It also has been described as unwanted sound by the EPA. A combination of decibel level, frequency, duration, and surrounding land use determine potential impacts of noise. As directed by the *Noise Control Act* of 1972, the EPA identified that on a 24-hour basis, 365 days per year, a person should limit exposure to noise to a level less than 70 dB. It should be noted that the EPA limit is an average, meaning that much larger levels can usually be tolerated for brief periods of time. Equipment used for the proposed project, as well as pump station operations, would not be expected to exceed 90 dB.

Impacts

All Alternatives

Infrastructure would be constructed over a 28 to 30 year time period for Alternatives 2 and 3, so air and noise quality impacts from construction activities would be localized and temporary, occurring only over a period of months at any one location. All City ordinances on air and noise quality standards (Title 6-1 and Title 9-2 respectively) would be met, both for temporary construction activities and for ongoing noise generated by pump stations.

Human Health and Safety

Existing Condition

Type I effluent is chlorinated tertiary treated recycled water and is relatively free of bacteria and viruses, and is treated to a standard that allows some public contact to occur. This includes uses such as irrigation of homes, public parks, golf courses, school yards, and some food crops, fire protection, or other urban uses. Nevertheless, precautions by the City are taken to assure limited human contact. These are mandated in 30 TAC 210, Titles 15 & 25 of the City’s ordinance, and the Austin Water Utility’s Requirements for Reclaimed Water Users (Appendix A) and O&M Plan (Appendix B). These include, but are not limited to, the placement of reclaimed water signs in user areas, color coding of all reclaimed conveyance structures, installation of backflow prevention devices, prohibition of hose bibs/faucets. To date, no known health related impacts have resulted from the City’s existing reclaimed water program.

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[23] Noise is measured in decibels, which is the sound pressure level as measured by a sound level meter using the "A" weighting network and the slow meter response as specified by the American National Standards Institute

Impacts

All Alternatives

If properly managed, reclaimed water poses virtually no risk to human health. Fecal coliform levels, which indicate presence of harmful pathogens, would regularly be monitored in order to determine the adequacy of wastewater treatment and the integrity of the reclaimed distribution system. This would ensure compliance with reclaimed water standards outlined by TCEQ. As well, implementation of preventative actions would minimize contact with humans and subsequent impacts to health and safety.

Aesthetics/Visual Resources

Existing Condition

The potential impact areas throughout the City of Austin consist of developed commercial and residential infrastructure, including tall office buildings, apartments, residential homes, schools, and associated utility rights of way.

For all infrastructure development, the City must follow zoning and development ordinances and procedures, including buffer yards, landscaping, compatible uses, etc. For instance, a tall system storage tank would be painted blue to match the sky, whereas a relatively short satellite packaging plant would be painted green to match the surrounding landscape. Approval of all reclaimed system construction contracts would be a public process, allowing public input into project development.

Impacts

Alternative 1: No Federal Action

The transmission main pipeline would be installed underground. One distribution system storage tank would be installed on 51st Street near Manor Road. This tank would be approximately 170 feet tall and is located in a developed area near existing infrastructure.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

All transmission mains would be installed underground. The thirteen satellite packaging plants would be installed throughout the City (Table 11) near existing infrastructure.

Table 11. Location and height of thirteen satellite treatment plants proposed under Alternative 2.

Location	Height (Feet)
University of Texas	20
Samsung	20
Freescale Bluestein	20
Riverside	20
AMD	20
IBM	20
US 290	20
Far West	20
Cameron	20
Manchaca	20
Sematech	20
St. David's	20
Sachem	20

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

All transmission mains would be installed underground. Six system storage tanks would be installed throughout the City near existing infrastructure (Table 12).

Table 12. Location and height of the six system tanks and one plant storage tank proposed under the Preferred Alternative.

Location	Estimated Height (Feet)
Harris Branch	162
Far West	215
Braker Lane	106
Montopolis	94
William Cannon #1	154
William Cannon #2	190
Walnut Plant Tank	20

Socioeconomic Conditions

Existing

The proposed project area lies completely within the boundaries of Travis County and the City of Austin. Austin is the state capital of Texas and is home to the University of Texas and major corporations such as Dell, Freescale, and IBM. These and other similar entities have contributed to the economic growth in the area over the last decade. Table 13 below provides a snapshot of the major social characteristics for the City of Austin from the 1990 and 2000 Census as well as how Austin compares to the state over the same period of time.

Table 13. Social characteristics for the City of Austin and the State of Texas.

Indicator	City of Austin 1990	City of Austin 2000	City of Austin Annual % Change (1990-2000)	Texas Annual % Change (1990-2000)
Population	465,622	656,562	3.5	2.1
Labor force	264,619	376,704	3.7	2.0
Unemployment rate	6.3%	4.4%	-3.5	-0.6
Per capita income	$14,295	$24,163	5.4	4.3
Poverty rate[1]	11.5%	9.1%	-2.3	-1.5

[1] Percentage of families below the poverty level

Impacts on Socioeconomic Conditions

This socioeconomic assessment identifies major social and economic impacts of the three alternatives, including:

- The project's effect on water rates for the average City resident; and
- Who will bear the cost of the project.

The City of Austin developed a model to predict the effects of the alternatives on the water rates of the average City resident (Appendix D). The model uses a yearly weighted average water rate as a base for each alternative. That base water rate contains already approved yearly increases through 2011 which includes the City's current 10-year capital improvement plan. Beyond 2011, the base water rate increases at an assumed yearly inflation rate of 3%.

The base water rate does not include any of the water diversion costs to the LCRA once the City begins withdrawing more than 201,000 af/yr or the operations and maintenance cost of the potable portion of the 21,096 af/yr reclaimed water need. Therefore a "new" weighted average water rate was developed for each alternative that took these factors into account. The LCRA payment was calculated on projected raw water withdrawals at $115 per acre foot increased at 3% per year for inflation. The operations and maintenance of the potable portion of each alternative was calculated at $56.07 per acre foot increased at 3% per year for inflation. The construction cost of each alternative was not included in the model as those costs would be covered under revenue bonds and as such, would not impact the water rates for the average City resident.

Alternative 1: No Federal Action

Under this alternative, the average City resident could expect to see a 3.36% annual increase in their water rates. The City would incur water diversion costs to the LCRA by 2018, and the City would incur a 15,678 af/yr municipal water deficit by 2050.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Under this alternative, the average City resident could expect to see a 3.36% annual increase in their water rates. The City would incur water diversion costs to the LCRA by 2019, and the City would incur a 9,469 af/yr municipal water deficit by 2050.

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

Under this alternative, the average City resident could expect to see a 3.35% annual increase in their water rates. The City would incur water diversion costs to the LCRA by 2021, and no municipal water deficit would exist in 2050.

Cultural Resources

Existing Condition

The City of Austin has a number of historic properties which are valuable assets to the community. Recorded assets include thirteen Historic Districts listed on the National Register of Historic Places, one combined Historic and Archeological District (Barton Springs), and one Archeological District (Henderson Falls). Of these fifteen Districts, eight are located in the vicinity of possible construction for this project. These include Barton Springs, Camp Mabry, Clarksville, Congress Avenue, Hyde Park, Old West Austin, Sixth Street and Zilker Park. There are also fifteen recorded archeological sites, which are in the vicinity of proposed improvements associated with this action. Furthermore, installation of transmission mains along terraces of the Colorado River could affect previously unrecorded buried archeological sites.

Impacts

All Alternatives

The No Federal Action Alternative would not impact any cultural resources or require further consultation with the Texas State Historic Preservation Officer (SHPO). Alternatives 2 and 3 may affect the fifteen Archeological Sites and eight National Historic Districts described above, but the type and extent of impacts are difficult to assess because exact construction locations are unknown at this point. As accurate locations for excavation and construction are mapped out, Texas law requires the City of Austin to identify and protect the State Archeological Landmarks and Recorded Texas Historical Landmarks in accordance with the Antiquities Code of Texas, and to consult with the Texas SHPO on effects of all future ground disturbing activities. As a result of that consultation, some design changes or mitigation may be required to protect sites potentially impacted by construction. Overall, these mandates would minimize any impacts to cultural resources.

Cumulative Impacts Resources

The Council on Environmental Quality defines cumulative impacts as impacts on the environment which result from the incremental impacts of the proposed action when added to other past, present, and reasonably foreseeable future actions, both federal and nonfederal (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time.

The proceeding cumulative impacts analysis focuses on the Preferred Alternative because, as previous analyses have shown, it represents the maximum relative impact to the environment. Therefore, if evidence suggests that the Preferred Alternative has insignificant cumulative impacts, then one should infer that the impacts associated with Alternatives 1 and 2 are insignificant. However, if evidence suggests that the Preferred Alternative does have significant cumulative impacts on the environment, then detailed analyses will be performed on Alternatives 1 and 2 in order to determine if those alternatives result in significant impacts.

Two criteria were used to determine whether an action should be considered under cumulative effects analysis:

1) It must be reasonably foreseeable. It must have a legislative mandate, agreement, or formal proposal that specifies the scope of the action such that its content and intensity can be measurably calculated without speculation.

2) It must occur within the same time and geographic space such that a measurable, combined impact actually exists.

Cumulative Impacts of the Preferred Alternative on Instream Flows of the Colorado River and Freshwater Inflows into Matagorda Bay

The objective of the cumulative effects analysis was to further modify the WAM Run 1 that includes demand and return flow factors proposed under the Preferred Alternative and to incorporate all future federal and nonfederal activities that met the established cumulative effects criteria. All potential future water resources management strategies outlined in the Adopted Region K Water Plan for the Lower Colorado Regional Water Planning Group (2006) were considered for incorporation into the modified WAM. However, only actions associated with a draft TCEQ water rights permit met the criteria. The remaining actions were dismissed from cumulative effects analysis because they did not meet either criterion. These include, (1) actions that reflect an identified water need, but do not represent reasonably foreseeable actions supported by mandates, agreements, or any other implementation mechanism (i.e., City of Austin's future direct reuse to meet steam electric needs); (2) actions associated with pending water rights applications; or (3) actions associated with a legislated mandate without such applications [i.e., LCRA-San Antonio Water Systems (SAWS)].

Although water rights permit applications could be considered a formal proposal and reasonably foreseeable, the scope of the action at this stage is still considered speculative, and thus does not meet criterion 1. For instance, when TCEQ receives a permit application, the permit is subjected to public comment and reviewed by TCEQ staff for administrative and technical requirements in order to evaluate its impact on other water rights, water availability, bays and estuaries, conservation, public welfare, etc. This initial review process may result in the denial of a water right permit (or portion thereof); or it may result in any number of approval conditions being placed on the permit, conditions that sometimes substantially modify the originally proposed scope. In fact, anyone may submit a permit application requesting rights for any amount of water; but until the initial application is approved through TCEQ's initial review process, it is considered preliminary and speculative.

This rationale also applies to actions, such as the LCRA-San Antonio Water Systems (SAWS) Project, which are supported by legislature and considered reasonably foreseeable, but lack the draft water rights permits needed to qualify for consideration under this cumulative effects analysis. Although the LCRA plans to apply for amendments of several existing water right permits, those amendments have not been filed with TCEQ. The LCRA-SAWS project is only in the fourth year of an eleven-year study[24] on the proposal's technical, environmental and financial feasibility. This includes an assessment on the amount of water that can be supplied to SAWS on a firm basis in compliance with interbasin transfer laws, as well as identification of mitigation requirements to offset adverse impacts from the project's construction, operation, and maintenance. Until a feasibility determination is made that includes an assessment of legal, permitting, and mitigation requirements, and more importantly, until the TCEQ publishes a draft water rights permit, it is too speculative to quantify the net amount of water that will actually be removed from the Colorado River, as well as the conditions TCEQ places on that removal.

Eight draft water right permits have been published by TCEQ for the Lower Colorado River (Table 14), but only three permits were incorporated into the WAM Run 1 simulation of cumulative impacts: 5731, 14-1190B, and 14-1441A. The remaining applications comprised of amendments to existing permits which do not affect their current representation in the WAM, or the scope was such that surface water availability was not impacted.

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[24] The LCRA recently extended the study and permitting period an additional five years, and parties have agreed to make a decision on feasibility by 2015.

Table 14. Draft water rights permits published by the TCEQ as of October 2007, which was when the WAM simulation was run. Shaded rows indicate permits that were incorporated into the Run 1 WAM cumulative effects simulation.

Permit Number	Applicant	Purpose
5731	Lower Colorado River Authority	Divert, store, and use excess flood waters of the Colorado River
5852	Golf Club at Circle C, LP	Maintain an existing off-channel reservoir and five existing dams and reservoirs on Danz Creek and an unnamed tributary of Danz Creek for recreational and/or agricultural purposes
14-1190B	Upper Colorado River Authority	Amend permit number 14-1190 to authorize the use of bed and banks of Bald Eagle Creek, O.C. Fisher Lake to convey contract water to the City of San Angelo's Lone Wolf water treatment plant
14-1190C	Upper Colorado River Authority	Amend permit number 14-1190 to authorize the use of the bed and banks of the North Concho River and the Concho River to deliver water to the City of Paint Rock for municipal use
14-1298B	City of San Angelo	Amend permit number 14-1298 by adding a downstream diversion point on the west bank of the South Concho river
14-1318B	San Angelo Water Supply Corporation	Amend permit number 14-1318 by adding an additional diversion point and changing the inlet elevation of an existing diversion structure on Twin Buttes Reservoir
14-1348A	City of San Angelo	Amend permit number 14-1348 by adding municipal purposes as an authorized use and by adding the City of San Angelo Municipal Water System as a place of use for municipal water
14-1441A	Boot Ranch Development, LP	Amend permit number 14-1441 by increasing the storage capacity of the Upper Palo Alto Creek reservoir from six acre-feet to 93 acre-feet; increasing the annual diversion amount from 34 acre-feet to 232 acre-feet; increase diversion rate, among other things

Draft Permit 5731

This permit allows LCRA to divert up to 853,514 af/yr of water from the Colorado River for storage in an off-channel reservoir(s) of capacity up to 500,000 af. Diversion from storage is authorized at an amount up to 327,591 af/yr. The TCEQ has placed a condition that the draft permit is subject to the LCRA meeting target instream flow and bay and estuary inflow criteria every month, regardless of the criteria required for Lakes Travis and Buchanan. The modeled draft permit is also restricted from making priority order-based calls on inflows originating in the watersheds upstream of Lakes O.H. Ivie and Brownwood. Furthermore, there will be very few, if any, years that the draft permit would be able to divert 853,514 acre-feet from the Colorado River because the river will seldom, if ever, produce 853,514 af of unappropriated water in excess of all target environmental criteria in years coincident with a completely empty off-channel reservoir.

Draft Permit 14-1190B

This permit allows the Upper Colorado River Authority (UCRA) to transfer up to 34,000 af/yr via pipeline from Lake O.H. Ivie or Lake Spence into Lake O.C. Fisher. The WAM code used to represent this draft permit seeks to fill the request for 34,000 af/yr first from Lake O.H. Ivie. Any remaining demand is drawn from Lake Spence. In this manner, the draft permit is conservatively weighted to produce the most potential for impact on Lake Buchanan since a subordination agreement allows Lake O.H. Ivie to impound water senior to Lake Buchanan’s refill priority date. If Lake O.H. Ivie is drawn down more, it has greater potential to require refilling with stream flow which might have otherwise been available to Lake Buchanan.

Draft Permit 14-1141A

This permit allows an increase in storage and diversion at an existing dam on the Palo Alto Creek tributary of the Pedernales River. Authorized storage is increased from 6 to 93 af, and authorized diversion from storage is increased from 34 to 232 af/yr. The increase in impoundment and diversion is subject to an instream flow criteria of 0.2 cfs on the Palo Alto Creek downstream of the dam and diversion points.

Draft permits 14-1190B and 14-1441A are upstream of Lake Buchanan and Lake Travis, respectively. Furthermore, Lake O.H. Ivie is not simulated as full to capacity either with or without Draft Permit 14-1190B during the drought of record. It therefore always exercises the maximum allowed refill at the Lake Buchanan subordination priority date. Draft Permit 14-1441A is junior to the Lake Travis refill priority date(s), and thus cannot reduce the lake’s refill ability. Therefore, the permits are not expected to impact environmental flow downstream of the City’s wastewater discharge points, nor will they impact the combined firm yield of Lakes Buchanan and Travis.

Bastrop Gage: Cumulative Impacts on Instream Flows of the Colorado River (Tables 15 and 16.)

Summary: The addition of three draft permits has some cumulative impacts on median and average regulated flows, but these do not affect critical and target flow frequency.

During the POR:

- The only decrease in median flows from the Preferred Alternative alone is 2,026 af (February). The cumulative effect is a decrease by 1,463 af.
- The maximum decrease in average flows from the Preferred Alternative alone is 699 af (March). The cumulative effect is an increase by 541 af.
- The maximum cumulative decrease in average flows is 1,549 af (October).
- Critical and target flow frequency remains unchanged from the Preferred Alternative alone.

During the DOR:

- The maximum decrease in median flows from the Preferred Alternative alone is 8 af (December). The cumulative effect, which is also the maximum, is a decrease of 1,183 af.
- The maximum decrease in average flows from the Preferred Alternative alone is 1 af (December). The cumulative effect is a decrease by 1,029 af.
- Critical and target flow frequency remains unchanged from the Preferred Alternative alone.

Table 15. Results of WAM Run 1 showing median and average regulated flows at the Bastrop gage in 2050. These flows result from discharge decreases associated with implementation of the Preferred Alternative combined with pending draft water rights permits on the Lower Colorado River. Red font represents decreases in flow; blue font represents increases in flow.

PERIOD OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Median	No Federal Action	44,129	50,649	43,420	57,462	101,555	112,073	109,823	87,396	68,024	41,603	32,743	39,255	68,422
	Preferred Alternative	42,958	51,212	48,626	57,576	103,079	113,156	109,823	87,138	66,827	39,776	31,137	38,887	67,363
	Preferred Alternative + Draft Permits	42,958	49,186	48,626	57,576	103,079	113,156	109,823	87,138	66,827	39,776	31,137	38,887	67,102
	Net Difference[25]	***0***	***2,026***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***261***
	Cumulative Effect[26]	***1,171***	***1,463***	***5,206***	***114***	***1,524***	***1,083***	***0***	***258***	***1,197***	***1,827***	***1,606***	***368***	***1,320***
Average	No Federal Action	79,738	107,347	93,249	100,269	154,556	206,509	109,440	85,097	69,175	95,269	56,491	75,277	102,701
	Preferred Alternative	79,565	107,117	94,489	99,718	156,705	207,054	109,768	84,866	68,388	94,165	54,995	74,631	102,622
	Preferred Alternative + Draft Permits	79,565	107,130	93,790	99,657	156,099	206,608	109,759	84,864	68,386	93,720	55,044	74,625	102,437
	Net Difference	***0***	***13***	***699***	***61***	***606***	***446***	***10***	***2***	***2***	***445***	***49***	***7***	***185***
	Cumulative Effect[1]	***173***	***217***	***541***	***612***	***1,543***	***99***	***319***	***233***	***789***	***1,549***	***1,447***	***652***	***264***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Median	No Federal Action	23,810	27,592	34,566	56,371	87,860	114,061	110,612	90,151	66,065	40,195	25,269	23,767	43,852
	Preferred Alternative	22,639	27,664	34,748	54,769	93,118	114,607	111,097	90,151	65,904	39,350	23,936	22,592	42,089
	Preferred Alternative + Draft Permits	22,639	27,663	34,748	54,769	93,118	114,607	111,097	90,151	65,904	39,350	23,936	22,584	42,089
	Net Difference[1]	***0***	***1***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***8***	***0***
	Cumulative Effect[1]	***1,171***	***72***	***182***	***1,602***	***5,258***	***547***	***486***	***0***	***162***	***845***	***1,333***	***1,183***	***1,763***
Average	No Federal Action	25,409	28,295	35,361	78,295	78,455	103,508	102,352	83,987	62,515	45,859	25,847	32,085	58,661
	Preferred Alternative	24,341	27,345	35,049	77,372	81,856	106,089	104,816	83,290	61,646	44,627	24,646	31,057	58,667
	Preferred Alternative + Draft Permits	24,341	27,345	35,049	77,372	81,856	106,089	104,817	83,290	61,646	44,627	24,647	31,056	58,667
	Net Difference[1]	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***1***	***0***
	Cumulative Effect[1]	***1,068***	***950***	***312***	***923***	***3,402***	***2,581***	***2,465***	***697***	***869***	***1,233***	***1,200***	***1,029***	***6***

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[25] Represents the difference between the Preferred Alternative and the Preferred Alternative combined with pending draft permits.

[26] Represents the difference between the Preferred Alternative combined with pending permits and the No Federal Action Alternative.

Table 16. Results of WAM Run 1 showing percentage of time critical and target environmental flow criteria are met at the Bastrop Gage in 2050 after implementation of the Preferred Alternative combined with pending draft water rights permits on the Lower Colorado River. Red font represents frequency decreases; blue font represents frequency increases.

PERIOD OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Preferred Alternative	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Preferred Alternative + Draft Permits	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Net Difference[27]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Cumulative Effect[28]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
Target	No Federal Action	95.5%	95.5%	81.8%	90.9%	93.2%	100%	100%	100%	100%	100%	95.5%	95.5%	95.6%
	Preferred Alternative	95.6%	95.6%	82.2%	91.1%	93.3%	100%	100%	100%	100%	97.8%	91.1%	95.6%	95.2%
	Preferred Alternative + Draft Permits	95.6%	95.6%	82.2%	91.1%	93.3%	100%	100%	100%	100%	97.8%	91.1%	95.6%	95.2%
	Net Difference[1]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Cumulative Effect[2]	***0.1%***	***0.1%***	***0.4%***	***0.2%***	***0.2%***	***0%***	***0%***	***0%***	***0%***	***-2.2%***	***-4.3%***	***0.1%***	***-0.5%***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Preferred Alternative	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Preferred Alternative + Draft Permits	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Net Difference[1]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Cumulative Effect[2]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
Target	No Federal Action	100%	50.0%	50.0%	100%	66.7%	100%	100%	100%	100%	100%	66.7%	66.7%	84.8%
	Preferred Alternative	100%	50.0%	50.0%	100%	66.7%	100%	100%	100%	100%	100%	66.7%	66.7%	84.8%
	Preferred Alternative + Draft Permits	100%	50.0%	50.0%	100%	66.7%	100%	100%	100%	100%	100%	66.7%	66.7%	84.8%
	Net Difference[1]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Cumulative Effect[2]	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***

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[27] Represents the difference between the Preferred Alternative and the Preferred Alternative combined with pending draft permits.

[28] Represents the difference between the Preferred Alternative combined with pending permits and the No Federal Action Alternative.

Bay City Gage: Cumulative Impacts on Freshwater Inflows into Matagorda Bay (Tables 17 and 18).

Summary: The addition of the three draft permits results in cumulative decreases in average regulated flow across all months during the POR. However, critical and target flows remain primarily unchanged.

During the POR:

- Median flows remain unchanged from the Preferred Alternative alone.
- The maximum decrease in average flows from the Preferred Alternative alone is 37,313 af (April). The cumulative effect, which also is the maximum, is a decrease by 37,969 af.
- Critical flow frequency remains unchanged from the Preferred Alternative alone.
- Target flow frequency never decreases; the maximum increase is 6.3% (February), with a cumulative increase of 5.1%.

During the DOR:

- Median flows remain unchanged from the Preferred Alternative alone.
- The maximum decrease in average flows from the Preferred Alternative alone is 30,161 af (April). The cumulative effect, which also is the maximum, is a decrease by 30,931 af.
- Critical and target flow frequency remains unchanged from the Preferred alternative alone.

Table 17. Results of WAM Run 1 showing median and average regulated flows at the confluence of Matagorda Bay in 2050, as extrapolated from the Bay City Gage that result from discharge decreases associated with implementation of the Preferred Alternative combined with pending draft water rights permits on the Lower Colorado River. Red font represents decreases in flow; blue font represents increases in flow.

PERIOD OF RECORD		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ALL
Median	No Federal Action	69,506	65,669	36,000	36,259	34,370	4,046	306	242	1,930	28,319	50,989	68,000	30,706
	Preferred Alternative	68,694	66,167	36,000	36,259	36,000	4,908	418	242	1,409	26,395	48,850	68,000	29,613
	Preferred Alternative + Draft Permits	68,694	66,167	36,000	36,259	36,000	4,908	418	242	1,409	26,395	48,850	68,000	29,613
	***Net Difference*[29]**	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
	***Cumulative Effect*[30]**	***812***	***498***	***0***	***0***	***1,630***	***862***	***112***	***0***	***521***	***1,924***	***2,139***	***0***	***1,093***
Average	No Federal Action	118,691	151,694	117,603	115,848	138,696	184,233	37,801	7,598	38,061	120,054	111,479	123,660	105,452
	Preferred Alternative	118,556	151,364	118,121	115,192	140,475	184,554	38,288	7,314	37,508	118,980	109,965	123,048	105,280
	Preferred Alternative + Draft Permits	107,585	146,154	84,332	77,879	134,244	152,612	33,202	6,791	28,677	84,586	90,152	86,816	86,086
	Net Difference	***10,971***	***5,210***	***33,789***	***37,313***	***6,231***	***31,942***	***5,086***	***523***	***8,830***	***34,394***	***19,813***	***36,232***	***19,194***
	Cumulative Effect	***11,107***	***5,541***	***33,270***	***37,969***	***4,452***	***31,621***	***4,599***	***807***	***9,384***	***35,468***	***21,328***	***36,844***	***19,366***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Median	No Federal Action	17,810	19,490	17,479	17,722	141	54	60	60	55	4,240	17,862	18,052	10,046
	Preferred Alternative	16,946	19,001	17,479	16,324	140	60	60	60	55	2,808	18,691	18,095	9,962
	Preferred Alternative + Draft Permits	16,946	19,001	17,479	16,324	140	60	60	60	55	2,808	18,691	18,095	9,962
	Net Difference	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
	Cumulative Effect	***864***	***490***	***0***	***1,398***	***1***	***6***	***0***	***0***	***0***	***1,432***	***830***	***43***	***84***
Average	No Federal Action	21,684	35,045	18,991	56,376	12,154	7,854	84	2,666	3,905	30,534	21,297	42,751	21,403
	Preferred Alternative	20,796	34,334	18,707	55,606	15,644	11,217	3,678	2,403	3,196	29,406	20,327	41,592	21,691
	Preferred Alternative + Draft Permits	20,796	34,334	18,707	25,445	15,644	11,217	3,678	2,403	3,196	21,359	20,327	35,495	17,781
	Net Difference	***0***	***0***	***0***	***30,161***	***0***	***0***	***0***	***0***	***0***	***8,047***	***0***	***6,097***	***3,911***
	Cumulative Effect	***888***	***711***	***284***	***30,931***	***3,491***	***3,364***	***3,594***	***263***	***709***	***9,175***	***971***	***7,256***	***3,622***

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[29] Represents the difference between the Preferred Alternative and the Preferred Alternative combined with pending draft permits.

[30] Represents the difference between the Preferred Alternative combined with pending permits and the No Federal Action Alternative.

Table 18. Results of WAM Run 1 showing percentage of time critical and target environmental flow criteria are met at the confluence of Matagorda Bay in 2050, as extrapolated from the Bay City Gage after implementation of the Preferred Alternative combined with pending draft water rights permits on the Lower Colorado River. Red font represents decreases in flow; blue font represents increases in flow.

PERIOD OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	57.1%	57.1%	42.9%	42.9%	42.9%	28.6%	14.3%	0%	14.3%	28.6%	46.4%	57.1%	36.0%
	Preferred Alternative	55.6%	59.3%	44.4%	40.7%	48.1%	33.3%	18.5%	0%	14.8%	29.6%	40.7%	51.9%	36.4%
	Preferred Alternative + Draft Permits	55.6%	59.3%	44.4%	40.7%	48.1%	33.3%	18.5%	0%	14.8%	29.6%	40.7%	51.9%	36.4%
	***Net Difference*[31]**	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	***Cumulative Effect*[32]**	***-1.6%***	***2.1%***	***1.6%***	***-2.1%***	***5.3%***	***4.8%***	***4.2%***	***0%***	***0.5%***	***1.1%***	***-5.7%***	***-5.3%***	***0.4%***
Target	No Federal Action	32.3%	35.5%	48.4%	54.8%	32.3%	32.3%	22.6%	9.7%	29.0%	41.9%	51.6%	54.8%	37.1%
	Preferred Alternative	31.3%	34.4%	50.0%	53.1%	31.3%	31.3%	21.9%	9.4%	25.0%	37.5%	50.0%	53.1%	35.7%
	Preferred Alternative + Draft Permits	31.3%	40.6%	50.0%	53.1%	31.3%	31.3%	21.9%	9.4%	25.0%	40.6%	53.1%	53.1%	36.7%
	Net Difference	***0%***	***6.3%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***3.1%***	***3.1%***	***0%***	***1.0%***
	Cumulative Effect	***-1.0%***	***5.1%***	***1.6%***	***-1.7%***	***-1.0%***	***-1.0%***	***-0.7%***	***-0.3%***	***-4.0%***	***-1.3%***	***1.5%***	***-1.7%***	***-0.4%***
DROUGHT OF RECORD		**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**ALL**
Critical	No Federal Action	10.0%	20.0%	10.0%	30.0%	22.2%	11.1%	0%	0%	0%	22.2%	11.1%	33.3%	14.3%
	Preferred Alternative	10.0%	20.0%	10.0%	30.0%	33.3%	22.2%	11.1%	0%	0%	22.2%	11.1%	33.3%	17.0%
	Preferred Alternative + Draft Permits	10.0%	20.0%	10.0%	30.0%	33.3%	22.2%	11.1%	0%	0%	22.2%	11.1%	33.3%	17.0%
	Net Difference	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Cumulative Effect	***0%***	***0%***	***0%***	***0%***	***11.1%***	***11.1%***	***11.1%***	***0%***	***0%***	***0%***	***0%***	***0%***	***2.7%***
Target	No Federal Action	n/a	n/a	n/a	100.0%	0%	0%	0%	0%	0%	0%	0%	0%	11.1%
	Preferred Alternative	n/a	n/a	n/a	100.0%	0%	0%	0%	0%	0%	0%	0%	0%	11.1%
	Preferred Alternative + Draft Permits	n/a	n/a	n/a	100.0%	0%	0%	0%	0%	0%	0%	0%	0%	11.1%
	Net Difference	n/a	n/a	n/a	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***
	Cumulative Effect	n/a	n/a	n/a	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***	***0%***

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[31] Represents the difference between the Preferred Alternative and the Preferred Alternative combined with pending draft permits.

[32] Represents the difference between the Preferred Alternative combined with pending permits and the No Federal Action Alternative.

Cumulative Impacts on Lakes Travis and Buchanan Reservoir Yield

As previously stated, the combined firm yield of Lakes Travis and Buchanan under the Preferred Alternative alone is 589,916 af. According to the WAM, the combined firm yield of both lakes would be 589,916 af, even with the addition of three draft water rights permits. The reason no change exists is because all three water right permits are junior to the refill dates outlined in existing water rights for Lakes Travis and Buchanan. Furthermore, in the case of LCRA's excess flood flow permit No. 5731, permit conditions placed by TCEQ require target environmental flow criteria to be met at all times, and the excess flood flow permit cannot reduce the lakes' combined firm yield if it cannot reduce, refill, or produce environmental deficits. In fact, the very nature of the flood flow permits is such that it only is allowed to "consume" large, unappropriated flood flow events that are typically well above the environmental flow criteria. For these reasons, no cumulative impacts would result on the combined firm yield of Lakes Travis and Buchanan from implementation of the Preferred Alternative combined with draft water right permits.

Cumulative Impacts on Groundwater Resources

The Williamson County Regional Reuse System Initiative was the only action considered for inclusion into the cumulative effects analysis on groundwater resources. Under this action, the LCRA, Brazos River Authority, and surrounding cities in Williamson County would expand their reuse capabilities into one comprehensive project aimed at delivering reclaimed water to irrigation customers, many of which are located over the Edwards Aquifer Recharge Zone. This project meets Criterion 1 for cumulative effects consideration because it is reasonably foreseeable due to authorization legislation that was passed in 2004 (Public Law 108-316. H.R. 1732). However, this project does not meet Criterion 2, which states that a project must occur in the same time and space as the Preferred Alternative, such that the combined impacts can be measurably acquired.

First, direct impacts to the Edwards Aquifer from construction of both projects would occur decades apart, so no direct cumulative impact from sedimentation would occur. Initial plans indicate that project construction over the Edwards Aquifer under the Williamson County project could begin as early as 2010, with completion in 2013, whereas project construction in the Recharge Zone under the Preferred Alternative would not occur until 2030.

Potential indirect impacts to the Edwards Aquifer from irrigation by both reuse projects would occur in separate geographic areas with no hydraulic connection, and therefore would not be considered cumulative. Irrigation in the Transition Zone under the Preferred Alternative would occur over the Barton Springs and

Northern Segments of the Edwards Aquifer within the Colorado River basin. There is no surface and groundwater connection between these segments and the Northern Segment over the Brazos River basin where irrigation under the Williamson County project would occur (Jones 2003). As a result, any potential contamination resulting from irrigation with reclaimed water by either project would be localized to their respective regions, and therefore not be cumulative.

Native American Trust Assets

It is the policy of the federal government to protect Native American Trust Assets. Assets of Native American tribes held in trust by the United States are determined by treaty or in association with a reservation. Only two Native American reservations exist in Texas. The Texas Kickapoo Tribe occupies a small tract along the Rio Grande near Eagle Pass, and the Alabama-Coushatta Tribe occupies a small reservation in eastern Texas near Livingston. Reclamation is unaware of any state recognized tribes or independent Indian communities in or near the proposed project area.

All Alternatives

Due to the absence of Native American Trust Assets in the region, no affect would occur on associated resources by any of the alternatives analyzed.

Environmental Justice

Executive Order 12898: Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (Federal Register 1994) provides that, "*each Federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health and environmental effects of its programs, policies and activities on minority populations and low-income populations.*"

Minority groups, as defined by the CEQ (1997), include individuals who are members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black (not of Hispanic origin), and Hispanic. A minority population, for the purposes of this document, is a group of individuals living in close proximity to one another where either: a) a minority group of the population within the affected area exceeds 50% of that population, b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population, or c) there is more than one minority group present and the minority percentage, as calculated by aggregating all minority persons, meets one of the first two thresholds.

Low-income groups, as defined by the CEQ (1997), include individuals who earn an annual family income below the statistical poverty thresholds provided by the Census Bureau's Current Population Reports, Series P-60. A low-income population, for purposes of this document, includes a group of individuals whose median family income for the year is below the identified poverty threshold. For the earning year 1999, used in developing median family income data for the 2000 Census, the Census Bureau set a poverty threshold for a household of three[33] individuals at $13,290.

For the purpose of identifying minority and low-income populations in the project area potentially affected by the three alternatives, individual county census tracts were chosen as geographic boundaries of a group of individuals that experience common conditions of environmental exposure as to not artificially dilute or inflate the affected minority or low-income populations. All of the data presented below are derived from the U.S. Bureau of Census 2000 Census Report.

In accordance with guidance provided by the CEQ, two questions were asked when evaluating environmental justice: 1) Are project components disproportionately located within minority or low-income populations? 2) In the context of this proportion, are the resulting direct, indirect, and cumulative impacts such that they appreciably exceed (or are likely to exceed) those that would occur to the general public? Following the narrative of impacts below is Table 19, which provides a detailed comparison of impacts by all three alternatives.

Alternative 1: No Federal Action

Under the No Federal Action Alternative, only one census tract would be impacted. This tract contains a minority population that is not low-income. Although all project components are located within the minority population, resulting impacts are very minor, as supported throughout this document. Because the impacts are so minor, there is no risk of adverse environmental effects appreciably exceeding those that would occur to the general population.

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Under Alternative 2, 75 census tracts would be impacted. Of these, 39 are considered minority populations, and three are considered low-income. No satellite plants, and only three miles of transmission main would be installed within low-income populations. Six satellite plants would be installed within minority populations, but this is less than the number installed within the general population. Although a greater length of transmission mains would be located within minority populations compared to the general public, the difference between the two amounts is very small and not considered disproportionately high, especially in the context of environmental impacts. These impacts, as

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[33] The 2000 Census mean household size for the City of Austin is 2.4 individuals. A conservative estimate of 3.0 individuals per household was used for this analysis.

documented throughout this report, are minor, localized, and most importantly, consistent throughout the entire project area. Therefore, the risks of exposure of minority and low-income populations to direct, indirect, and cumulative environmental impacts would not appreciably exceed those occurring to the general public.

Preferred Alternative: Wastewater Facility Reuse Expansion via Transmission Main Extension

Under the Preferred Alternative, 91 census tracts would be impacted. Forty-one are considered minority populations; one is considered low-income. No storage tanks, and less than one mile of transmission main would be installed within a low-income population. Only two out of the seven storage tanks would be installed within minority populations. Although a greater length of transmission mains would be installed within minority populations compared to the general public, the difference between the two amounts is very small and not considered disproportionately high, especially in the context of environmental impacts. These impacts, as documented throughout this report, are minor, localized, and most importantly, consistent throughout the entire project area. Therefore, the risks of exposure to environmental impacts from installation of transmission mains and storage tanks would not appreciably exceed those occurring to the general public.

Table 19. Impacts on minority and low-income populations under all three alternatives proposed under the City of Austin's wastewater reuse initiative.

	Alternative 1: No Federal Action		**Alternative 2: Satellite Systems**		**Preferred Alternative**	
	Minority Population	**Low-income population**	**Minority Population**	**Low-income population**	**Minority Population**	**Low-income population**
# of Minority/Low-income Census Tracts Impacted	1	0	39	3	41	1
Total # of Census Tracts Impacted	1	1	75	75	91	91
Percentage of Census Tracts Impacted	**100%**	**0%**	**52%**	**< 1%**	**45%**	**1.1%**
Miles of Transmission Main Over Impacted Tracts	1	0	50	3	73	0.8
Total Miles of Transmission Main	1	1	93	93	117	117
Percentage of Transmission Main Inside Impacted Tracts	**100%**	**0%**	**54%**	**< 1%**	**62%**	**< 1%**

	Alternative 1: No Federal Action		Alternative 2: Satellite Systems		Preferred Alternative	
	Minority Population	**Low-income population**	**Minority Population**	**Low-income population**	**Minority Population**	**Low-income population**
# of Satellite Plants/Storage Tanks Installed Over Tracts	1	0	6	0	2	0
Total Satellite Plants/Storage Tanks	1	1	13	13	7	7
Percentage of Satellite Plants/Storage Tanks Inside Impacted Tracts	**100%**	**0%**	**46%**	**0%**	**29%**	**0%**

Environmental Commitments

The following environmental commitments were developed for both action alternatives by Reclamation in coordination with the City of Austin. Implementation would occur during or after construction, unless otherwise specified.

Commitments for construction of infrastructure to convey reclaimed water

- The City must comply with all federal, state, and local regulations in the installation of transmission main pipelines, storage tanks and associated pump stations, or any other infrastructure related to conveyance of reclaimed water. This includes Sections 402 and 404 of the Clean Water Act, as well as rules established under TAC 210 and 213, and the City of Austin ordinance.
- The City must comply with the Antiquities Code of Texas as well as the National Historic Preservation Act prior to construction of any pipelines or facilities. The City will have a qualified archeologist survey the proposed project area prior to the initiation of any ground disturbance and provide Reclamation with copies of any permits and/or concurrence letters from the State Historic Preservation Officer.
- Existing trees and woody vegetation should remain undisturbed if possible. If not avoidable, stands of woody vegetation would be surveyed for nesting migratory birds during the nesting period of March through August, and then not disturbed if any were found.
- The City will reseed areas to their original condition.

Commitments for the conveyance of reclaimed water to customers

- The City must ensure that all mandates outlined in 30 TAC 210 for reclaimed water use are met. This includes general requirements for the production, conveyance, and use of reclaimed water and the maintenance of water quality standards at the point of intended use.
- The City must ensure that the terms and conditions are met in the Austin Water Utility’s Reclaimed Water Service Application and associated O&M Plan. This includes managing discharges in accordance with any permit issued by TCEQ, maintaining groundwater quality, and avoidance of uses consistent with surface run-off or excessive percolation into the ground.

Consultation and Coordination

Public Involvement

Two meetings were held for the potentially affected public to comment on the proposed project during its planning. The first public meeting was held on December 11, 2003. The second public meeting was held on July 26, 2005. Both meetings were promoted through a bilingual advertisement in the Austin American Statesman. The City mailed approximately 490 letters of invitation to known stakeholder groups and sent invitations by e-mail to large commercial water users. A list of attendees is provided in Appendix E.

Public testimony at both meetings was generally supportive of the expansion of the City's reclaimed water program and initiatives to improve water conservation. Questions that were asked focused on program details such as volumes of reclaimed water used under the various alternatives, the cost of the alternatives, cost per gallon under the various alternatives, the number of customers these volumes could serve, miles of transmission main needed for each alternative, and a possible partnership with the Austin Clean Water Program.

Most comments related to the potential impact on instream flows in the Colorado River. In particular, the public was concerned about the seasonality of reclaimed water use and its impact on flows during dry periods. The public also noted that there were no state requirements for instream flows and thought that this issue should be studied further.

Consultation and Coordination

A meeting was held March 10, 2004 between Reclamation, TPWD, and TCEQ regarding potential impacts of the proposed project on instream flows. Additional meetings were held on May 19, 2005 with the Edwards Aquifer Authority and on June 14, 2005 with the San Antonio Water System regarding potential irrigation impacts over recharge areas on the Edwards Aquifer[34]. These discussions resulted in the exclusion of irrigation over recharge areas. Other informal discussions were held with the Edwards Aquifer Barton Springs Conservation District, Sierra Club, and National Wildlife Federation regarding potential impacts to aquatic resources. All formal consultation correspondence is included in Appendix F.

In pursuit of its requirements under the National Historical Preservation Act, Reclamation submitted a consultation letter dated June 16, 2005 to the SHPO on the potential impacts of the proposed project to cultural and historical properties.

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[34] Although the Edwards Aquifer Authority and San Antonio Water Systems jurisdictions fall outside geographic scope of this project, they were consulted due to their extensive knowledge and experience dealing with impacts of effluent irrigation over the Edwards Aquifer recharge zone.

In a letter dated July 14, 2005, the SHPO determined that no historic properties were affected by the proposed action.

In a letter dated ?, Reclamation requested concurrence from the U.S. Fish and Wildlife Service on Reclamation's determination of effects to threatened and endangered species as required under Section 7 of the Endangered Species Act. The U.S. Fish and Wildlife Service concurred on ? that the proposed action is not likely to adversely affect any threatened or endangered species or their habitats.

In a letter dated February 10, 2006, Reclamation requested review of the proposed project by the Environmental Protection Agency (EPA) as required under Section 1424(e) of the Safe Drinking Water Act for designated Sole Source Aquifers. EPA determined that the project should not have an adverse effect on the quality of ground water underlying the project site.

Report Distribution

On November 20, 2006, Reclamation solicited comments on the Draft Environmental Assessment from the agencies and individuals below. Comments were accepted through January 4, 2007. During that period, two letters were received. Responses to those comments are provided at the end of this report in the "Comments and Responses" section.

Federal Agencies

U.S. Fish and Wildlife Service
U.S. Environmental Protection Agency
Bureau of Reclamation Great Plains Regional Office
USDA Natural Resources Conservation Service

Texas State Agencies

Texas Council on Environmental Quality
Texas Parks and Wildlife Department
Texas Historical Commission

Organizations and Businesses

American YouthWorks
Austin Adventure Racers
Austin Chamber of Commerce
Austin Community College
Austin Community Land Trust
Austin Independent School District
Austin Metro Trails and Greenways
Austin Parks Foundation
Austin Ridge Riders
Austin Sierra Club
Austin Youth River Watch
Baker, Hafif & Hielsher
Barton Springs Edwards Aquifer Conservation District
Bradley Development
Bull Creek Foundation
Central Texas Groundwater Guardians
CH_2M Hill
Circle C Homeowners PAC
Clean Water Action
City of Austin Parks and Recreation Department
Conservation History Association of Texas
Earth Share of Texas
Endeavor Real Estate Group
Environmental Defense – Texas
Envision Central Texas
Hays County Water Planning Partnership
Herndon Stauch & Associate
Hill Country Conservancy
Hill Country Land Trust
Hornsby Bend Partnership
Klotz Associates
Lower Colorado River Authority
National Wildlife Federation
PODER
Real Estate Council of Austin
Save Barton Creek Association
Save Our Springs
Save Our Springs Alliance
Sierra Club – Lone Star Chapter
Sierra Club – Central Texas Group
South Austin Greenways Alliance
Sustainable Indicators Project
Sustainable Living Alliance
Texas Cave Management Association
Texas Speleological Association
Texas Urban Forestry Council
Travis Audubon Society
Travis County – TNR
TreeFolks
University of Texas at Austin
Urban Forestry Resources
Victor Emanuel Nature Tours

Wild Basin Wilderness

Neighborhood Associations

12th Street Business/ Property Owner Assoc.
2222 Property Owners Assoc.
620 Community Center Property Owners Assoc.
Acres West Homeowners Assoc.
Allandale Neighborhood Assoc.
Allen Road Homeowners Assoc.
Alliance to Save Hyde Park
AMA Neighborhood Assoc.
Anberly Airport Assoc.
Anderson Hill Residential Property Owners Assoc.
Anderson Mill Estates Homeowners Assoc.
Anderson Mill Neighborhood Assoc.
Angus Estates Neighborhood Assoc.
Angus Valley Area Neighborhood
Apache Shores Property Owners Assoc.
Austin City Parks Neighborhood
Austin Great Hills Homeowners Assoc., Inc.
Austin Neighborhoods Council
Avery Ranch Neighborhood Assoc.
Avery Ranch Owners Assoc., Inc
Balcones Civic Assoc.
Balcones Village-Spicewood Homeowners Assoc.
Balcones Woods Homeowners
Barrio Unido Neighborhood Assoc.
Barton Creek Associations
Barton Creek West Homeowners Assoc.
Barton Hills-Horseshoe Bend Assoc.
Barton Oaks Neighborhood Assoc.
Barton Springs Coalition
Barton View Neighborhood Assoc.
Battle Bend Springs Assoc.
Beaconridge Neighborhood Assoc.
Beau Site Neighborhood
Bee Caves Road Alliance
Bee Creek Hills Homeowners Assoc.
Blackland Neighborhood Assoc.
Blackland Prairie Concerned Citizens Assoc.
Blackshear Prospects Hills
Blackshear Residents
Booker T Washington Neighborhood Assoc.
Bouldin Creek Neighborhood Assoc.
Bouldin Creek Neighborhood Planning Team Liaison-COA
Bouldin Forward Thinking
Bouldin Oaks Neighborhood Assoc.
Brentwood Neighborhood Assoc.
Brentwood/Highland Combined Neighborhood Planning Team-COA Liaison
Bridgehill Homeowners Assoc.
Brodie Lane Homeowners Assoc.
Brooke Elementary Neighborhood
Brooke Neighborhood Assoc.
Brownie Drive Homeowners Assoc.
Bryker Woods Neighborhood Assoc.
Bull Creek Homeowners Assoc.
Bull Mountain Civic Assoc.
Bunny Run Neighborhood Assoc.
Burleson Heights Neighborhood Assoc.
Burleson Parker Neighborhood Associations
Camelot Roundtable Neighborhood Assoc.
Canyon Creek Homeowners Assoc.
Canyon Mesa Homeowners Assoc.
Carson Creek Neighborhood Assoc.
Castlewood-Oak Valley Neighborhood Assoc.
Caswell Pease Neighborhood Assoc.
Cavalier Park Neighborhood Assoc.
Cedar Valley Neighborhood Assoc.
Central East Austin Business Owners Assoc.
Chalmers Court Neighborhood Assoc.
Chambord-Austin Owner's Assoc.
Champions Forest Homeowners Assoc.
Cherry Creek on Brodie Neighborhood Assoc.

Cherry Creek SW Neighborhood Assoc.
Cherry Meadows Neighborhood Assoc.
Cherrywood Neighborhood Assoc.
Chestnut Addition Neighborhood Assoc.
Chimney Hills North Neighborhood Assoc.
Circle C Homeowners Assoc.
Circle C Neighborhood Assoc.
Circle S. Ridge Neighborhood Assoc.
City of Austin Downtown Commission
City of Rollingwood
City of Sunset Valley
Clifford-Sanchez Neigh. Assoc.
Collinwood Homeowners Assoc.
Collinwood West Owner's Assoc.
Colony Park Neighborhood Assoc.
Comanche Trail Community Assoc.
Commons Ford Neighborhood Assoc.
Concerned Citizens For P&B of FM 2222
Convict Hill Neighborhood Assoc.
Cooper Lane Neighborhood Assoc.
Coronado Hills Neighborhood Assoc.
Coronado Hills/ Creekside Neighborhood Assoc.
Courtyard Homeowner Assoc.
Craigwood Assoc.
The Creek at Riverbend Homeowners Assoc.
Creek Bend Neighborhood Assoc.
Crestview Neighborhood Assoc.
Crestview/Wooten Combined Neighborhood Planning Team-COA Liaison
The Crossing Gardenhome Owners Assoc.
Davenport Ranch Master Neighborhood Assoc.
Davenport West / Hunterwood Homeowners Assoc.
Davis Hills Estate Homeowners Assoc.
Davis Spring Homeowners Assoc.
Davis-Thompson American Millennium Neighborhood Assoc.
Dawson Neighborhood Assoc.
Dawson Neighborhood Planning Team
Dawson Neighborhood Planning Team Liaison-COA
Deer Park at Maple Run Homeowners Assoc.
Deerwood Premier Manufactured Home Community
Dellwood Neighborhood Assoc.
Dove Springs Neighborhood Assoc.
Downtown Austin Alliance
Downtown Austin Neighborhood Assoc.
East Cesar Chavez Neighborhood Planning Team
East MLK Neighborhood Plan Contact Team
East Riverside/Oltorf & Montopolis Neighborhood Planning Team-COA Liaison
East Slaughter Lane Neighborhood Assoc.
East Town Lake Citizens Neighborhood Organizations
Eastville - Central
Eastwoods Assoc.
Edgewater Assoc.
Edward Joseph Developments, LTD
El Concilio, Coalition of Mexican American Neighborhood Assoc.
Elm Ridge Tenant's Assoc.
Estates at Shadowridge
Estates of Barton Creek Property Owners Assoc.
Estates of Brentwood
Estates of Shady Hollow Community Assoc.
EYE-H35/ Airport Blvd Neighborhood Assoc.
Fairview Estates Neighborhood Assoc.

Fairway at Great Hills Owners Assoc. (The)
Far South Austin Community Assoc.
Five Rivers Neighborhood Assoc.
Fox Run Ridge Homeowners Assoc.
Franklin Park Neighborhood Assoc.
Friendly Fiends of Haskell Street
Gaines Ranch Homeowners Assoc.
Galindo Elementary Neighborhood Assoc.
Garden's Neighborhood Assoc. (The)
Gaston Place Neighborhood Assoc.
Georgian Acres Neighborhood Assoc.
Georgian Manor Neighborhood Assoc.
Glen Oaks, Rosewood Village, Neighborhood Organization
Glenlake Neighborhood Assoc.
Goodrich Neighborhood Assoc.
Govalle/Johnston Terrace Planning Team of Neighborhood Organizations
Granada Homeowners Assoc.
Great Hills Homeowner Assoc.
Great Hills Park Neighborhood Assoc.
Great Hills Sec. VIII Homeowners, Inc.
Great Hills Sections IX and X Homeowners Assoc., Inc.
Green Trails Area Alliance
Greenwood Hills-Colonial Park Neighborhood Assoc.
Gregg Neighborhood Assn
Guadalupe Assoc. for an Improved Neighborhood
Guadalupe Neighborhood Development Corp.
Hancock Neighborhood Assoc.
Harris Glenn Homeowners Assoc.
Harris Ridge Homeowners Assoc.
Heritage Hills Neighborhood Assoc.
Heritage Neighborhood Assoc.
Hidden Meadow Neighborhood Assoc.
Highland Club Village Neighborhood Assoc.
Highland Neighborhood Assoc.
Highland Park West Balcones Area Neighborhood Assoc.
Hill Country Estates Homeowners Assoc.
Hillcrest Homeowners Assoc.
Holly Street Assoc.
Hudson Bend Colony Neighborhood Assoc.
Hughes Park Lake Subdivision 2 Assoc. of Property Owners
Hyde Park Neighborhood Assoc.
Indian Oaks Neighborhood Assoc.
Island at Mt Bonnell Shores Neighborhood Assoc. (The)
J.J. Seabrook Neighborhood Assoc.
Jackson Estates Neighborhood Assoc.
Jester Homeowners Assoc., Inc.
Johnston Terrace Neighborhood Assoc.
Judges' Hill Neighborhood Assoc.
Keep the Land
Kensington Park Homeowners Assoc.
Kincheonville Neighborhood Assoc.
Knolls at Slaughter Creek
Knollwood/Camelot I
Koenig Lane Neighborhood Assoc.
L.B.J. Neighborhood Assoc.
Lake Austin Business Owners
Lake Pointe Homeowners Assoc.
Lakeside Neighborhood Assoc.
Lakewood Club
Lakewood Homeowners Assoc.
Lamplight Village Area Neighborhood Assoc.
Laurel Oaks Neighborhood Assoc.
Laurels Owners Assoc.
Laurelwood Estates Neighborhood Assoc.
Legend Oaks Neighborhood Assoc.
Liberty Park Homeowners Assoc.
Lincoln Garden Assoc.
Lost Creek Neighborhood Assoc.

Lower Waller Creek
M.E.T.S.A. Neighborhood Assoc.
M.K. Hage
Manchaca Estates Neighborhood Assoc.
Manchaca II Neighborhood Assoc.
Manchaca Village Neighborhood Assoc.
Marbry's Ridge Homeowners Assoc.
Martin Luther King Jr. Neighborhood Assoc.
Martin Luther King Jr./Airport Blvd. Sector
Matthews Lane Neighborhood Assoc.
McKinley Heights Neigh. Assoc.
McNeil Drive Neighborhood Assoc.
McNeil Estates Neighborhood Group
Meadow Creek Neighborhood Assoc.
Meadow Mountain P.O.A. #1, Inc.
Meadow Mountain PUD II-A
Meadowbrook Neighborhood Assoc.
Mesa Park Neighborhood Assoc.
Metcalfe Neighborhood Assoc.
METSA-NIC
Middle Bull Creek Neighborhood Assoc.
Milwood Neighborhood Assoc.
Mockingbird Hill Neigh. Assoc.
Montopolis Area Neighborhood Alliance
Mount Bonnell Shores/ Colorado Crossing
Mountain Trail Homeowners Assoc.
Mueller Neighborhoods Coalition
Neigh. Assoc. of SW Williamson County
Neighborhood of Westgate
North Acres Homeowners Assoc.
North Austin Civic Assoc.
North Austin Neighborhood Alliance
North Capitol Area Neighborhood Assoc.
North Cat Villas Assoc.
North Copperfield Neighborhood Assoc.
North Gracy Woods Neigh. Assoc.
North Growth Corridor Alliance
North Loop Neighborhood Assoc.
North Loop Neighborhood Planning Team
North Loop Neighborhood Planning Team Liaison - COA
North Oaks Neighborhood Assoc.
North Park Estates Homeowners Assoc.
North Shields
North Shoal Creek Neighborhood Assoc.
North University Neighborhood Assoc.
NorthEast Action Group
Northeast Walnut Creek Neighborhood Assoc.
Northfield Neighborhood Assoc.
Northgate Neighborhood Assoc.
Northwest Austin Civic Assoc.
Northwood Neighborhood Assoc.
Oak Deer Park Neighborhood Assoc.
Oak Hill Assoc. of Neighborhoods
Oak Hill Heights Neighborhood Assoc.
Oakmont Heights Neighborhood Assoc.
Old Austin Neighborhood
Old Enfield Homeowners Assoc.
Old Pecan Street Assoc.
Old Spicewood Springs Rd. Neighborhood Assoc.
Old Town Homeowners Assoc.
Old West Austin Neighborhood Assoc.
Onion Creek Homeowners Assoc.
Organization of Central East Austin Neighborhoods
Overland Park Homeowners Assoc.
Palomino Park Homeowners Assoc.
Park at Quail Creek Homeowners Assoc.
Park Ridge Owners Assoc.
Park Springs Neighborhood Assoc.
Parkstone PUD Phasing Agreement

Parmer/ Avery Island Neighborhood Assoc.
Pecan Springs - Springdale Neighborhood Assoc.
Pedernales Neighborhood Assoc.
Pemberton Heights Neighborhood Assoc.
Penick Place Neighborhood Assoc.
Peninsula at Lake Austin Homeowners Assoc.
Peppertree Parkway Neighborhood Assoc.
Pioneer Crossing West Homeowners Assoc.
Plantation Neighborhood Assoc.
Prairie Dove Neigh. Organization
Preston Oaks Owners Assoc.
Ranch Road 620 Neighborhood Assoc.
Rattan Creek Neighborhood Assoc.
Richland Estates Neighborhoods Assoc. Inc.
The Ridge at Scofield Homeowners Assoc.
Ridge at Barton Creek Homeowners Assoc. (The)
Ridge at Grandview Hills
Ridgelea Neighborhood Assoc.
Ridgetop Neighborhood Assoc.
Rio Lado Neighborhood Assoc.
River Bluff Neighborhood Assoc.
River Hills Neighborhood Assoc.
River Oaks Lakes Estates Neighborhood
River Place Residential Community Assoc., Inc.
Riverside Farms Road Neighborhood Assoc.
Riviera Springs Community Development Assoc.
Rob Roy Home Owners' Assoc. Inc.
Rob Roy on the Creek Homeowners Assoc., Inc.
Rob Roy on the Lake Section ll Owners' Assoc. Inc.
Robertson Hill Neighborhood Organization
Rosedale Neighborhood Assoc.
Rosewood Courts Neighborhood Assoc.
Salem Walk Assoc. of Neighbors
Salina Neighborhood Assoc.
Santa Rita Neighborhood Assoc.
Saucedo Street Neighborhood Assn
Scenic Brook Neigh. Assoc.
Scofield Farms Residents Assoc.
Scofield Residential Owners Assoc.
Scofield Ridge Condominiums
Sendera Homeowners Assoc.
Sentral Plus East Austin Koalition
Shadow Bend Neighborhood Assoc.
Shady Hollow Homeowners Assoc.
Shenandoah Neighborhood Assoc.
Shepherd Mountain Homeowners Assoc.
Shoal Crest Neighborhood Assoc.
Silverstone Neighborhood Assoc.
Ski Slope Neighborhood Assoc.
Skyview Neighborhood Assoc.
Slaughter Lane Neighborhood Assoc.
South Austin Commercial Alliance
South Bank Alliance
South Bee Cave Woods Neigh. Assoc.
South Boggy Creek Neigh. Assoc.
South by Southeast Neighborhood Organization
South Central Coalition
South Lamar Neighborhood Assoc.
South River City Citizens Assoc.
Southeast Austin Neighborhood Alliance
Southeast Austin Trails & Greenbelt Alliance
Southeast Corner Alliance of Neighborhoods
Southeast Neighborhood Planning Contact Team
Southwest Austin Neighborhood Assoc.
Southwest Oaks-Shiloh Neighborhood Assoc.
Southwood Neighborhood Assoc.

Spicewood Estates Homeowners' Assoc.
Spicewood Hills Neighborhood Assoc.
Spicewood on Bull Creek Homeowners Assoc.
Springfield Village Homeowners Assoc.
St. Johns Advisory Board
St. Johns Neighborhood Assoc.
Steiner Ranch Residential Owners Assoc.
Stone Gate Neigh. Assoc.
Stonegate Neigh. Assoc.
Stoneridge Neighborhood Assoc.
Stratford Drive Neigh. Assoc.
Summerwood II Homeowners Assoc. of Austin Inc.
Summit Oaks Neighborhood Assoc.
Summit Oaks Sec 2 Neighborhood Assoc.
Sunchase Homeowners Assoc. Inc.
Sunridge Homeowners Assoc.
Sunrise Country
Sunset View Neigh. Assoc.
Swansons Ranch Rd. Neighborhood Assoc.
Swede Hill Neighborhood Assoc.
Sweetbriar I
Taking Action Inc.
Tanglewild Estates Neighborhood Assoc.
Tanglewood Estates Neighborhood Assoc.
Tanglewood Forest Neighborhood Assoc.
Tanglewood Oaks Owners Assoc.
Tarrytown Boat Club
Ten on Wood Trail Owners Assoc., Inc.
Terrell Lane Interceptor Assoc.
Texas Oaks (Section 6) Neighborhood Assoc.
Texas Oaks North Neighborhood Assoc.
Texas Oaks South Neighborhood Assoc.
The Bluffs at Milwood Homeowner Assoc. Inc.
The Chestnut Neighborhood Planning Team
The Holly Group
The Island on Westlake Owners Assoc.
The New Villages at Western Oaks Owners Assoc., Inc
The Parke Homeowners Assoc.
The Village at Kinney Court
The Woodlands of Austin, Inc
The Woods of Westlake Heights
Thurmond Heights Neighborhood Assoc.
Tillery Square Neighborhood Assoc
Towers of TownLake Condominium Assoc.
Travis Country Community Service Assoc.
Travis Country West Home Owners Assoc.
Treemont Homeowners Assoc., Inc.
Truman Heights Neighborhood Assoc.
UBC Neighborhood Planning Team Contact
University Area Partners
University Hills Neighborhood Assoc.
Upper Boggy Creek Neighborhood Planning Team
Upper Boggy Creek Neighborhood Planning Team Contact
Upper Bull Creek Neighborhood Assoc.
Valley Oaks and more Neighborhood Assoc.
Victory Hill Neighborhood Assoc.
Village at Western Oaks Neigh. Assoc.
Villages Neighborhood Assoc.
Villages of Shady Hollow Homeowners Assoc. (The)
Villas of Coronado Hills Homeowner's Assoc.
Vista Grande Homeowners Assoc.

Volente Neighborhood Assoc.
Walnut Creek Neighborhood Assoc., Inc.
Walnut Crossing Neigh. Assoc.
Walnut Place Neighborhood Assoc.
Walsh-Tarlton Neighborhood Assoc.
Waterford Place Homeowners Assoc.
West Austin Neighborhood Group
West Campus Neighborhood Assoc.
West End Austin Alliance
West University Neighborhood
Westbridge Homeowners Assoc.
Westcliff Homeowners Assoc.
Westcreek Neighborhood Assoc.
Western Oaks Neighborhood Assoc.
Western Trails Neigh. Assoc.
Westgate Blvd./Jones Rd. Neighborhood Assoc.
Westminister Manor Residents' Assoc.
Westview Estates Homeowners Assoc.
Westview on Lake Austin, Phase A
Wilshire Wood-Delwood I Neighborhood Assoc.
Windsor Hills Neighborhood Assoc.
Windsor Park Neighborhood Assoc.
Woodcliff Homeowners Assoc.
Woodcliff Neighborhood Assoc.
Woods of Legend Oaks
Woods of Westlake Hill Top
Wooten Neighborhood Assoc.
Wyldwood-Kellywood Neighborhood Assoc.
Wynnrock Area Neighborhood Assoc.
Yaupon Bluffs Community Assoc.
Zilker Neighborhood Assoc.

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Appendices

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Appendix A. Requirements for obtaining an application for reclaimed water service with the Austin Water Utility.

General Requirements

- The user shall use the reclaimed water in accordance with this agreement, City ordinances, and TAC Chapter 210 relating to reclaimed water.

- The City of Austin will not be liable for misapplication of reclaimed water by users.

- The City of Austin may conduct periodic audits of appropriate controls implemented by reclaimed water users.

- There shall be no nuisance conditions resulting from the user's distribution, use, and/or storage of reclaimed water.

- Use of hose bibs and faucets are prohibited unless specifically approved by the City of Austin, Austin Water Utility, Director.

- Backflow prevention devices shall be installed on both the reclaimed service line (double check valve assembly) and the potable water service line (reduced pressure backflow assembly).

- One of the following requirements must be met by the user for any area where reclaimed water is stored or where there exist hose bibs or faucets: Signs having a minimum size of eight inches shall be posted at all storage areas and on all hose bibs and faucets reading, in both English and Spanish, "Reclaimed Water, Do Not Drink" and "Agua Reclamada, No Tome el Agua" or similar warning; or the area shall be secured to prevent access by the public.

- The reclaimed water user shall provide reasonable control of the application rates for reclaimed water applied to irrigation areas. These controls shall encourage the efficient use of reclaimed water and avoid excessive application of reclaimed water that results in surface runoff or excessive percolation below the root zone.

- A user is responsible for ensuring that reclaimed water overflow, crop stress, and undesirable soil contamination by salt does not occur.

- All exposed piping and piping within a building shall be purple. All buried piping installed after the effective date of these rules shall be one of the following: manufactured in purple, purple fusion-bonded epoxy coated, or bagged in purple. All exposed piping should be stenciled in white with a warning reading "Non-Potable Water."

Appendix A Continued.

- A user may not resell, trade or transfer reclaimed water to any other person or legal entity. The user is also prohibited from conveying reclaimed water to any other premises or location.

- The user is solely responsible for any private distribution system costs, including the initial construction cost, and operation and maintenance of the private reclaimed water system on the user’s property.

- A user may construct storage facilities for reclaimed water. Storage facilities shall be designed, constructed, and operated in accordance with 30 TAC, Chapter 210.

- Reclaimed water shall not be utilized in a way that degrades ground water quality to a degree adversely affecting its actual or potential uses.

- Reclaimed water managed in storage ponds must be prevented from discharge into waters in the state, except for discharges directly resulting from rainfall events or in accordance with a permit issued by the Texas Commission on Environmental Quality (TCEQ). All other discharges are unauthorized. If any unauthorized overflow of a storage pond occurs causing discharge into or adjacent to waters in the state, the user shall report any non-compliance within five working days to the TCEQ and to the City of Austin.

- Irrigation sites must be maintained with a vegetative cover or be under cultivation during times when reclaimed water is applied. Distribution systems must be designed to prevent operation by unauthorized personnel. Irrigation operations shall be managed in a manner to minimize the inadvertent contact of reclaimed water with humans. Operational or tail water controls shall be provided to preclude discharge of reclaimed water from irrigation sites.

- Food crops that may be consumed raw by humans shall not be spray irrigated. Food crops including orchard crops that will be substantially processed prior to human consumption may be spray irrigated. Other types of irrigation that avoid contact of reclaimed water with edible portions of food crops are acceptable.

Appendix B. Operations and Maintenance Plan for obtaining reclaimed water service from the Austin Water Utility

Labeling and Separation

- To indicate that reclaimed water is in use at least one sign, in both English and Spanish, shall be posted on the property and at each storage area, hose bib, and faucet reading “Reclaimed Water, Do Not Drink” and “Agua Reclamada, No Tome el Agua.”

- All exposed piping and piping within a building shall be either manufactured in purple or painted purple and shall be stenciled in white with a label reading “Non-Potable Water.”

- All buried piping installed after the effective date of these rules shall be one of the following: manufactured in purple, painted purple, taped with purple metallic tape, or bagged in purple.

Unauthorized Access

- Distribution systems shall be designed to prevent operation by unauthorized personnel.

Transfers and Use

- The reclaimed water user shall provide reasonable control of the application rates for reclaimed water. These controls shall encourage the efficient use of reclaimed water and avoid excessive application of reclaimed water.
- Irrigation practices shall be designed to prevent incidental ponding or standing water.
- There shall be no application of reclaimed water when the ground is saturated or frozen.

Minimizing Human Exposure

- Backflow prevention devices shall be installed on both the reclaimed service line and the potable water service line.
- Irrigation operations shall be at night or when the potential for human contact is low.
- Irrigation rates and times shall be managed to minimize “wet grass” conditions in unrestricted landscaped areas during the periods the area could be in use.

Appendix B Continued.

- Irrigation systems shall be designed so that the irrigation spray does not reach any privately owned premises outside the designated irrigation area or reach public drinking fountains.

Routine Maintenance

- Broken equipment shall be repaired promptly.

Training and Safety

- Backflow prevention devices shall be inspected annually per City of Austin's ordinances.

Contingency Plan

- Any unauthorized reclaimed water discharge into or adjacent to waters in the state shall be reported to the City of Austin Water Utility and the Texas Commission on Environmental Quality within five working days of becoming aware of the discharge.

Appendix C. Rare species, statuses, and habitat types occurring in eight counties.

The list represents a combination of lists provided by both the U.S. Fish and Wildlife Service and Texas Parks and Wildlife. Any discrepancies were reconciled by deferring to the list provided by the U.S. Fish and Wildlife Service.

BURNET COUNTY	Federal Status[1]	State Status[1]
ARACHNIDS		
Bee Creek Cave Harvestman (*Texella reddelli*) - small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties	E	
BIRDS		
American Peregrine Falcon (*Falco peregrinus anatum*) - year-round resident and local breeder in west Texas; nests in tall cliff eyries; also, potential migrant, and can be found in urban areas, concentrations along coast and barrier islands; stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DM	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) - near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T
Black-capped Vireo (*Vireo atricapillus*) - oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover	E	E
Golden-cheeked Warbler (*Dendroica chrysoparia*) - juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction	E	E
REPTILES		
Texas Horned Lizard (*Phrynosoma crnutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees		T

LLANO COUNTY		
BIRDS		
American Peregrine Falcon (*Falco peregrinus anatum*) - year-round resident and local breeder in west Texas; nests in tall cliff eyries; also, potential migrant, and can be found in urban areas, concentrations along coast and barrier islands; stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DM	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) - near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T

LLANO COUNTY	Federal Status[1]	State Status[1]
Black-capped Vireo (*Vireo atricapillus*) - oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover	E	E
Golden-cheeked Warbler (*Dendroica chrysoparia*) - juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction	E	E
Zone-tailed Hawk (*Buteo albonotatus*) - arid open country; deciduous or pine-oak woodland, mesa or mountain county, often near watercourses, and wooded canyons and tree-lined rivers along middle-slopes of desert mountains; nests in various habitats and sites, ranging from small trees in lower desert, giant cottonwoods in riparian areas, to mature conifers in high mountain regions		T
REPTILES		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees		T

TRAVIS COUNTY		
AMPHIBIANS		
Barton Springs Salamander (*Eurycea sosorum*) - dependent upon water flow/quality from the Barton Springs segment of the Edwards Aquifer; only known from the outlets of Barton Springs	E	E
ARACHNIDS		
Bee Creek Cave Harvestman (*Texella reddelli*) - small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties	E	
Bone Cave Harvestman (*Texella reyesi*) - small, blind, cave-adapted harvestman endemic to a few caves in Travis and Williamson counties	E	
Tooth Cave Pseudoscorpion (*Tartarocreagris texana*) - small, cave-adapted pseudoscorpion known from small limestone caves of the Edwards Plateau	E	
Tooth Cave Spider *(Neoleptoneta myopica*) - very small, cave-adapted, sedentary spider	E	
BIRDS		
American Peregrine Falcon (*Falco peregrinus anatum*) - year-round resident and local breeder in west Texas; nests in tall cliff eyries; also, potential migrant, and can be found in urban areas, concentrations along coast and barrier islands; stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DM	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) - near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T

TRAVIS COUNTY	Federal Status[1]	State Status[1]
Black-capped Vireo (*Vireo atricapillus*) - oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover	E	E
Golden-cheeked Warbler (*Dendroica chrysoparia*) - juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction	E	E
Whooping Crane (*Grus americana*) - potential migrant; winters in and around Aransas National Wildlife Refuge and migrates to Canada for breeding	E, EXPN	E
INSECTS		
Kretschmarr Cave Mold Beetle (*Texamaurops reddelli*) - small, cave-adapted beetle found under rocks buried in silt; small, Edwards Limestone caves in of the Jollyville Plateau, a division of the Edwards Plateau	E	
Tooth Cave Ground Beetle (*Rhadine persephone*) - resident, small, cave-adapted beetle found in small Edwards Limestone caves in Travis and Williamson counties	E	
REPTILES		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland		T

BASTROP COUNTY		
AMPHIBIANS		
Houston Toad (*Bufo houstonensis*) - endemic; sandy substrate, water in pools, ephemeral pools, stock tanks	E, CH	
BIRDS		
American Peregrine Falcon (*Falco peregrinus anatum*) - year-round resident and local breeder in west Texas; nests in tall cliff eyries; also, potential migrant, and can be found in urban areas, concentrations along coast and barrier islands; stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DM	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) - near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags; formerly nested in Texas, but no breeding records since 1960		T
FISHES		
Blue Sucker (*Cycleptus elongatus*) - inhabits channels and flowing pools with a moderate current		T

BASTROP COUNTY	Federal Status^1	State Status^1
REPTILES		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland		T
PLANTS		
Navasota ladies'-tresses (Spiranthes parksii) - cool, wet conditions (without hard frosts) between January and May provide ideal growing conditions for this orchid; often found in areas that are slightly wetter than surrounding areas of the landscape, although surface moisture may not be obvious.	E	E
FAYETTE COUNTY		
BIRDS		
American Peregrine Falcon (*Falco peregrinus anatum*) - year-round resident and local breeder in west Texas; nests in tall cliff eyries; also, potential migrant, and can be found in urban areas, concentrations along coast and barrier islands; stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DM	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) - near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including saltwater; usually roosts communally in tall snags; formerly nested in Texas, but no breeding records since 1960		T
REPTILES		
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto		T
COLORADO COUNTY		
AMPHIBIANS		
Houston Toad (*Bufo houstonensis*) - endemic; species sandy substrate, water in pools, ephemeral pools, stock tanks	E, CH	E
BIRDS		
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T

COLORADO COUNTY	Federal Status[1]	State Status[1]
Attwater's Greater Prairie-chicken (*Tympanuchus cupido attwateri*) - this county within historic range; endemic; open prairies of mostly thick grass one to three feet tall	E	E
Bald Eagle (*Haliaeetus leucocephalus*) - near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T
White-faced Ibis (*Plegadis chihi*) - freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk (*Buteo albicaudatus*) - near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags; formerly nested in Texas, but no breeding records since 1960		T
FISHES		
Blue Sucker (*Cycleptus elongatus*) - inhabits channels and flowing pools with a moderate current		T
MAMMALS		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas; bottomland hardwoods and large tracts of undeveloped forested areas		T
REPTILES		
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs		T
Smooth Green Snake (*Liochlorophis vernalis*) - Gulf Coastal Plain; mesic coastal shortgrass prairie vegetation; prefers dense vegetation		T
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees		T

WHARTON COUNTY		
BIRDS		
American Peregrine Falcon (*Falco peregrinus anatum*) - year-round resident and local breeder in west Texas; nests in tall cliff eyries; also, potential migrant, and can be found in urban areas, concentrations along coast and barrier islands; stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.	DM	E
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) –near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T

WHARTON COUNTY	Federal Status[1]	State Status[1]
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk (*Buteo albicaudatus*) – near coast on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral		T
Wood Stork (*Mycteria americana*) - forages in prairie ponds, flooded pastures or fields, ditches, and other shallow standing water, including salt-water; usually roosts communally in tall snags formerly nested in Texas, but no breeding records since 1960		T
MAMMALS		
Black Bear (*Ursus americanus*) – within historical range of Louisiana Black Bear in eastern Texas; bottomland hardwoods and large tracts of undeveloped forested areas		T
REPTILES		
Texas Horned Lizard (*Phrynosoma cornutum*) – open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs		T
MATAGORDA COUNTY		
BIRDS		
Arctic Peregrine Falcon (*Falco peregrinus tundrius*) - potential migrant		T
Bald Eagle (*Haliaeetus leucocephalus*) –near seacoasts, rivers, and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter	DM	T
Brown Pelican (*Pelecanus occidentalis*) – largely coastal and near shore areas, where it roosts on islands and spoil banks	E, DM	E
Piping Plover (*Charadrius melodus*) – wintering migrant along the Texas Gulf Coast; beaches and bayside mud or salt flats	T, CH	T
Reddish Egret (*Egretta rufescens*) - resident of the Texas Gulf Coast; brackish marshes and shallow salt ponds and tidal flats; nests on ground or in trees or bushes, on dry coastal islands in brushy thickets of yucca and prickly pear		T
Sooty Tern (*Sterna fuscata*) –breeding April-July		T
White-faced Ibis (*Plegadis chihi*) - prefers freshwater marshes, sloughs, and irrigated rice fields, but will attend brackish and saltwater habitats; nests in marshes, in low trees, on the ground in bulrushes or reeds, or on floating mats		T
White-tailed Hawk (*Buteo albicaudatus*) – near coast it is found on prairies, cordgrass flats, and scrub-live oak; further inland on prairies, mesquite and oak savannas, and mixed savanna-chaparral		T

MATAGORDA COUNTY	Federal Status[1]	State Status[1]
Whooping Crane *(Grus americana*) - potential migrant; winters in and around Aransas National Wildlife Refuge and migrates to Canada for breeding	E, EXPN	E
MAMMALS		
Black Bear (*Ursus americanus*) - within historical range of Louisiana Black Bear in eastern Texas; bottomland hardwoods and large tracts of undeveloped forested areas		T
REPTILES		
Green Sea Turtle *(Chelonia mydas*) - Gulf and bay system	T	T
Kemp's Ridley Sea Turtle *(Lepidochelys kempii*) - Gulf and bay system	E	E
Loggerhead Sea Turtle *(Caretta caretta*) – Gulf and bay system	T	T
Leatherback Sea Turtle (*Dermochelys coriacea*) – Gulf and bay system	E	E
Smooth Green Snake (*Liochlorophis vernalis*) - Gulf Coastal Plain; mesic coastal shortgrass prairie vegetation; prefers dense vegetation		T
Texas Horned Lizard (*Phrynosoma cornutum*) - open, arid and semi-arid regions with sparse vegetation, which could include grass, cactus, scattered brush or scrubby trees		T
Texas Scarlet Snake (*Cemophora coccinea lineri*) - mixed hardwood scrub on sandy soils		T
Texas Tortoise (*Gopherus berlandieri*) – open brush with a grass understory		T
Timber/Canebrake Rattlesnake (*Crotalus horridus*) - swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs		T

[1] E = Endangered
T = Threatened
AD = Proposed Delisting
EXPN = Experimental population; nonessential
CH = Critical habitat designated
DM = Delisted taxon, recovered, being monitored first five Years

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Appendix D. City of Austin Water Rate Impact Model

Alternative 1: No Federal Action

Year	Weighted Average Water Rate Per 1000 Gallons	Projected Reclaimed Use (af)	Projected Raw Water Withdrawals (af)	LCRA Payment	O&M of Potable Portion of Alternative	New Weighted Water Rate Per 1000 Gallons
2006	$3.26	2,952	168,645	$0	$0	$3.26
2007	$3.43	2,796	171,379	$0	$0	$3.43
2008	$3.69	2,939	174,037	$0	$0	$3.69
2009	$3.92	3,142	176,521	$0	$0	$3.92
2010	$4.17	3,250	179,326	$0	$0	$4.17
2011	$4.17	3,301	181,896	$0	$0	$4.17
2012	$4.30	3,327	184,715	$0	$996,313	$4.32
2013	$4.43	3,327	187,448	$0	$1,026,203	$4.44
2014	$4.56	3,327	190,404	$0	$1,056,989	$4.58
2015	$4.70	3,327	193,361	$0	$1,088,699	$4.71
2016	$4.84	3,327	196,430	$0	$1,121,360	$4.86
2017	$4.98	3,327	199,499	$0	$1,155,000	$5.00
2018	$5.13	3,327	202,679	$8,637,440	$1,189,650	$5.28
2019	$5.29	3,327	205,860	$9,433,736	$1,225,340	$5.45
2020	$5.45	3,327	209,153	$10,289,522	$1,262,100	$5.62
2021	$5.61	3,327	213,030	$11,292,806	$1,299,963	$5.79
2022	$5.78	3,327	217,019	$12,367,699	$1,338,962	$5.97
2023	$5.95	3,327	221,007	$13,496,922	$1,379,131	$6.16
2024	$6.13	3,327	225,108	$14,704,700	$1,420,505	$6.35
2025	$6.31	3,327	229,209	$15,972,796	$1,463,120	$6.55
2026	$6.50	3,327	233,534	$17,350,279	$1,507,013	$6.75
2027	$6.70	3,327	237,859	$18,796,035	$1,552,224	$6.96
2028	$6.90	3,327	242,296	$20,337,606	$1,598,791	$7.18
2029	$7.11	3,327	246,845	$21,980,179	$1,646,754	$7.40
2030	$7.32	3,327	251,394	$23,703,003	$1,696,157	$7.63
2031	$7.54	3,327	255,203	$25,331,207	$1,747,042	$7.86
2032	$7.76	3,327	259,012	$27,035,771	$1,799,453	$8.11
2033	$8.00	3,327	262,933	$28,848,426	$1,853,436	$8.36
2034	$8.24	3,327	266,853	$30,745,509	$1,909,040	$8.61
2035	$8.48	3,327	270,886	$32,760,811	$1,966,311	$8.88
2036	$8.74	3,327	275,031	$34,900,629	$2,025,300	$9.15
2037	$9.00	3,327	279,176	$37,139,353	$2,086,059	$9.43
2038	$9.27	3,327	283,433	$39,514,162	$2,148,641	$9.72
2039	$9.55	3,327	287,690	$41,998,035	$2,213,100	$10.02
2040	$9.84	3,327	292,171	$44,665,765	$2,279,493	$10.33
2041	$10.13	3,327	297,072	$47,591,670	$2,347,878	$10.65
2042	$10.43	3,327	302,085	$50,690,267	$2,418,314	$10.97
2043	$10.75	3,327	306,118	$53,595,513	$2,490,864	$11.31
2044	$11.07	3,327	311,383	$57,065,095	$2,565,589	$11.66
2045	$11.40	3,327	316,760	$60,735,415	$2,642,557	$12.02
2046	$11.74	3,327	322,249	$64,616,620	$2,721,834	$12.39
2047	$12.10	3,327	327,738	$68,676,035	$2,803,489	$12.77
2048	$12.46	3,327	333,339	$72,965,442	$2,887,594	$13.16
2049	$12.83	3,327	339,053	$77,496,325	$2,974,221	$13.56
2050	$13.22	3,327	344,878	$82,280,691	$3,063,448	$13.98

Appendix D. Continued

Alternative 2: Wastewater Facility Reuse Expansion via Satellite Systems Construction

Year	Weighted Average Water Rate Per 1000 Gallons	Projected Reclaimed Use (af)	Projected Raw Water Withdrawals (af)	LCRA Payment	O&M of Potable Portion of Alternative	New Weighted Water Rate Per 1000 Gallons
2006	$3.26	2,952	168,645	$0	$0	$3.26
2007	$3.43	2,796	171,379	$0	$0	$3.43
2008	$3.69	2,939	174,037	$0	$0	$3.69
2009	$3.92	3,466	176,198	$0	$0	$3.92
2010	$4.17	4,091	178,486	$0	$0	$4.17
2011	$4.17	4,641	180,556	$0	$0	$4.17
2012	$4.30	5,181	182,861	$0	$892,343	$4.31
2013	$4.43	5,584	185,190	$0	$895,842	$4.44
2014	$4.56	5,913	187,818	$0	$903,127	$4.58
2015	$4.70	6,298	190,390	$0	$906,679	$4.71
2016	$4.84	6,707	193,049	$0	$908,033	$4.85
2017	$4.98	7,099	195,726	$0	$909,785	$5.00
2018	$5.13	7,487	198,519	$0	$911,129	$5.15
2019	$5.29	7,807	201,380	$8,677,159	$916,408	$5.43
2020	$5.45	8,083	204,396	$9,462,137	$924,256	$5.60
2021	$5.61	8,305	208,052	$10,400,870	$935,760	$5.78
2022	$5.78	8,489	211,856	$11,415,061	$949,973	$5.96
2023	$5.95	8,649	215,685	$12,485,235	$966,030	$6.14
2024	$6.13	8,792	219,643	$13,634,720	$983,602	$6.33
2025	$6.31	8,927	223,609	$14,843,508	$1,002,000	$6.53
2026	$6.50	9,056	227,805	$16,160,309	$1,021,115	$6.73
2027	$6.70	9,163	232,023	$17,547,575	$1,042,442	$6.94
2028	$6.90	9,255	236,368	$19,031,278	$1,065,380	$7.16
2029	$7.11	9,325	240,847	$20,618,745	$1,090,842	$7.38
2030	$7.32	9,380	245,341	$22,287,894	$1,118,328	$7.61
2031	$7.54	9,426	249,104	$23,862,586	$1,147,362	$7.85
2032	$7.76	9,465	252,873	$25,513,395	$1,177,824	$8.09
2033	$8.00	9,495	256,765	$27,272,882	$1,210,097	$8.34
2034	$8.24	9,518	260,663	$29,116,626	$1,243,921	$8.59
2035	$8.48	9,529	264,684	$31,079,935	$1,279,962	$8.86
2036	$8.74	9,533	268,825	$33,168,233	$1,317,914	$9.13
2037	$9.00	9,535	272,968	$35,354,420	$1,357,221	$9.41
2038	$9.27	9,535	277,225	$37,675,682	$1,397,938	$9.70
2039	$9.55	9,535	281,482	$40,104,400	$1,439,876	$10.00
2040	$9.84	9,535	285,963	$42,715,321	$1,483,072	$10.31
2041	$10.13	9,535	290,864	$45,582,713	$1,527,564	$10.63
2042	$10.43	9,535	295,877	$48,621,041	$1,573,391	$10.96
2043	$10.75	9,535	299,910	$51,464,210	$1,620,593	$11.29
2044	$11.07	9,535	305,175	$54,869,853	$1,669,210	$11.64
2045	$11.40	9,535	310,552	$58,474,317	$1,719,287	$12.00
2046	$11.74	9,535	316,041	$62,287,688	$1,770,865	$12.37
2047	$12.10	9,535	321,530	$66,277,235	$1,823,991	$12.75
2048	$12.46	9,535	327,131	$70,494,679	$1,878,711	$13.14
2049	$12.83	9,535	332,844	$74,951,439	$1,935,072	$13.54
2050	$13.22	9,535	338,669	$79,659,457	$1,993,125	$13.96

Appendix D. Continued

Alternative 3 (Preferred Alternative): Wastewater Facility Reuse Expansion via Transmission Main Extension

Year	Weighted Average Water Rate Per 1000 Gallons	Projected Reclaimed Use (af)	Projected Raw Water Withdrawals (af)	LCRA Payment	O&M of Potable Portion of Alternative	New Weighted Water Rate Per 1000 Gallons
2006	$3.26	2,952	168,645	$0	$0	$3.26
2007	$3.43	2,796	171,379	$0	$0	$3.43
2008	$3.69	3,482	173,493	$0	$0	$3.69
2009	$3.92	4,852	174,812	$0	$0	$3.92
2010	$4.17	6,050	176,526	$0	$0	$4.17
2011	$4.17	6,845	178,352	$0	$0	$4.17
2012	$4.30	7,407	180,634	$0	$0	$4.30
2013	$4.43	7,803	182,972	$0	$0	$4.43
2014	$4.56	7,970	185,761	$0	$0	$4.56
2015	$4.70	8,689	187,999	$0	$0	$4.70
2016	$4.84	9,926	189,831	$0	$0	$4.84
2017	$4.98	10,882	191,943	$0	$0	$4.98
2018	$5.13	11,821	194,185	$0	$0	$5.13
2019	$5.29	12,753	196,434	$0	$0	$5.29
2020	$5.45	13,414	199,065	$0	$0	$5.45
2021	$5.61	13,880	202,477	$9,402,087	$0	$5.75
2022	$5.78	14,253	206,092	$10,351,345	$0	$5.93
2023	$5.95	14,497	209,837	$11,373,648	$0	$6.12
2024	$6.13	14,867	213,569	$12,445,475	$0	$6.31
2025	$6.31	17,005	215,531	$13,214,585	$0	$6.50
2026	$6.50	19,904	216,958	$13,907,263	$0	$6.70
2027	$6.70	21,396	219,790	$14,930,465	$0	$6.91
2028	$6.90	22,343	223,280	$16,147,419	$0	$7.12
2029	$7.11	23,032	227,140	$17,507,819	$0	$7.34
2030	$7.32	23,364	231,357	$19,019,004	$0	$7.57
2031	$7.54	23,728	234,802	$20,418,914	$0	$7.81
2032	$7.76	24,246	238,093	$21,847,778	$0	$8.05
2033	$8.00	24,794	241,466	$23,364,752	$0	$8.29
2034	$8.24	25,316	244,864	$24,959,905	$0	$8.55
2035	$8.48	25,760	248,453	$26,681,340	$0	$8.81
2036	$8.74	25,982	252,376	$28,576,682	$0	$9.09
2037	$9.00	26,074	256,429	$30,599,378	$0	$9.37
2038	$9.27	26,111	260,649	$32,767,018	$0	$9.66
2039	$9.55	26,113	264,904	$35,047,727	$0	$9.96
2040	$9.84	26,113	269,385	$37,506,948	$0	$10.26
2041	$10.13	26,113	274,286	$40,218,089	$0	$10.58
2042	$10.43	26,113	279,299	$43,095,479	$0	$10.91
2043	$10.75	26,113	283,332	$45,772,881	$0	$11.24
2044	$11.07	26,113	288,597	$49,007,784	$0	$11.59
2045	$11.40	26,113	293,974	$52,436,385	$0	$11.95
2046	$11.74	26,113	299,463	$56,068,619	$0	$12.32
2047	$12.10	26,113	304,952	$59,871,594	$0	$12.70
2048	$12.46	26,113	310,553	$63,896,868	$0	$13.09
2049	$12.83	26,113	316,266	$68,155,694	$0	$13.49
2050	$13.22	26,113	322,091	$72,659,840	$0	$13.91

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Appendix E: List of Public Meeting Attendees

December 11, 2003

Name	Organization
Myron Hess	National Wildlife Federation
Elisabeth Welsh	Austin Youth River Watch
Mark Treviño	Bureau of Reclamation
Deborah Blackburn	Bureau of Reclamation
Geneva Oliva	PODER
Catalina Herrera	PODER
Dora Rivera	PODER
Laurie Lentz	City of Austin-Water Utility
Rebecca Cobos	City of Austin-Water Utility
Myron “Rusty” Osborne	University of Texas at Austin
Dan Pedersen	City of Austin-Presenter

July 26, 2005

Lisa Sandy	City of Austin-Water Utility
Collin Balcombe	Bureau of Reclamation
Deborah Blackburn	Bureau of Reclamation
Jennifer Walker	Sierra Club
Ashley Ladd	Bureau of Reclamation
Dick Finnegan	City of Austin-Parks and Recreation
Scott Dukette	Klotz Associates
Odette Tan	Klotz Associates
Nora Mullarkey	Lower Colorado River Authority
Matt Berg	CH_2M Hill
Dan Pedersen	City of Austin-Presenter

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Correspondence

Comments and Responses

RECLAMATION
Managing Water in the West

Draft Finding of No Significant Impact

Austin SWIFT Loan Application
Part D, 65

Title XVI Wastewater Reuse Initiative, Austin, Texas

FONSI NUMBER:

Approved: ______________________________________ Date: ______________
Area Manager, Oklahoma-Texas Area Office

U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office
Austin, Texas

February 2008

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Draft Finding of No Significant Impact

Title XVI Wastewater Reuse Initiative, Austin, Texas
Great Plains Region

U.S. Department of the Interior
Bureau of Reclamation
Great Plains Region
Oklahoma-Texas Area Office
Austin, Texas
February 2008

BACKGROUND

The City of Austin (City) is proposing to expand its existing wastewater reuse infrastructure in order to provide a continuous and dependable alternative water supply for the future. The Bureau of Reclamation (Reclamation) is assisting the City in the development of a feasibility report to evaluate reuse alternatives, and Reclamation may provide a portion of funds for construction of associated facilities if Congress provides the necessary authorization and appropriations.

The *Reclamation Wastewater and Groundwater Study and Facilities Act*, Public Law 102-575, Title XVI as amended in 1992, directs the Secretary of the Interior (Secretary) to "*undertake a program to investigate and identify opportunities for reclamation and reuse of municipal, industrial, domestic, and agricultural wastewater, and naturally impaired ground and surface waters, for the design and construction of demonstration and permanent facilities to reclaim and reuse wastewater….*" Section 1604 further authorizes the Secretary to work with federal, state, regional, and local authorities to determine the feasibility of water reclamation and reuse projects that are identified in appraisal level reports. An Appraisal Report was completed in 2003 by the City and Reclamation, which concluded that there is a Federal interest in pursuing water reclamation and reuse investigations in Austin. Before Reclamation may participate in the financing or construction of the proposed project, compliance with the National Environmental Policy Act (NEPA) is required, and it was determined that an Environmental Assessment (EA) must be prepared to identify impacts resulting from the City's wastewater reuse initiative.

PURPOSE AND NEED

Growth and development of the City has placed a strain on water supply resources. Water demand is projected to exceed water supply by 2043[1], resulting in a water deficit. The City is expected to incur large water diversion costs by 2018[1] to meet these demands based on the payment structure of their water storage contract. This would limit funding for much needed capital improvements, including the expansion of existing water treatment facilities. The City's goal is to maximize the use of local water supplies, and provide a continuous and dependable source of supplemental water for the area. To meet this goal, there is a need to expand the City's existing recycled water program to serve additional areas in the central and southern part of the City.

PREFERRED ALTERNATIVE

The Preferred Alternative includes construction of approximately 117 miles of transmission main, one plant storage tank, six system storage tanks, and five pump stations to be installed throughout the City. The Preferred Alternative would result in an additional water savings of approximately 22,786 acre-feet/year. Reclamation has prepared an Environmental Assessment (EA) which

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[1] This is based on the City's most recent modeling efforts.

analyzes the potential impacts of this and other alternatives. The Draft EA is hereby made part of this finding by attachment.

CONCLUSIONS OF FACT

Based on the evidence presented in the Draft EA, I have drawn the following conclusions about the potential impacts of the Preferred Alternative:

Environmental Effects

I find that the Preferred Alternative would have insignificant environmental effects.

- The project area would be located entirely within an urban setting and construction activities would almost exclusively impact previously disturbed areas.
- Direct impacts to groundwater resources would be limited to construction of a one-mile pipeline over the recharge zone in the Northern Segment of the Edwards Aquifer, and approximately 10 miles of pipeline over the Transition Zone. Water quality impacts would be minimal because activities would be subject to Edwards Aquifer protection and reclaimed water rules, as well as National Pollution Discharge Elimination System stormwater protection, all of which include pollution abatement plans and/or sedimentation/erosion control measures. Furthermore, construction would be completed over a several month time frame, and impacts would be localized and temporary.
- Indirect impacts to groundwater resources caused by irrigation over the Transition Zone in both the Northern and Barton Springs segments of the Edwards Aquifer would be minimal. In those areas, groundwater circulation is low, recharge to the aquifer is much less pronounced, and the risk of contamination is minimized due to impermeable geologic barriers. As well, reuse customers would be located in areas where directional flow occurs away from the recharge zone.
- Direct impacts on surface water quality from construction activities would be localized and temporary, and erosion control measures outlined in the Austin's City ordinance would be followed.
- Indirect impacts on surface water quality would be minimal and similar to that which would normally occur from WWTP releases into the Colorado River. Most irrigated reuse water would infiltrate into the ground, buffers would further reduce impacts to surface water resources, and all customers would be required to follow the terms and conditions of the Austin Water Utility's General Requirements for Reclaimed Water Users and Operations and Maintenance Plan.
- Indirect impacts on instream flows of the Colorado River would be minimal. Using environmental flow criteria established in the 1999 LCRA Water Management Plan at the Bastrop Gage, Water Availability Modeling (WAM) efforts predicted that removal of 22,786 acre-feet per year (af/yr) would have no impact on critical flow frequency, and only minor impacts on target flow frequency during both the Period of Record (POR) and Drought of Record (DOR).

- Indirect impacts on freshwater inflows into Matagorda Bay would be minimal. Using environmental flow criteria established in the 2006 Matagorda Bay Freshwater Inflow Needs Study, the WAM predicted that removal of 22,786 af/yr would result in minor changes in critical and target flow frequency during the POR and no changes during the DOR.
- Indirect impacts on the reservoir yield of Lakes Travis and Buchanan would be minimal because the Lower Colorado River Authority will likely utilize other water supply sources to supplement existing supplies. Furthermore, “demand-side” drought management strategies would likely result in a decrease in effluent demand, further minimizing impacts.
- Indirect impacts on climate change resulting from increased CO_2 emissions would be minor compared to emissions of the County as a whole.

Public Health or Safety

I find that public health and safety in the project area would not be affected by the Preferred Alternative.

- If properly managed, reclaimed water poses virtually no risk to human health. Fecal coliform levels, which indicate presence of harmful pathogens, would regularly be monitored in order to determine the adequacy of wastewater treatment and the integrity of the reclaimed distribution system. This would ensure compliance with reclaimed water standards outlined by TCEQ. As well, implementation of preventative actions would minimize contact with humans and subsequent impacts to health and safety.
- Construction-related impacts would be localized and temporary. All City ordinances on air and noise quality standards would be met, both for temporary construction activities and for ongoing noise generated by pump stations.

Unique Characteristics

I find that the Preferred Alternative would not affect refuges, park lands, prime and unique farmlands, wetlands, wild and scenic rivers, rivers in the national inventory, floodplains, or ecologically critical areas. During the EA analysis, the geographic area potentially affected by the project was surveyed for these unique characteristics, and each was found absent.

Controversial Effects

I find that the nature and extent of the potential effects to the quality of the human environment from the Preferred Alternative are not controversial. In ? 2008, Reclamation provided six Federal and State agencies, as well as approximately 470 organizations, businesses, and neighborhood associations with an opportunity to comment on the Draft EA. During the 45-day review period, Reclamation received comments indicating ?.

Uncertain Effects

Based on existing information, I find that the nature and extent of the potential effects to the quality of the human environment from the Preferred Alternative are known with high degree of certainty, and there are no unique risks associated with any aspect of the Preferred Alternative.

Precedent

I find that the Preferred Alternative would not establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration.

Cumulative Effects

I find that the Preferred Alternative is not related to other actions with individually insignificant but cumulatively significant impacts.

- Cumulative effects on instream flows of the Colorado River would be insignificant. According to the WAM, the addition of three draft water rights permits would have minimal impacts on median and average regulated flows, and these do not affect critical and target flow frequency.
- Cumulative effects on freshwater inflows into Matagorda Bay would be insignificant. According to the WAM, the addition of three draft water rights permits would result in cumulative decreases in average regulated flow across all months during the POR, but critical and target flows would remain primarily unchanged.
- No cumulative impacts would result on the combined firm yield of Lakes Travis and Buchanan. All three draft water right permits are junior to the refill dates outlined in existing water rights for Lakes Travis and Buchanan. Furthermore, permit conditions placed by TCEQ on draft permits require target environmental flow criteria to be met at all times, and permits cannot reduce the combined firm yield if it cannot reduce, refill, or produce environmental deficits.
- With regards to direct or indirect cumulative impacts on all other resources, no other actions were identified that either could be measurably calculated without speculation or were within the same time and geographic space such that a measurable, combined impact actually exists.

Historical and Cultural Resources

I find that the Preferred Alternative would not significantly nor adversely affect any district, site, highway, structure or object listed in or eligible for listing in the National Register of Historic Places.

- The Preferred Alternative may affect fifteen Archeological Sites and eight National Historic Districts. As accurate locations for excavation and construction are mapped out, Texas law requires the City of Austin to identify and protect the State Archeological Landmarks and Recorded Texas Historical Landmarks in accordance with the Antiquities Code of Texas, and to consult with the Texas SHPO on effects of all future ground disturbing activities. As a result of that consultation, some design changes or mitigation may be required to protect sites potentially impacted by construction. Overall, these mandates would minimize any impacts to cultural resources.

Endangered Species

I find that the Preferred Alternative would not adversely affect any species listed under the Endangered Species Act as threatened or endangered, nor any designated critical habitat. Upon review of the project, the U.S. Fish and Wildlife Service concurs that the Preferred Alternative is not likely to adversely affect the 12 threatened and endangered species, or their designated critical habitat, that occur within the project area.

Other Laws

I find that the Preferred Alternative would be consistent with Federal, State and local laws, as well as requirements imposed for the protection of the environment.

- The Migratory Bird Treaty Act would not be violated because woody vegetation, including trees, would be avoided during construction and only a minimal loss would occur. If construction does occur within the migratory bird breeding season and potential migratory bird habitat exists, surveys for nests would be required and avoidance of impacts would be mandated by federal law.
- Any impacts on invasive or nonnative species would be mitigated by reseeding areas to their original vegetative composition in order to prevent both the spread of existing invasive species and the establishment of pioneer invasives.
- Only minimal aesthetic or visual impacts would occur. The City must follow zoning and development ordinances and procedures, including buffer yards, landscaping, compatible uses, etc. Approval of all reclaimed system construction contracts would be a public process, allowing public input into project development.
- Due to the absence of Native American Trust Assets in the region, no affect would occur on associated resources by any of the alternatives analyzed.
- A total of 91 census tracts would be impacted. Forty-one are considered minority populations; one is considered low-income. No storage tanks, and less than one mile of transmission main would be installed within a low-income population. Only two out of the seven storage tanks would be installed within minority populations. Although a greater length of transmission mains would be installed within minority populations compared to the general public, the difference between the two amounts is very small and not considered disproportionately high, especially in the context of environmental impacts. Therefore, the risks of exposure to environmental impacts from installation of transmission mains and storage tanks would not appreciably exceed those occurring to the general public.

FINDING OF NO SIGNFICANT IMPACT

Based on the evidence presented in the Final EA and upon the conclusions of fact presented above, I find that the Preferred Alternative would not significantly affect the quality of the human environment and the preparation of an environmental impact statement is not warranted.

Cooke, Heather

From: Balcombe, Collins <cbalcombe@usbr.gov>
Sent: Monday, May 09, 2016 1:35 PM
To: Pedersen, Dan
Cc: mtrevino@usbr.gov; Cooke, Heather
Subject: Re: City of Austin FONSI and EA

Follow Up Flag: Follow up
Flag Status: Flagged

Austin SWIFT Loan Application Part D, 65

Dan,
My apologies for not getting back with you. If you recall, the EA was never finalized because our policy requirements changed during the middle of the feasibility study such that we were able to approve the feasibility study without needing a FONSI/EA (Note: before that time, we did require a FONSI/EA in order to approve Title XVI feasibility studies). Therefore, the City of Austin believed (and rightly so) that there was no need to put the added time, $$, and effort to finalizing an EA and issuing a FONSI that was not even needed anymore. Recall that the National Wildlife Federation had major concerns with our analysis and that much work still needed to be done to address their comments. At the time, it was seen as a win-win. We approved your report w/out having to complete a potentially controversial EA/FONSI.

Call me if you need to discuss this further. FYI - I do have correspondence from the USFWS concurring that the project, as proposed back in 2006, would not have impacts to Federally T&E species (if that helps).

Collins K. Balcombe
Supervisory Program Coordinator
Oklahoma-Texas Area Office
5316 Hwy 290 W. Ste 110
Austin TX 78745
512.899.4162 (wk); 512.922.0525 (cell)
cbalcombe@usbr.gov

On Mon, May 9, 2016 at 1:16 PM, Pedersen, Dan <Dan.Pedersen@austintexas.gov> wrote:

Collins,

I left a message on your phone and spoke briefly with Mark on Friday. The Austin Water is likely to get $40 million in low interest loans from the TWDB for construction of its reclaimed program. The application asks whether or not a FONSI or EA has been done. I have a copy of drafts of these from our Title XVI work, but not the signed originals. Can you send me a copy of those? Electronic versions would be best, but I can stop by and pick them up if that is easier.

Dan W Pedersen, PE

Reclaimed Program Manager

512-972-0074

“Using Purple to Keep Austin Green”

City of Austin SWIFT Loan Application for Reuse Projects - TWDB Project 51041
Proposed Project Schedules as of June 21, 2016 - Subject to Change

2016 Region K Plan - Austin Direct Reuse Strategy Projects	Austin Reference # (E-Capris Subproject)	Design Engineer Consultants	Construction Contractor	End of Planning Phase (Design Start)	Design Phase Complete	Start of Construction	Construction Completion
South Austin Regional WWTP Tertiary Filter Improvements	3333.015	AECOM	Matous	April 2011	Sept 2015	March 2016	Oct 2018
Walnut Creek WWTP Tertiary Filter Rehabilitation	3023.025	Black & Veatch	TBD	Dec 2012	July 2016	Nov 2016	Feb 2020
Burleson Road Reclaimed Water Pressure Conversion	5267.036	K. Friese & Assoc	TBD	Oct 2013	Jan 2016	Jan 2017	March 2018
Montopolis Reclaimed Water Reservoir and Pump Station	5267.035	CH2M Hill	TBD	Dec 2013	July 2016	Jan 2017	June 2018
Decker Lane Reclaimed Main Phase 1	5267.049	Chan & Partners	TBD	June 2015	June 2017	Jan 2018	May 2020
Onion Creek Reclaimed Water Main Phase 1	5267.025	Davcar Engineering	TBD	Oct 2016	Oct 2017	May 2018	May 2020
Cemetery Reclaimed Water Main	5267.037	TBD	TBD	Oct 2016	Dec 2017	June 2018	Oct 2019
Onion Creek Reclaimed Water Main Phase 2	5267.061	TBD	TBD	Oct 2019	Dec 2020	July 2021	Nov 2022

City of Austin SWIFT Loan Applications, Part E, #69 - Projects 51041 and 51042

Requested Loan Closing Schedule for Multi-Year Commitments - June 2, 2016 REVISED
Direct Reuse and Conservation Strategies

Direct Reuse Strategy Projects (51041)

		Calendar Year 2016	**Calendar Year 2017**	**Calendar Year 2018**	**Calendar Year 2019**	**Calendar Year 2020**	**Calendar Year 2021**	**Calendar Year 2022**		
Direct Reuse Project Name	Austin ID #	Austin FY 17	Austin FY18	Austin FY19	Austin FY20	Austin FY21	Austin FY22	Austin FY23	**Reuse Totals**	
Walnut Creek WWTP Tertiary Filter Rehabilitation	3023.025	5,075,547	6,000,000	4,900,000	2,525,000	1,500,000			20,000,547	
South Austin Regional WWTP Tertiary Filter Improvements	3333.015	4,402,453	6,000,000	6,000,000	6,000,000	5,930,000			28,332,453	
Onion Creek Reclaimed Water Main Phase 1	5267.025	530,000	1,155,000	1,835,000	1,610,000				5,130,000	
Montopolis Reclaimed Water Reservoir and Pump Station	5267.035	5,285,000	4,695,000	1,050,000	120,000				11,150,000	
Burleson Road Reclaimed Water Pressure Conversion	5267.036	3,970,000	1,360,000	240,000					5,570,000	
Cemetery Reclaimed Water Main	5267.037	150,000	625,000	1,620,000	1,570,000	560,000			4,525,000	
Decker Lane Reclaimed Main Phase 1	5267.049	1,015,000	2,755,000	2,402,000	300,000				6,472,000	
Onion Creek Reclaimed Water Main Phase 2	5267.061	-		95,000	435,000	1,120,000	1,925,000	2,225,000	5,800,000	
	TOTALS	**20,428,000**	**22,590,000**	**18,142,000**	**12,560,000**	**9,110,000**	**1,925,000**	**2,225,000**	**86,980,000**	**Direct Reuse Total**

Conservation Strategy - Advanced Meter Infrastructure (AMI) Project (51042)

	Calendar Year 2016	**Calendar Year 2017**	**Calendar Year 2018**	**Calendar Year 2019**	**Calendar Year 2020**	**Calendar Year 2021**	**Calendar Year 2022**		
Austin ID #	Austin FY 17	Austin FY18	Austin FY19	Austin FY20	Austin FY21	Austin FY22	Austin FY23	**AMI Total**	
6935.057	-	**5,195,000**	**10,000,000**	**10,000,000**	**10,000,000**	**25,000,000**	**20,000,000**	**80,195,000**	**AMI Total**

Combined Totals (Reuse & AMI)	**TOTALS**	**20,428,000**	**27,785,000**	**28,142,000**	**22,560,000**	**19,110,000**	**26,925,000**	**22,225,000**	**167,175,000**	**Combined Total**
Requested Loan Closing Dates		**Dec 2016**	**Dec 2017**	**Dec 2018**	**Dec 2019**	**Dec 2020**	**Dec 2021**	**Dec 2022**		

This proposed schedule is based on the assumption that the City of Austin will borrow a total of $167 million through Calendar Year 2022 (Austin's Fiscal Year 2023) for the AMI project and all of the Direct Reuse projects listed on this spreadsheet. If the total loan amout will be lower, adjustments may be needed to this schedule.

Austin's Fiscal Year starts on October 1 and ends on September 30. Austin is assuming that loan closings will occur between October 1 and December 31 of each year.

CITY OF AUSTIN
$86,980,000 TWDB Loan, Fall 2016 Close
20 year Debt Service - ESTIMATE*

City of Austin - Austin Water
SWIFT Loan - Reuse Project 51041
Principal Maturity Schedule

Payment Date	Principal Payment	Interest Payment	Total	Fiscal Year Total
05/15/17	$ -	$ 701,950	$ 701,950	$ 701,950
11/15/17	3,914,100	701,950	4,616,050	
05/15/18	-	689,230	689,230	5,305,280
11/15/18	3,914,100	689,230	4,603,330	
05/15/19	-	674,943	674,943	5,278,273
11/15/19	3,914,100	674,943	4,589,043	
05/15/20	-	659,287	659,287	5,248,330
11/15/20	3,914,100	659,287	4,573,387	
05/15/21	-	641,673	641,673	5,215,060
11/15/21	3,914,100	641,673	4,555,773	
05/15/22	-	621,907	621,907	5,177,680
11/15/22	4,175,040	621,907	4,796,947	
05/15/23	-	598,944	598,944	5,395,891
11/15/23	4,175,040	598,944	4,773,984	
05/15/24	-	574,103	574,103	5,348,087
11/15/24	4,175,040	574,103	4,749,143	
05/15/25	-	547,174	547,174	5,296,317
11/15/25	4,175,040	547,174	4,722,214	
05/15/26	-	518,784	518,784	5,240,997
11/15/26	4,349,000	518,784	4,867,784	
05/15/27	-	487,688	487,688	5,355,472
11/15/27	4,349,000	487,688	4,836,688	
05/15/28	-	452,244	452,244	5,288,932
11/15/28	4,349,000	452,244	4,801,244	
05/15/29	-	413,755	413,755	5,214,999
11/15/29	4,349,000	413,755	4,762,755	
05/15/30	-	372,440	372,440	5,135,195
11/15/30	4,522,960	372,440	4,895,400	
05/15/31	-	327,210	327,210	5,222,610
11/15/31	4,609,940	327,210	4,937,150	
05/15/32	-	278,806	278,806	5,215,956
11/15/32	4,783,900	278,806	5,062,706	
05/15/33	-	226,661	226,661	5,289,367
11/15/33	4,870,880	226,661	5,097,541	
05/15/34	-	171,864	171,864	5,269,405
11/15/34	4,870,880	171,864	5,042,744	
05/15/35	-	115,605	115,605	5,158,349
11/15/35	4,870,880	115,605	4,986,485	
05/15/36	-	57,885	57,885	5,044,370
11/15/36	4,783,900	57,885	4,841,785	4,841,785
	$ 86,980,000	$ 18,264,304	$ 105,244,304	$ 105,244,304

City of Austin
Austin Water P.O. Box 1088 Austin, Texas 78767 (512) 972-0101

June 14, 2016

Jeff Walker
Executive Administrator
Texas Water Development Board
1700 North Congress Ave
Austin, Texas 78701

Subject: City of Austin SWIFT Loan for Reuse (Project 51041) – Water Loss Waiver Request

Dear Mr. Walker,

I am writing to request a waiver from the requirement in TWDB's water loss rule under Title 31, Texas Administrative Code, Part 10, Section 358.6(f) for the City of Austin's SWIFT loan application (Project 51041). This rule requires that part of TWDB's financing be used to mitigate water loss if the applicant's water loss exceeds certain thresholds established by TWDB. Project 51041 is a SWIFT loan application for several projects that will expand and improve Austin's reclaimed water system infrastructure, enabling us to serve more reclaimed customers. The Infrastructure Leakage Index (ILI) that Austin Water reported for 2014 of 3.17, was slightly above TWDB's water loss threshold of 3.0. For 2013, the ILI was 2.72, and for 2012, it was 2.06. In our most recent water loss audit, submitted to TWDB on April 26, 2016 for the 2015 calendar year, we reported an ILI of 3.65.

Austin Water has a mature and aggressive water loss control program, spanning all aspects of the TWDB mandated water loss audit. Under that program, we have continued our leak detection efforts on both our distribution mains and our transmission mains, having surveyed over 3400 miles of distribution mains and over 30 miles of transmission mains since 2011. We have maintained an average time to repair for all reported leaks of less than two days since 2012, reaching an average of 1.09 days in 2015. We have increased the frequency of large meter accuracy testing and repair efforts, raising the number of 3" and larger meters tested within the previous 12 months from 42% to 75% between 2014 and 2016. The Renewing Austin main replacement program focuses on replacing old water mains that have a high potential for failure and leakage. Since its launch in 2011, we have replaced over 51 miles of mains under almost 200 projects.

Since 2014, we have established two district metered area pilots to assist in identifying and reducing high rates of non-revenue water, and have reinstituted our small meter replacement program that focuses on old and high-usage meters to maximize savings. We performed an unparalleled small meter accuracy study where we pulled and tested over 700 meters, and data logged over 300 installed meters to accurately determine apparent losses. To track unmetered water, we have set up agreements with all City departments that use unmetered water to log and report their usage, implemented a system to track water used for flushing newly installed water mains, and have reinvigorated our off-meter consumption monitoring program. The main replacement portion of Renewing Austin and the leak detection programs alone have budgets totaling $17.04 million for FY16 and $14.59 million requested for our FY 17 proposed budget.

Given the above proactive water loss control efforts that Austin Water has implemented we are requesting that the significant resources Austin Water has dedicated to water loss reduction be considered as mitigation for the SWIFT loan for our reclaimed water project (Project 51041). Please let us know if you need any additional information. Our primary point of contact for this loan application is Heather Cooke who can be reached at 512-972-0083 or by email at heather.cooke@austintexas.gov. Thank you for your consideration of this request.

Sincerely,

Greg Meszaros
Director, Austin Water

CC: Chris Chen, Assistant Director, Engineering Services, Austin Water
Rick Coronado, Assistant Director, Operations and Maintenance, Austin Water