

# 2023 REGIONAL FLOOD PLAN REGION 6 SAN JACINTO

July 2023

PREPARED FOR THE SAN JACINTO  
REGIONAL FLOOD PLANNING GROUP



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**Appendix 5-4AN:  
Danubina BCA Memorandum**

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DATE: February 28<sup>th</sup>, 2023

TO: San Jacinto Regional Flood Planning Group

CC: City of Baytown; Texas Water Development Board

FROM: Evan Adrian, PE, CFM, ENV SP; Jacob Torres, PhD, PE, CFM, D.WRE; Cristian Ayala, EIT

PROJECT NO.: 10-220120-00

PROJECT: TWDB San Jacinto Regional Flood Plan

SUBJECT: Danubina Street Storm Sewer System Improvement Plan Benefit-Cost Analysis

The evaluation for the Danubina Street Storm Sewer System Improvement was conducted in 2020 as part of the CDBG-MIT Application prepared by the City of Baytown and Dannenbaum Engineering Corporation. The storm sewer system for Danubina Street was identified as a critical system due to excessive flooding during frequent storm events. The proposed project objective is to help mitigate flooding concerns for more frequent rainfall events while reducing flooding risks for the 100-year storm event. The improvements include improving the Hull Gully channel, detention, and storm sewer improvements along Hunnicutt Street. The CDBG-MIT Application is included as **Appendix 1**.

The Texas Water Development Board (TWDB) requires each Flood Mitigation Project (FMP) included in a regional flood plan to have a benefit/cost analysis (BCA) performed. The CDBG-MIT Application prepared by the City of Baytown and Dannenbaum Engineering Corporation did not include a BCA. This memorandum documents a benefit cost analysis performed for the Danubina Street Storm Sewer System Improvement Plan by Torres and Associates within the regional flood planning process.

## Benefit Cost Analysis Methodology

TWDB developed the Benefit-Cost Analysis (BCA) Input Tool to facilitate the calculation of flood mitigation benefits due to FMP. The TWDB BCA Input Tool is provided as **Appendix 2**. This tool receives input of existing and proposed conditions to determine expected benefits related to the construction of the FMP in question. The benefits considered in the analysis include the reduction in damages to residential structures, commercial structures, and social benefits. The BCA Input Tool was modified to handle the nearly 20,000 structures included in the analysis. The modified BCA Input Tool is provided as **Appendix 3**.

The BCA Input Tool was used in conjunction with the Federal Emergency Management Agency (FEMA) BCA Toolkit v6.0.0. The FEMA BCA Toolkit is provided as [Appendix 4](#). Social benefits used in the analysis were developed within the FMEA Benefit-Cost Calculator.

## Project Costs

According to the report, the overall cost to design and construct Phase 1 of the Danubina Street Drainage Improvements was estimated to be \$18,467,088 based on 2020 construction costs. The conveyance improvements were assumed to have a useful life of 30 years. The project cost used in the BCA includes Construction (70%), Engineering (12%), Acquisition (11%), and Administration (7%). The annual maintenance cost is estimated at \$0.

## Benefit Cost Analysis

### 1.1 Building Information

The “Texas Buildings with SVI and Estimated Population (November 2021)” dataset provided by TWDB for Regional Flood Planning was used to determine building sizes and building types. The Finished Floor Elevations (FFE) for all structures were assumed to 0.5 feet above ground level and all structures were assumed to be 1 story. Based on the provided building types, structures were reclassified as either residential, commercial, industrial, or agricultural. Public buildings were reclassified as commercial structures. Buildings marked as “Vacant or Unknown” in the TWDB dataset were reclassified as agricultural buildings.

### 1.2 Flood Hazard Data

The flood depths for each structure within the study area was determined for the 1 percent, 10 percent, and 20 percent annual chance events. The flood hazard data was obtained from the depth grid data resulting from hydrologic and hydraulic models developed as part of the CDBG-MIT Application. All hydrological and hydraulic analyses were completed by Dannenbaum Engineering Corporation. No hydrologic or hydraulic models were provided as part of this analysis. The baseline structural flood damages are included in [Table 1](#).

**Table 1. Summary of Damages by Recurrence Interval for Without and With Project Conditions**

	1% AEP Storm		10% AEP Storm		20% AEP Storm	
	Without Project	With Project	Without Project	With Project	Without Project	With Project
<b>Residential Flood Damage</b>	\$12,510,105	\$2,669,320	\$3,964,534	\$0	\$2,551,824	\$0
<b>Commercial Flood Damage</b>	\$1,072,743	\$246,280	\$162,831	\$0	\$53,782	\$0
<b>Total Structural Damage</b>	<b>\$13,582,849</b>	<b>\$2,915,600</b>	<b>\$4,127,364</b>	<b>\$0</b>	<b>\$2,605,606</b>	<b>\$0</b>

### 1.3 Expected Flood Damages After FMP Implementation

For the structures analyzed, the Danubina Street Storm Sewer Improvement plan results in \$13,755,112 in standard mitigation benefits and \$466,201 in other benefits from a residual value of investment.

### 1.4 Benefit-Cost Analysis Summary

The benefit-cost analysis for this project was completed using the FEMA BCA Tool Version 6.0. The final benefit-cost ratio (BCR) with standard benefits was determined to be 0.96.

**Table 2. Benefit-Cost Analysis Summary**

<b>Input Into BCA Toolkit</b>		
Project Useful Life	30 years	
<b>Event Damages</b>	<b>Baseline</b>	<b>Project</b>
1% AEP storm event	\$13,582,849	\$2,915,600
10% AEP storm event	\$4,127,364	\$0
20% AEP storm event	\$2,605,606	\$0
<b>Results from BCA Toolkit:</b>		
Total Benefits from BCA Toolkit	\$13,755,112	
Other Benefits (Not Recreation)	\$446,201	
Discounted Total Costs from TWDB Spreadsheet	\$14,748,946	
Net Benefits	\$14,201,313	
<b>Final BCR</b>	<b>0.96</b>	

## List of Appendices

Appendix 01 – Baytown CDBG-MIT Application - Danubina

Appendix 02 – TWDB BCA Input Workbook (included as an excel document)

Appendix 03 – Modified Benefit Cost Analysis Spreadsheet (Included as an excel document)

Appendix 04 – FEMA BCA Toolkit 6.0 (included as an excel document)

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**Appendix 5-4AO:  
Mary's Creek Conveyance Improvements**

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## Assumptions for Mary's Creek - 063000063

**TO:** San Jacinto Regional Flood Planning Group

**CC:** City of Pearland  
Texas Water Development Board

**FROM:** Judith Lamptey

**SUBJECT:** Mary's Creek Conveyance Improvements Benefit-Cost Analysis

**DATE:** 03/10/2023

**PROJECT:** San Jacinto Regional Flood Plan

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### **Data Collection**

- Texas Buildings with SVI and Estimated Population (November 2021) from the TWDB Datahub
- Land Parcels from the TWDB Datahub
- Waster Surface Elevation Raster
- Terrain
- Capital and Operation & Maintenance costs
- Project Lifespan

### Tools

- TWDB Benefit-Cost Analysis (BCA) Input Tool
- FNI Adapted TWDBE BCA Input Tool
- FEMA BCA Toolkit

### **Data Processing**

A residential threshold was in place to assure that the dataset has no extraneous buildings, such as garages and sheds which can skew the BCA's result. The Texas buildings are categories in Simp type that vary from public, residential, commercial, and industrial. Removing the extraneous building was performed by defining query for residential property under 500sq-ft in GIS, then inspected before deleting it from the dataset.

### **Extracting Damage Depths**

Due to the lack of information for the Finished Floor Elevation, the initial assumption was that the homes were elevated 0.5ft from the terrain. the Water Surface Elevations (WSE) were used to access the damage depth. A new attribute field was added to the building inventory to generate the area of each structure before using the GIS tool, features to point to convert all the structures to points

### **Assumptions**

All critical facilities, per FEMA BCA toolkit instruction, were to have a separate Mitigation Action from commercial property. Consequently, a new tab was added the FNI Adapted TWDBE BCA Input Tool spreadsheet. All critical Infrastructure were treated as school.

1. FFE assumed to be 6" above terrain. This can be varied spatially if regions are drawn in GIS and each structure has an associated value.
2. All structures were assumed to be 1 story.
3. Public Buildings were treated as commercial buildings.
4. Vacant or Unknown Buildings were treated as Agricultural Buildings and use the lowest structure value in TWDB spreadsheet.
5. Critical Infrastructures were treated as schools.

## **Results**

*Table 1. Total Number of Structure in Mary's Creek Benefit Cost Analysis*

<b>Agricultural</b>	<b>35</b>
Correctional Facility	35
<b>Commercial</b>	<b>1039</b>
Fast Food	1039
<b>Critical Infrastructure</b>	<b>5</b>
Schools	5
<b>Industrial</b>	<b>28</b>
Industrial - Light	28
<b>Public</b>	<b>26</b>
Fast Food	26
<b>Residential</b>	<b>17503</b>
Average Home	3937
Large Home	12334
Small Home	1232
<b>Vacant or Unknown</b>	<b>469</b>
Correctional Facility	469

*Table 2. Mary's Creek Impact by Recurrence Intervals from Texas Water Development Board*

Mary's Creek						
	50 - year storm		100 - year storm		500 - year storm	
Project Impacts by	Baseline	Project	Baseline2	Project2	Baseline3	Project3

<b>Recurrence Interval</b>						
Residential Flood Damage	\$27,795,015	\$1,110,636	\$52,146,203	\$2,479,664	\$269,081,668	\$45,963,940
Commercial Flood Damage	\$5,624,096	\$2,874,351	\$11,574,925	\$4,324,918	\$102,753,469	\$33,330,424
Critical Infrastructure	-	-	\$120,089	-	\$268,616	-
<b>Total</b>	<b>\$33,419,111</b>	<b>\$3,984,987</b>	<b>\$63,841,217</b>	<b>\$6,804,582</b>	<b>\$372,103,753</b>	<b>\$79,294,364</b>

Table 3. Summary of Mary's Creek Analysis from Benefit Cost Analysis Spreadsheet.

<b>Input Into BCA Toolkit</b>		
Project Useful Life		<b>30</b> years
<b>Event Damages</b>	<b>Baseline</b>	<b>Project</b>
50 - year storm	<b>\$32,762,865</b>	<b>\$3,906,734</b>
100 - year storm	<b>\$62,589,934</b>	<b>\$6,670,962</b>
500 - year storm	\$364,823,090	\$77,737,273
<b>Results from BCA Toolkit:</b>		
Total Benefits from BCA Toolkit		<b>\$25,297,654</b>
Other Benefits (Not Recreation)		\$0
Recreation Benefits		\$0
Discounted Total Costs from TWDB Spreadsheet		<b>\$154,039,885</b>
Net Benefits		\$25,297,654
Net Benefits with Recreation		\$25,297,654
<b>Final BCR</b>		<b>0.16</b>
<b>Final BCR with Recreation</b>		<b>0.16</b>

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**Appendix 5-4AP:  
Blalock Road Drainage Improvements BCA Memorandum**

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## Assumptions for Blalock – 063000327

**TO:** San Jacinto Regional Flood Planning Group

**CC:** City of Piney Point Village  
Texas Water Development Board

**FROM:** Judith Lamptey

**SUBJECT:** Blalock Benefit-Cost Analysis

**DATE:** 03/10/2023

**PROJECT:** San Jacinto Regional Flood Plan

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### **Data Collection**

- Texas Buildings with SVI and Estimated Population (November 2021) from the TWDB Datahub
- Land Parcels from the TWDB Datahub
- Waster Surface Elevation Raster
- Terrain
- Capital and Operation & Maintenance costs
- Project Lifespan

### Tools

- TWDB Benefit-Cost Analysis (BCA) Input Tool
- FNI Adapted TWDBE BCA Input Tool
- FEMA BCA Toolkit

### **Data Processing**

A residential threshold was in place to assure that the dataset has no extraneous buildings, such as garages and sheds which can skew the BCA's result. The Texas buildings are categories in Simp type that vary from public, residential, commercial, and industrial. Removing the extraneous building was performed by defining query for residential property under 500sq-ft in GIS, then inspected before deleting it from the dataset.

### **Extracting Damage Depths**

Due to the lack of information for the Finished Floor Elevation, the initial assumption was that the homes were elevated 0.5ft from the terrain. the Water Surface Elevations (WSE) were used to access the damage depth. A new attribute field was added to the building inventory to generate the area of each structure before using the GIS tool, features to point to convert all the structures to points

**Assumptions**

All critical facilities, per FEMA BCA toolkit instruction, were to have a separate Mitigation Action from commercial property. Consequently, a new tab was added the FNI Adapted TWDBE BCA Input Tool spreadsheet. All critical Infrastructure were treated as school.

1. FFE assumed to be 6" above terrain. This can be varied spatially if regions are drawn in GIS and each structure has an associated value.
2. All structures were assumed to be 1 story.
3. Public Buildings were treated as commercial buildings.
4. Vacant or Unknown Buildings were treated as Agricultural Buildings and use the lowest structure value in TWDB spreadsheet.
5. Critical Infrastructures were treated as schools.

**Results**

*Table 1. Total Number of Structures Type in Blalock in Benefit Cost Analysis*

<b>Public</b>	<b>20</b>
Fast Food	20
<b>Residential</b>	<b>691</b>
Average Home	89
Large Home	581
Small Home	21
<b>Vacant or Unknown</b>	<b>7</b>
Correctional Facility	7

*Table 2. Summary of Blalock Analysis from Benefit Cost Analysis Adapted Spreadsheet.*

Project Impacts by Recurrence Interval	25 - year storm		100 - year storm	
	Baseline	Project	Baseline2	Project2
Residential Flood Damage	\$325,367	\$154,533	\$154,533	\$0
Commercial Flood Damage	\$0	\$0	\$0	\$0
Flooded Streets from TWDB Spreadsheet	\$0	\$0	\$0	\$0
Utility Impacts from TWDB Spreadsheet	\$0	\$0	\$0	\$0
Agricultural Losses from TWDB Spreadsheet	\$0	\$0	\$0	\$0

Low Water Crossing Damages from TWDB Spreadsheet	\$0	\$0	\$0	\$0
	\$325,367	\$154,533	\$154,533	\$0
<b>Other Project Impacts</b>	<b>Benefits</b>			
Water Supply Benefits from TWDB Spreadsheet	\$0			
Environmental Benefits from TWDB Spreadsheet	\$0			
Residual Value of Investment from TWDB Spreadsheet	\$0			
Recreational Benefits from TWDB Spreadsheet	\$0			

<b>Input Into BCA Toolkit</b>		
Project Useful Life	30 years	
<b>Event Damages</b>	<b>Baseline</b>	<b>Project</b>
25 - year storm	\$325,367	\$154,533
100 - year storm	\$154,533	\$0
<b>Results from BCA Toolkit:</b>		
Total Benefits from BCA Toolkit	\$78,028	
Other Benefits (Not Recreation)	\$0	
Recreation Benefits	\$0	
Discounted Total Costs from TWDB Spreadsheet	\$19,245,423	
Net Benefits	\$78,028	
Net Benefits with Recreation	\$78,028	
<b>Final BCR</b>	<b>0.004</b>	
<b>Final BCR with Recreation</b>	<b>0.00</b>	

Table 3. Summary of Benefit Cost Analysis from Texas Water Development Board.

<b>Input Into BCA Toolkit</b>
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Project Useful Life

30

Event Damages	Baseline	Project
25 - year storm	\$157,628	\$0
100 - year storm	\$331,884	\$157,628

Total Benefits from BCA Toolkit \$78,028

Other Benefits (Not Recreation) \$0

Recreation Benefits -

Total Costs \$19,323,451

Net Benefits \$19,245,423

Net Benefits with Recreation \$19,245,423

**Final BCR 0.0**

**Final BCR with Recreation 0.0**

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**Appendix 5-4AQ:  
Rivershire West – Alligator Creek and Grand Lake BCA  
Memorandum**

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## Assumptions for Rivershire West - 063000453

**TO:** San Jacinto Regional Flood Planning Group

**CC:** City of Conroe  
Texas Water Development Board

**FROM:** Judith Lamptey

**SUBJECT:** Rivershire West – Alligator Creek and Grand Lake Watersheds Benefit-Cost Analysis

**DATE:** 03/10/2023

**PROJECT:** San Jacinto Regional Flood Plan

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### Data Collection

- Texas Buildings with SVI and Estimated Population (November 2021) from the TWDB Datahub
- Land Parcels from the TWDB Datahub
- Waster Surface Elevation Raster
- Terrain
- Capital and Operation & Maintenance costs
- Project Lifespan

### Tools

- TWDB Benefit-Cost Analysis (BCA) Input Tool
- FNI Adapted TWDBE BCA Input Tool
- FEMA BCA Toolkit

### Data Processing

A residential threshold was in place to assure that the dataset has no extraneous buildings, such as garages and sheds which can skew the BCA's result. The Texas buildings are categories in Simp type that vary from public, residential, commercial, and industrial. Removing the extraneous building was performed by defining query for residential property under 500sq-ft in GIS, then inspected before deleting it from the dataset.

### Extracting Damage Depths

Due to the lack of information for the Finished Floor Elevation, the initial assumption was that the homes were elevated 0.5ft from the terrain. the Water Surface Elevations (WSE) were used to access the damage depth. A new attribute field was added to the building inventory to generate the area of each structure before using the GIS tool, features to point to convert all the structures to points

## Assumptions

All critical facilities, per FEMA BCA toolkit instruction, were to have a separate Mitigation Action from commercial property. Consequently, a new tab was added the FNI Adapted TWDBE BCA Input Tool spreadsheet. All critical Infrastructure were treated as school.

1. FFE assumed to be 6" above terrain. This can be varied spatially if regions are drawn in GIS and each structure has an associated value.
2. All structures were assumed to be 1 story.
3. Public Buildings were treated as commercial buildings.
4. Vacant or Unknown Buildings were treated as Agricultural Buildings and use the lowest structure value in TWDB spreadsheet.
5. Critical Infrastructures were treated as schools.

## Results

*Table 1. Total Number of Structures Type in Rivershire's Benefit Cost Analysis*

<b>Agricultural</b>	<b>2</b>
Correctional Facility	2
<b>Commercial</b>	<b>24</b>
Fast Food	24
<b>Critical Infrastructure</b>	<b>2</b>
Schools	2
<b>Industrial</b>	<b>11</b>
Industrial - Light	11
<b>Public</b>	<b>4</b>
Fast Food	4
<b>Residential</b>	<b>838</b>
Average Home	134
Large Home	692
Small Home	12
<b>Vacant or Unknown</b>	<b>95</b>
Correctional Facility	95
<b>Grand Total</b>	<b>976</b>

*Table 2. Rivershire's Damage Impact by Recurrence Intervals from Texas Water Development Board.*

	100 - year storm	
Project Impacts by Recurrence Interval	Baseline	Project

Residential Flood Damage	\$22,883,464	\$1,581,706
Commercial Flood Damage	\$1,502,948	\$473,108
Critical Infrastructure	\$788,373	-
Total	\$25,174,785	\$2,054,814

Table 3. Rivershire's Damage Impact by Intervals from Adapted Spreadsheet.

Project Impacts by Recurrence Interval	100 - year storm		500 - year storm	
	Baseline	Project	Baseline2	Project2
Residential Flood Damage	\$22,434,105	\$1,550,646	\$0	\$0
Commercial Flood Damage	\$2,415,430	\$463,818	\$0	\$0
Flooded Streets from TWDB Spreadsheet	\$0	\$0	\$0	\$0
Utility Impacts from TWDB Spreadsheet	\$0	\$0	\$0	\$0
Agricultural Losses from TWDB Spreadsheet	\$0	\$0	\$0	\$0
Low Water Crossing Damages from TWDB Spreadsheet	\$0	\$0	\$0	\$0
	\$24,849,535	\$2,014,464	\$0	\$0
<b>Other Project Impacts</b>	Benefits			
Water Supply Benefits from TWDB Spreadsheet	\$0			
Environmental Benefits from TWDB Spreadsheet	\$0			
Residual Value of Investment from TWDB Spreadsheet	\$0			
Recreational Benefits from TWDB Spreadsheet	\$0			

Table 4. Summary of Benefit Cost Analysis from Texas Water Development Board.

<b>Input Into BCA Toolkit</b>		
Project Useful Life	<b>30</b>	
<b>Event Damages</b>	<b>Baseline</b>	<b>Project</b>
100 - year storm	<b>\$23,671,837</b>	<b>\$1,581,706</b>

Total Benefits from BCA Toolkit	\$2,868,933
Other Benefits (Not Recreation)	\$0
Recreation Benefits	-
Total Costs	\$26,418,115
	-
Net Benefits	\$23,549,182
	-
Net Benefits with Recreation	\$23,549,182
<b>Final BCR</b>	<b>0.1</b>
<b>Final BCR with Recreation</b>	<b>0.1</b>

Table 5. Summary of Benefit Cost Analysis from Adapted Spreadsheet.

Input Into BCA Toolkit		
Project Useful Life	<b>30</b>	years
<b>Event Damages</b>	<b>Baseline</b>	<b>Project</b>
100 - year storm	\$24,849,535	\$2,014,464
500 - year storm	\$0	\$0
Results from BCA Toolkit:		
Total Benefits from BCA Toolkit	<b>\$2,868,933</b>	
Other Benefits (Not Recreation)	\$0	
Recreation Benefits	\$0	
Discounted Total Costs from TWDB Spreadsheet	<b>\$26,418,115</b>	
Net Benefits	\$2,868,933	
Net Benefits with Recreation	\$2,868,933	
<b>Final BCR</b>	<b>0.11</b>	
<b>Final BCR with Recreation</b>	<b>0.11</b>	

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**Appendix 5-4AR:  
Warren Lake and Dam**

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# **INCE ENGINEERING, LLC**

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**Warren Lake  
Hydrology and Hydraulic Analysis  
Hockley, Texas  
Harris County**

April 10, 2014



*B. Trent Street*  
4/11/2014

Ince Engineering – Firm #-6660

**Written Report**

**Appendix 1**

**General Plan & Profiles**

**Appendix 2**

**Dam and Reservoir Data**

**Appendix 3**

**Hydrology Data**

**Appendix 4**

**PMP and PMF Data**

**Appendix 5**

**SITES Analysis**

# WARREN LAKE DAM HYDROLOGY AND HYDRAULIC ANALYSIS REPORT

## INTRODUCTION

The Katy Prairie Conservancy and Warren Ranch own Warren Lake in partnership with Katy Prairie Conservancy being the major Shareholder. Warren Lake is located approximately 2 miles south of Hockley, Harris County, Texas. The owners plan to rehabilitate the dam. The plans for rehabilitation include removal of trees, patching borrow holes, removing debris for the embankment slopes, providing a structural chute spillway, excavating the shoreline to provide an area for marsh vegetation and adding earthfill over and downstream of the existing embankment. The new embankment will have a non-typical look with an even top with rounded edges and flat slopes to blend into the existing topography. The proposed concept plan for modifying the dam was developed by Kevin Shanley with SWA Group. The concept drawing is included in Appendix 1. Katy Prairie Conservancy requested a hydrology and hydraulic study to determine if the new structure will meet TCEQ requirements. Ince Engineering performed studies and completed a report entitled "Hydrology and Hydraulic Analysis Report". This report was based on the TCEQ's rules in place at that time.

## SCOPE OF THIS STUDY

Katy Prairie Conservancy contracted with Ince Engineering to perform a hydrology and hydraulic (H&H) study based on the revised rules and considering the dam as a significant hazard. The scope consists of determining the adequacy of the top of dam elevation to contain the probable maximum flood (PMF) for a series of frequency as outlined by TCEQ rules. The basis for this analysis is Texas Administrative Code (TAC) Chapter 299, titled "Dams and Reservoirs and TCEQ's publication "Hydrologic and Hydraulic Guidelines for Dams in Texas".

## SURVEY

A topography survey was performed by Ince Surveying and Engineering from Whitney, Texas. The area surveyed includes: the entire property around Warren Lake bound by the county road on the west, the north property line and the fence line east of the Warren Lake. The bearings and distances are based on Texas State Plane Coordinate System, South Central Zone 4204, NAD 83 as established using Trimble VRS Network. All elevations were established using Trimble VRS Network and Geoid 2009 adjustment.

## DAM AND RESERVOIR DATA

The orientation, layout and topography of the existing dam and reservoir is shown in Appendix 1.

### Hazard Class

TCEQ has the classification of this dam as significant. There are structures below the embankment that could have an influence on the classification. Since it is unknown at this time whether these structures will cause a hazard change, this analysis will assume the dam is high hazard.

### Size of Dam – (From 30 TAC 2199.13)

Intermediate – Appendix 3 contains a table for determining the classification size.

### Primary Principal Spillway

Crest Elevation: 192.0 ft. (NAVD 88)

Conduit: Assumed 36-inch smooth steel with transition to 24-inch corrugated metal at downstream toe. The pipe is in poor conditions and does not appear to be functioning. The routing of hydrograph through the structure assumes minimal principal spillway discharge.

Inlet: 36-inch smooth steel

Length: Approx. 280 ft.

#### Secondary Principal Spillway

20-inch smooth steel siphon pipe - It appears to inoperable

#### Auxiliary (Emergency) Spillway

Left Abutment - Crest Elevation = 194.0 ft.

Right Abutment - Crest Elevation = 196.0

Width: 50 ft.

Type: Vegetated

#### Dam

Crest Elevation: 201.0 ft.

Top Width: 7 to 12 ft.

Side Slopes: Varies from 2 horizontal to 1 vertical to 6 horizontal to 1 vertical

#### Storage

The stage storage table was developed from the topography survey performed by Ince Surveying and Engineering. Appendix 2 shows the stage-storage calculation for the existing and proposed modified reservoir.

The review of the survey revealed an unusual feature for Warren Lake. The topography on the east side at the upper end of the reservoir is lower in elevation than the auxiliary spillway that was constructed adjacent to the dam. The topography is such that this natural saddle provides significant capacity for passage of floodwaters. Appendix 1 shows a layout of the Warren Lake and the saddle.

### **HYDROLOGY DATA**

#### Drainage Area (DA):

The DA is 2,966 acres and was determined from USGS topography quad maps and contour maps on Harris County's webpage. The webpage contains maps with 2-foot contours that were interpolated from the 2008 USGS 10-foot contours. See Appendix 3 for drainage area map for details.

#### Curve Number (CN):

CN was determined using Natural Resources Conservation Service (NRCS) standard methods, Harris County Soils Survey, aerial photos, field review and NRCS's Technical Release 55 (TR55) computer program. Soils in the drainage area are Hockley, Hydrologic Group B; Katy and Segno, Hydrologic Group C; and Wockley, Hydrologic Group D. Current land use is pasture in good condition. Appendix 3 shows the calculation of the CN.

CN (condition II) = 78

CN (condition I) = 60

CN (condition III) = 90

#### Time of Concentration ( $T_c$ ):

The time of concentration was calculated by TR-55 and the Kirpich methods. Procedure contained in NRCS-TR55 uses flow characteristics to determine time of concentration.

TR55 procedure:

Length = 100 feet, slope = .03 ft/ft overland flow.

Length = 1,400 feet, slope = .036 ft/ft shallow flow.

Length = 20,530 feet, slope = .0017 ft/ft channel flow.

Length and elevation fall were determined from Harris County contour data available on their web page.

$T_c = 3.2$  hours.

The Kirpich method was also calculated.

Length = 22,030 feet

Elevation drop = 36 feet

$T_c = 3.4$  hrs

A  $T_c$  of 3.2 hours was used in SITES. The calculations for  $T_c$  are shown in Appendix 3.

#### Rainfall Data:

TCEQ's Hydrologic Design Criteria from 30 TAC 299.15 indicates the design flood for an intermediate size high hazard dam is 75% PMF. Appendix 3 contains a table for determining the design flood as dictated by the size and hazard class for dams. The PMF is the runoff produced from the probable maximum precipitation (PMP).

From Table 4.1 of "Hydrologic and Hydraulic Guidelines for Dams in Texas", the dam shall be analyzed for the following 75% PMF storm durations: 1-hour, 2-hour, 3-hour, 6-hour, 12-hour, 24-hour, and 72-hour.

The PMP for the 6, 12, 24, 48, 72 hour storms were obtained from Hydrometeorological Report 51 (HMR 51). The 1 hour PMP was obtained from HMR 52. The 2 and 3 hour PMP were obtained by interpolating the plot of the above on semi-log plot. Appendix 4 contains the procedure and calculations of the 75% PMF.

A determination was made on an equivalent rainfall that would produce 75% of the PMF hydrograph.

#### **SITES MODEL**

NRCS'S SITES program was used for the H&H analysis. SITES models watershed runoff from a rainfall event and then routes the resulting hydrograph through a dam to hydraulically proportion the principal spillway and auxiliary spillway. SITES runs were performed for all durations for the existing dam. Only the 2-yr duration was run for the modified dam, because it closely matched the 2-yr duration run for the existing dam. Since the two 2-yr duration closely matched, the same results can be expected for all durations.

The principal spillway flow for the existing dam was considered minimal since the spillway appears not to be functioning. A minimum data entry for the principal spillway was entered for the existing dam to make the SITES program run. The proposed modified dam includes a 40 feet wide weir with 6 feet wide by 1-foot high orifice located below the weir crest. A hydraulic program was used to develop a discharge rating for this proposed spillway. The discharge rating is considered conservative for this analysis.

A hydraulic rating was developed for each of the left and right spillways adjacent to the dam and for the upstream saddle. The spillway ratings were developed using standard hydraulic methods. The modified plan does not include any changes to the existing auxiliary spillway other than minor reshaping. The auxiliary spillways capacity ratings are the same for both the existing and modified dams. Appendix 2 shows the calculations for the spillways. The table below is a summary of peak elevations for the storm duration runs for the 75% PMF. The detailed SITES runs for the existing dam and the 2-yr duration run for the modified dam are shown in Appendix 5.

**Summary of SITES Results for 75% PMF**

Storm Duration (hours)	Rainfall (in)	Inflow Peak (cfs)	Peak Elev. Existing Dam	Peak Elev. Modified Dam
1	13.04	12,706	195.59	
2	17.17	15,383	195.83	195.82
3	19.95	14,813	195.81	
6	25.43	14,626	195.79	
12	30.99	14,320	195.78	
24	37.07	10,987	195.53	
48	40.22	6,381	195.04	
72	43.22	4,574	194.75	

**CONCLUSION**

Hydraulically the existing embankment is significantly higher than the peak elevation produced by the 75% PMF. The 2-hr duration is the most critical storm and the peak water surface elevation is 195.83 ft. The top of dam elevation through the deep fill of the existing embankment is ranges from 202.5 to 201.4. The low point in the embankment is elevation 198.4 at station 22+80. The profile of the existing top of dam is shown in Appendix 1. The lowest elevation for the modified embankment is 204.0

Prepared by:

*B. Trent Street*

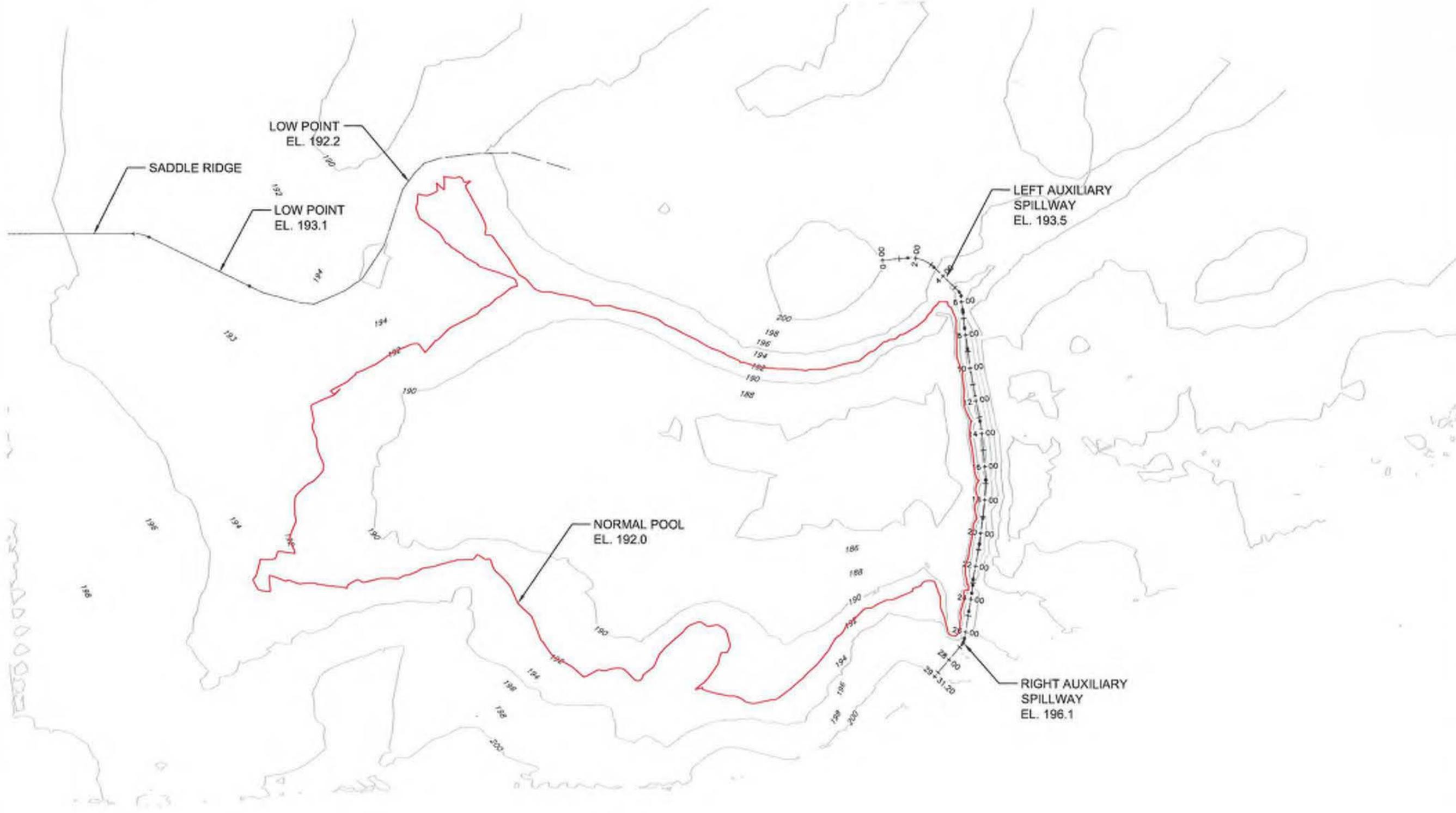
B. Trent Street, P.E.



*B. Trent Street*  
4/11/2014

## **Appendix 1**

### **General Plan and Profiles**



DESIGNED BY: BTS  
 DRAWN BY: GAK  
 CHECKED BY: BTS  
 FILE NAME: Warren Upgrade.dwg  
 DATE PLOTTED: 4/9/14

GENERAL PLAN  
 WARREN LAKE  
 EXISTING CONDITIONS  
 WARREN RANCH  
 WARREN COUNTY, TEXAS



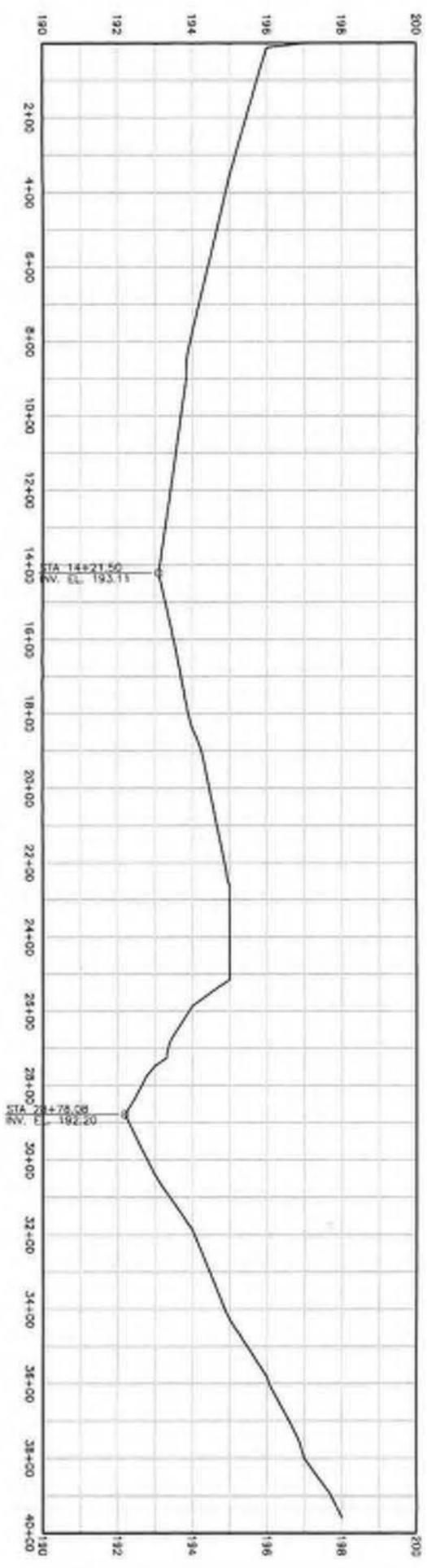
**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 P.O. BOX 9  
 HEIDENHEIMER, TX 78533  
 (254) 983-9103, 9104 (FAX)



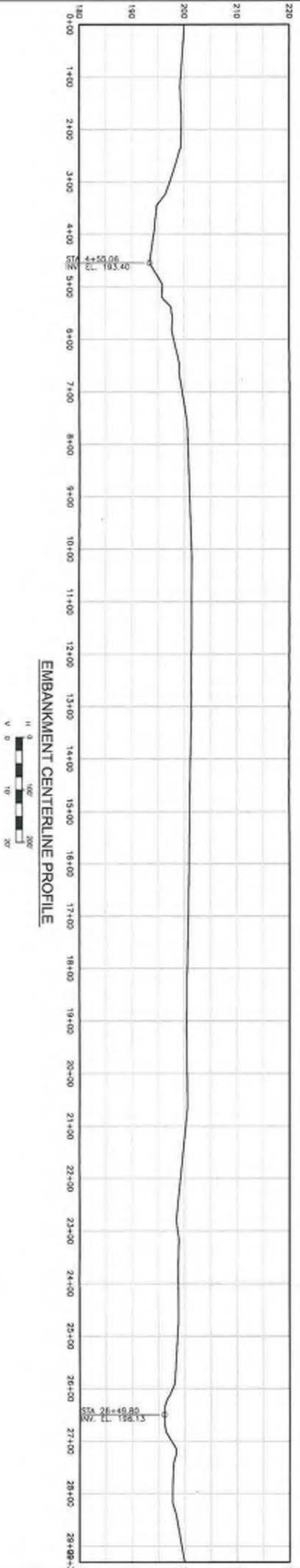
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**SADDLE SPILLWAY**



**EMBANKMENT CENTERLINE PROFILE**



DESIGNED BY: BJS  
 DRAWN BY: DMK  
 CHECKED BY: BJS  
 FILE NAME: Warren Upgrade.dwg  
 DATE PLOTTED: 4/8/14

PROFILES  
 WARREN LAKE  
 EXISTING CONDITIONS  
 WARREN RANCH  
 IN  
 HARRIS COUNTY, TEXAS



**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 P.O. BOX 9  
 HEIDENHEIMER, TX 76533  
 (254) 983-9103, 9104 (FAX)

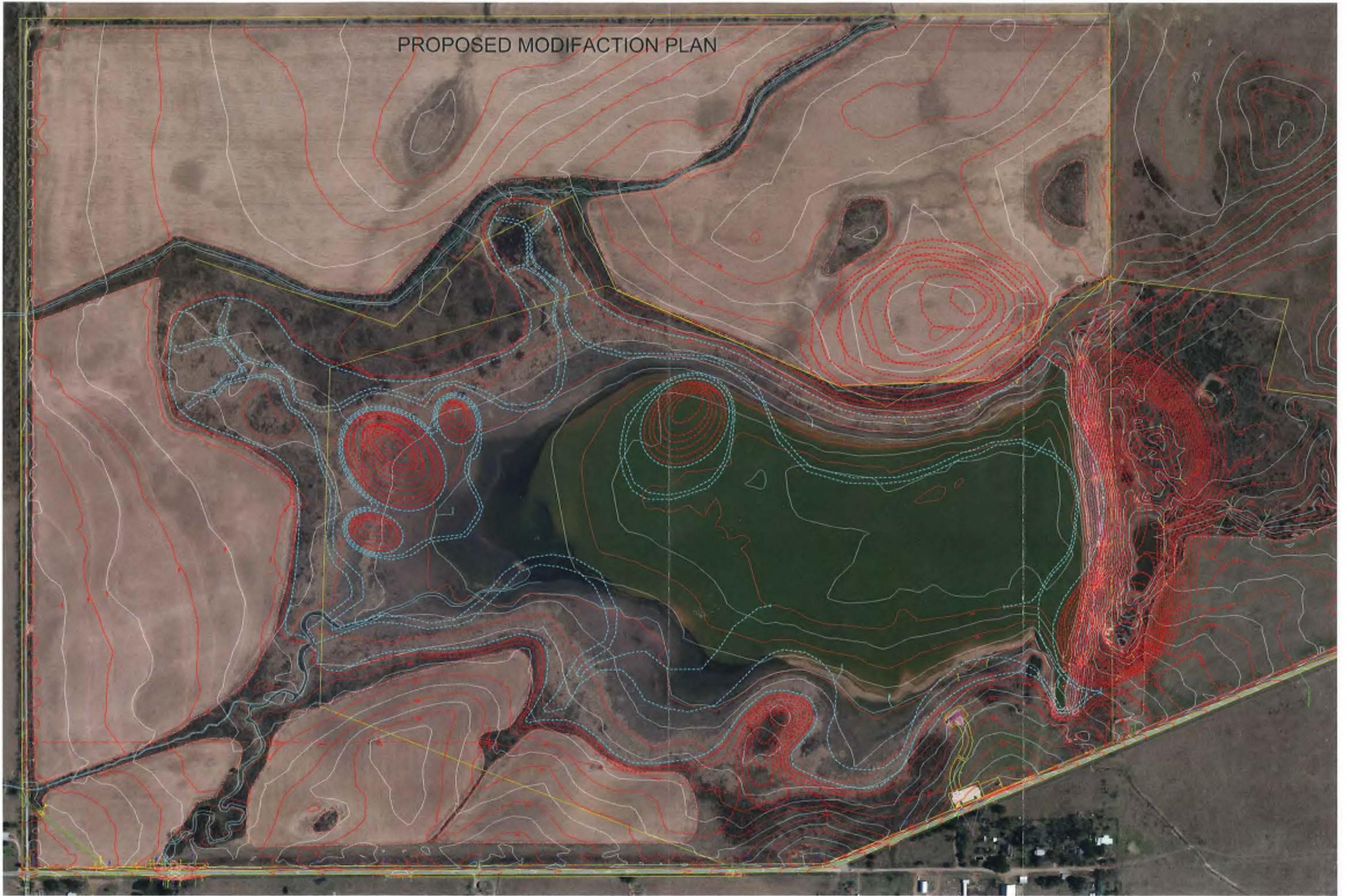


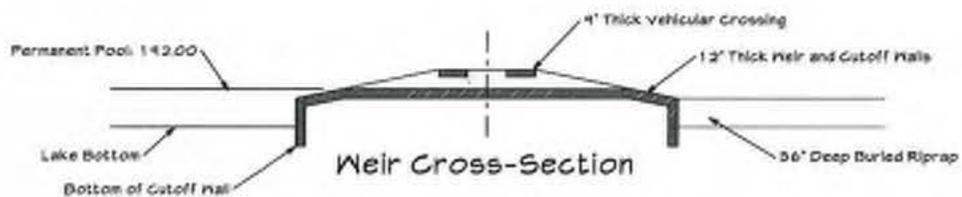
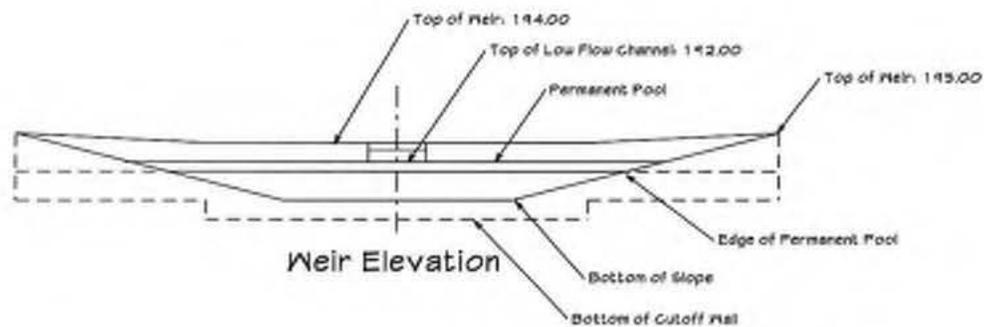
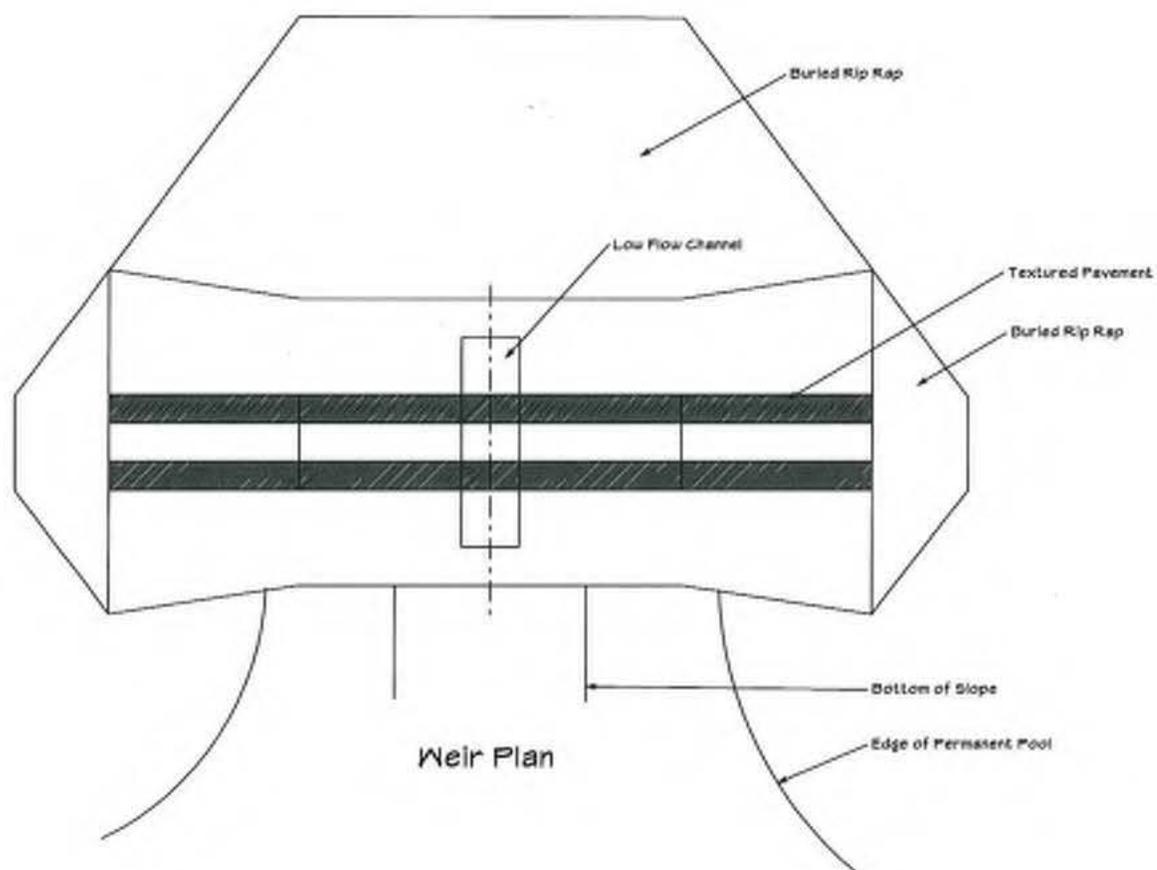
REVISIONS  
 DATE

SHEET

2

PROPOSED MODIFACTION PLAN





**Warren Lake Weir Details**  
 Scale 1"=20'-0" 2014 January 30

## **Appendix 2**

### **Dam and Reservoir Data**

## STAGE-STORAGE

Existing Condition				Modified Condition			
Elev., Ft.	Area from Autocad-Existing, SF	Surface Area, Ac.	Storage, Ac-Ft	Elev., Ft.	Area from AutoCad-Modified, SF	Modified Area, Ac.	Storage, Ac-Ft
184	0	0	0				0
184.5	238614.55	5.48	1.37				
185	877479.54	20.14	7.77	185		20.14	7.77
186	1739046.76	39.92	37.81	186	3524025.40	80.90	58.30
187	2471753.14	56.74	86.14				
188	3054273.54	70.12	149.57	188	4873711.92	111.89	251.08
189	3663259.52	84.10	226.68				
190	4924069.86	113.04	325.25	190	8042500.86	184.63	547.60
191	5919683.91	135.90	449.72				
192	6983564.27	160.32	597.83	192	8553306.11	196.36	928.59
193	8432472.91	193.58	774.78				
194	10119282.58	232.31	987.72	194	9441093.57	216.74	1341.68
195	11360436.57	260.80	1234.28				
196	12743738.41	292.56	1510.95	196	12265899.89	281.59	1840.00
197	14061744.35	322.81	1818.64				
				198	15228487.60	349.60	2471.19

## SPILLWAY CAPACITY RATING

Water Surface, El.	North Saddle Area from AutoCad, SF	South Saddle Area from AutoCad, SF	Total North & South, SF	Area Adjusted for Scale, SF	Mannings n value	Wetted Perimeter, Ft.	Hydraulic Radius	Slope, Ft/Ft	Velocity, FPS	Saddle Capacity, CFS	Spillway at Dam Capacity, CFS	Total Spillway Capacity, CFS
92.5	0.0	1677.9	1677.9	16.8	0.04	112	0.15	0.002	0.47	7.9		7.9
93.0	0.0	10360.4	12038.4	120.4	0.04	293	0.41	0.002	0.92	110.8		110.8
93.5	8835.1	18065.0	38938.5	389.4	0.04	904	0.43	0.002	0.95	369.9		369.9
94.0	38625.0	26283.6	103847.0	1038.5	0.04	1671	0.62	0.002	1.21	1259.6		1259.6
94.5	62302.7	34054.5	200204.2	2002.0	0.04	2215	0.90	0.002	1.56	3117.7		3117.7
95.0	84033.3	41966.2	326203.8	3262.0	0.04	2820	1.16	0.002	1.84	5988.4	33.0	6021.4
95.5	100471.2	59453.6	486128.5	4861.3	0.04	3325	1.46	0.002	2.15	10433.3	207.9	10641.2
96.0	109240.1	63183.2	658551.8	6585.5	0.04	3571	1.84	0.002	2.51	16501.4	489.8	16991.1
96.5	113660.5	67715.4	839927.7	8399.3	0.04	3677	2.28	0.002	2.89	24275.5	863.0	25138.5
97.0	113778.7	72767.2	1026473.6	10264.7	0.04	3797	2.70	0.002	3.23	33194.9	1319.5	34514.4

**NOTES:**

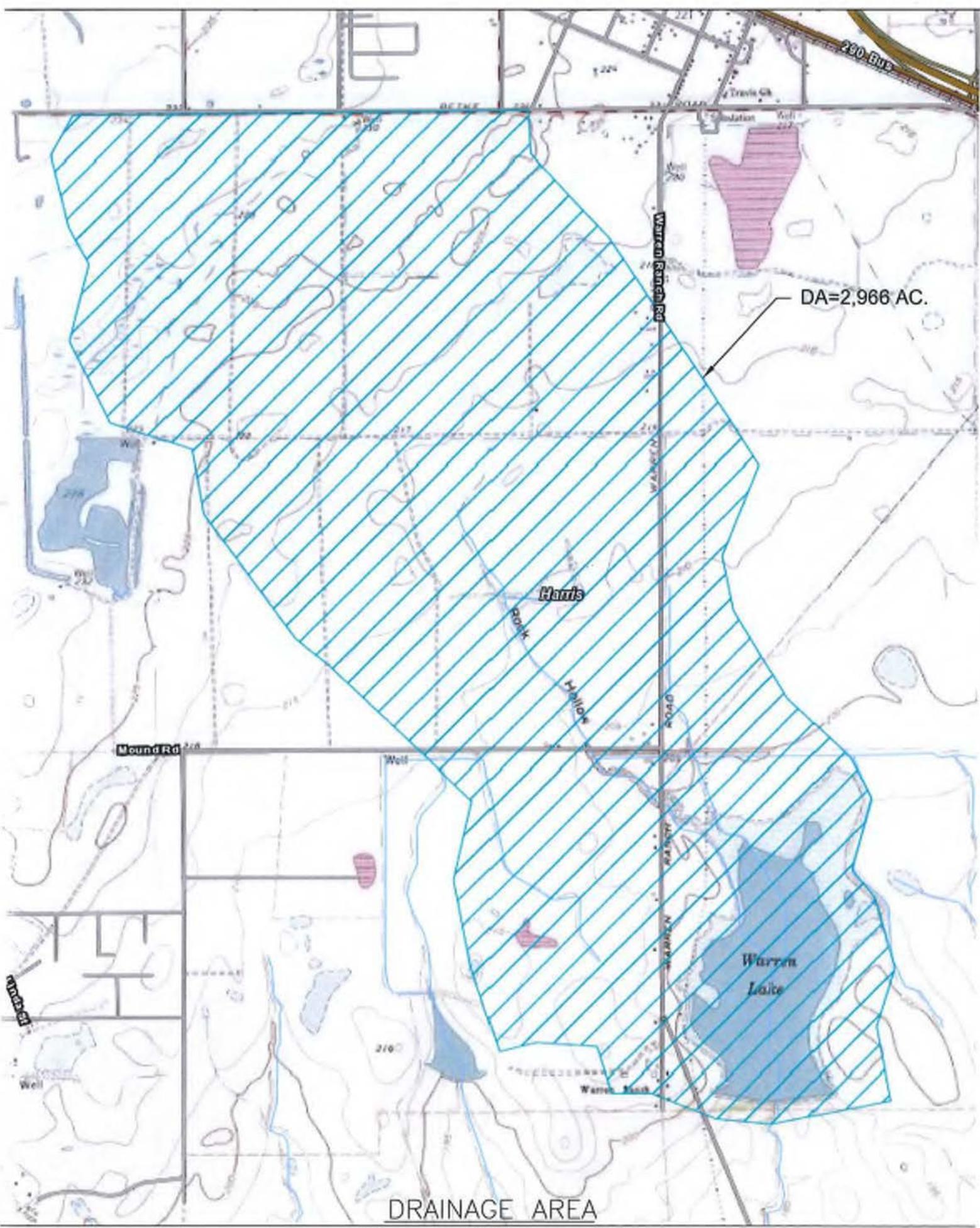
1. Capacity calculation are based on Manning's Formula
2. Cross sectional areas for the north and south saddle were measured from the profile in AutoCad. The profile scale is 1"=100' horizontal and 1"=1' vertical. The correction factor to actual area is .01
3. Conservative values were used for "n" and slope, which will give lower capacity values.

### Left and Right Spillway Capacity Located @ Dam 200 feet width with 6:1 slopes

Water Surface, El.	Area, SF	Mannings n value	Wetted Perimeter, Ft.	Hydraulic Radius	Slope, Ft/Ft	Velocity, FPS	Capacity, CFS
95.0	50	0.04	200	0.25	0.002	0.66	33.0
95.5	153.4	0.04	209	0.73	0.002	1.36	207.9
96.0	259.4	0.04	215	1.21	0.002	1.89	489.8
96.5	368.4	0.04	221	1.67	0.002	2.34	863.0
97.0	480.4	0.04	227	2.12	0.002	2.75	1319.5

This spreadsheet is a combined capacity calculation for the left and right spillways adjacent to the dam. A best fit template of the crest was used for the calculation. The template is 200 feet wide with 6:1 side slopes. This is a very conservative approximation of the capacity.

**Appendix 3**  
**Hydrology Data**

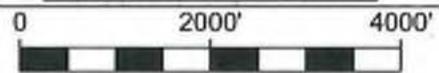


DA=2,966 AC.

Harris

Warren  
Lake

DRAINAGE AREA



## WinTR-55 Current Data Description

## --- Identification Data ---

User: BTS Date: 3/9/2014  
 Project: Warren Lake Units: English  
 SubTitle: Areal Units: Acres  
 State: Texas  
 County: Harris  
 Filename: M:\PUBLIC\Projects - Current\Ince Engineering\Warren Lake\Hydrology\Warren Lake.w55

## --- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
West	West Channel	Outlet	1877	79	3.238
East	East Channel	Outlet	1089	77	2.968

Total area: 2966 (ac)

## --- Storm Data ---

## Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
5.0	6.8	8.3	9.6	11.0	12.5	3.75

Storm Data Source: Harris County, TX (NRCS)  
 Rainfall Distribution Type: Type III  
 Dimensionless Unit Hydrograph: <standard>

Kirpich Method for  $T_c$

$$T_c = \left( \frac{11.9 L^3}{H} \right)^{0.385}$$

$L$  = Longest travel distance, miles = 29,530' / 5280  
 $H$  = Elev. difference in watershed, feet = 44 ft

$$T_c = \left( \frac{11.9 \left( \frac{29530}{5280} \right)^3}{44} \right)^{0.385}$$

$$T_c = 2.9 \text{ hrs.}$$

## WEST CHANNEL

Sub-area Name

### Land Use Details

Land Use Categories  
 Urban Area  
  Developing Urban  
  Cultivated Agriculture  
  Other Agriculture  
  Arid Rangeland

Cover Description	Condition	Area (Acres) for Hydrologic Soil Groups							
		A	CN	B	CN	C	CN	D	CN
<b>OTHER AGRICULTURAL LANDS</b>									
Pasture, grassland or range	Poor		68		79		86		89
	Fair		49		69		79		84
	Good		39	106.000	61	4.000	74	1767.000	80
Meadow -cont. grass (non grazed)			30		58		71		78
Brush - brush, weed, grass mix	Poor		48		67		77		83
	Fair		35		56		70		77
	Good		30		48		65		73
Woods - grass combination	Poor		57		73		82		86
	Fair		43		65		76		82
	Good		32		58		72		79
Woods	Poor		45		66		77		83
	Fair		36		60		73		79
	Good		30		55		70		77
Farmsteads	—		59		74		82		86

Project Area(ac)   
 Summary Screen  Off  On  
 Sub-Area Area (ac)   
 Weighted CN:   

Sub-area Name

2-Year Rainfall (in)

### Time of Concentration Details

Flow Type	Length (ft)	Slope (ft/ft)	Surface (Manning's n)	n	Area (ft <sup>2</sup> )	WP (ft)	Velocity (f/s)	Time (hr)
Sheet	100	0.0300	Grass, Bermuda (0.41)					0.248
Shallow Concentrated	1400	0.0300	Unpaved					0.139
Shallow Concentrated								
Channel	20530						2.000	2.851
Channel								
<b>Total</b>	<b>22,030</b>						<b>1.8899</b>	<b>3.238</b>

## EAST CHANNEL

Sub-area Name

### Land Use Details

Land Use Categories  
 Urban Area  
  Developing Urban  
  Cultivated Agriculture  
  Other Agriculture  
  Arid Rangeland

Area (Acres) for Hydrologic Soil Groups

Cover Description	Condition	A	CN	B	CN	C	CN	D	CN
<b>OTHER AGRICULTURAL LANDS</b>									
Pasture, grassland or range	Poor		68		79		86		89
	Fair		49		69		79		84
	Good		39	106.000	61	140.000	74	843.000	80
Meadow - cool, grass (non grazed)			30		58		71		78
Brush - brush, weed, grass mix	Poor		48		67		77		83
	Fair		35		56		70		77
	Good		30		48		65		73
Woods - grass combination	Poor		57		73		82		86
	Fair		43		65		76		82
	Good		32		58		72		79
Woods	Poor		45		66		77		83
	Fair		36		60		73		79
	Good		30		55		70		77
Farmsteads	---		59		74		82		86

Project Area(ac)   
 Summary Screen  Off  On  
 Sub-Area Area (ac)   
 Weighted CN:   

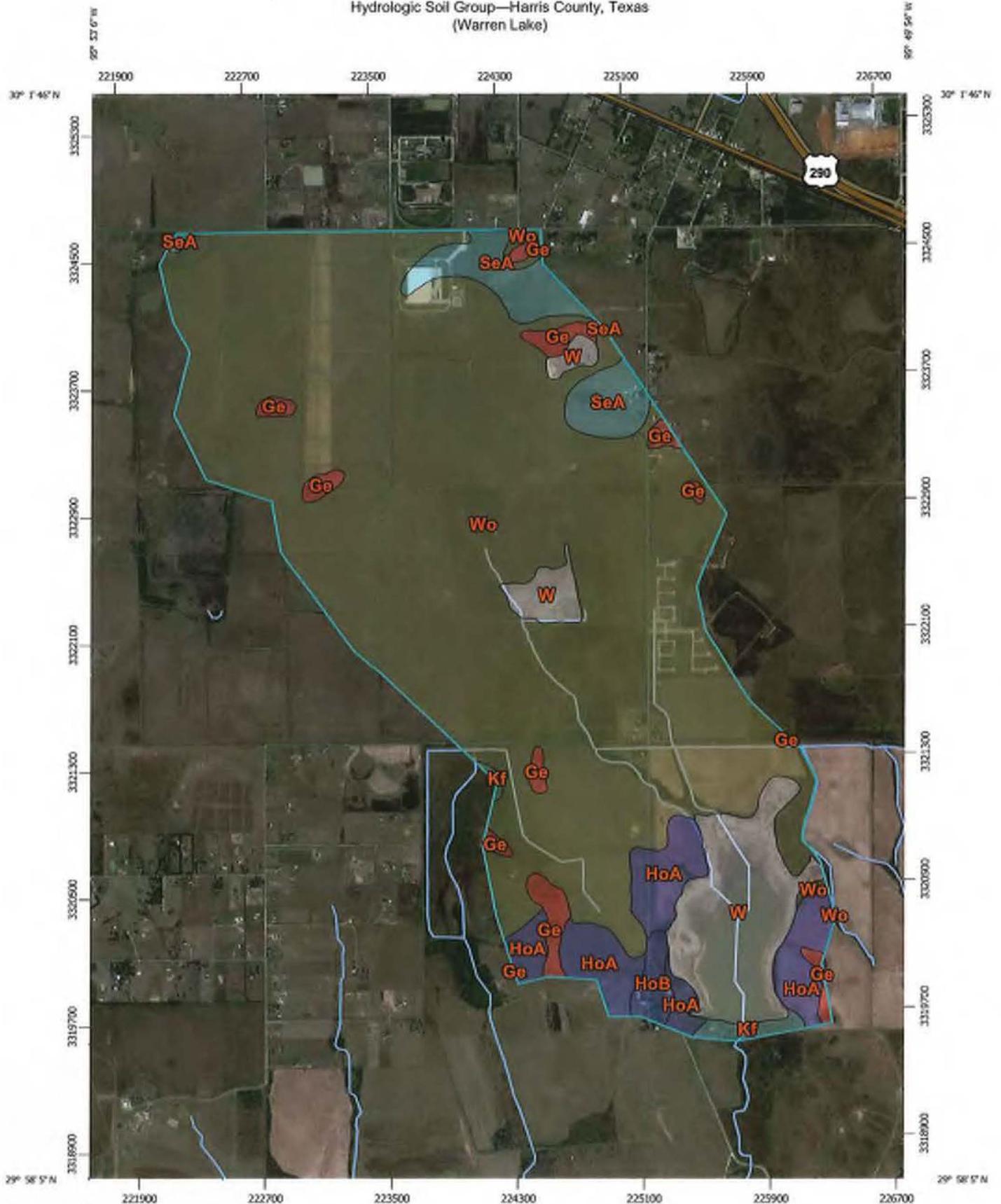
Sub-area Name

2-Year Rainfall (in)

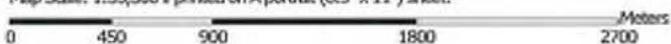
### Time of Concentration Details

Flow Type	Length (ft)	Slope (ft/ft)	Surface (Manning's n)	n	Area (ft <sup>2</sup> )	WP (ft)	Velocity (F/s)	Time (hr)
Sheet	100	0.0020	Grass Dense (0.24)					0.478
Shallow Concentrated	1240	0.0050	Unpaved					0.302
Shallow Concentrated								
Channel	15757						2.000	2.188
Channel								
<b>Total</b>	<b>17,097</b>						<b>1.6001</b>	<b>2.968</b>

Hydrologic Soil Group—Harris County, Texas  
(Warren Lake)



Map Scale: 1:33,300 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge ticks: UTM Zone 15N WGS84



## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Harris County, Texas (TX201)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ge	Gessner fine sandy loam, 0 to 1 percent slopes, ponded	D	81.5	2.7%
HoA	Hockley fine sandy loam, 0 to 1 percent slopes	B	186.4	6.3%
HoB	Hockley fine sandy loam, 1 to 4 percent slopes	B	25.6	0.9%
Kf	Katy fine sandy loam, 0 to 1 percent slopes	C	20.1	0.7%
SoA	Segno fine sandy loam, 0 to 1 percent slopes	C	124.4	4.2%
W	Water		258.2	8.7%
Wo	Wockley fine sandy loam	C/D	2,269.5	76.5%
<b>Totals for Area of Interest</b>			<b>2,965.7</b>	<b>100.0%</b>

## **Appendix 4**

### **PMP and PMF Data**

## TCEQ REQUIREMENTS

SIZE CLASSIFICATION		
Category	Impoundment Maximum Storage (Acre-Foot)	Height (Ft.)
Small	Equal to or Greater than 15 and Less than 1,000 Equal to or Greater than 50 and Less than 1,000	Equal to or Greater than 25 and Less than 40 Greater than 6 & Less than 40
Intermediate	Equal to or Greater than 1,000 and Less than 50,000	Equal to or Greater than 40 and Less than 100
Large	Equal to or Greater than 50,000	Equal to or Greater than 100

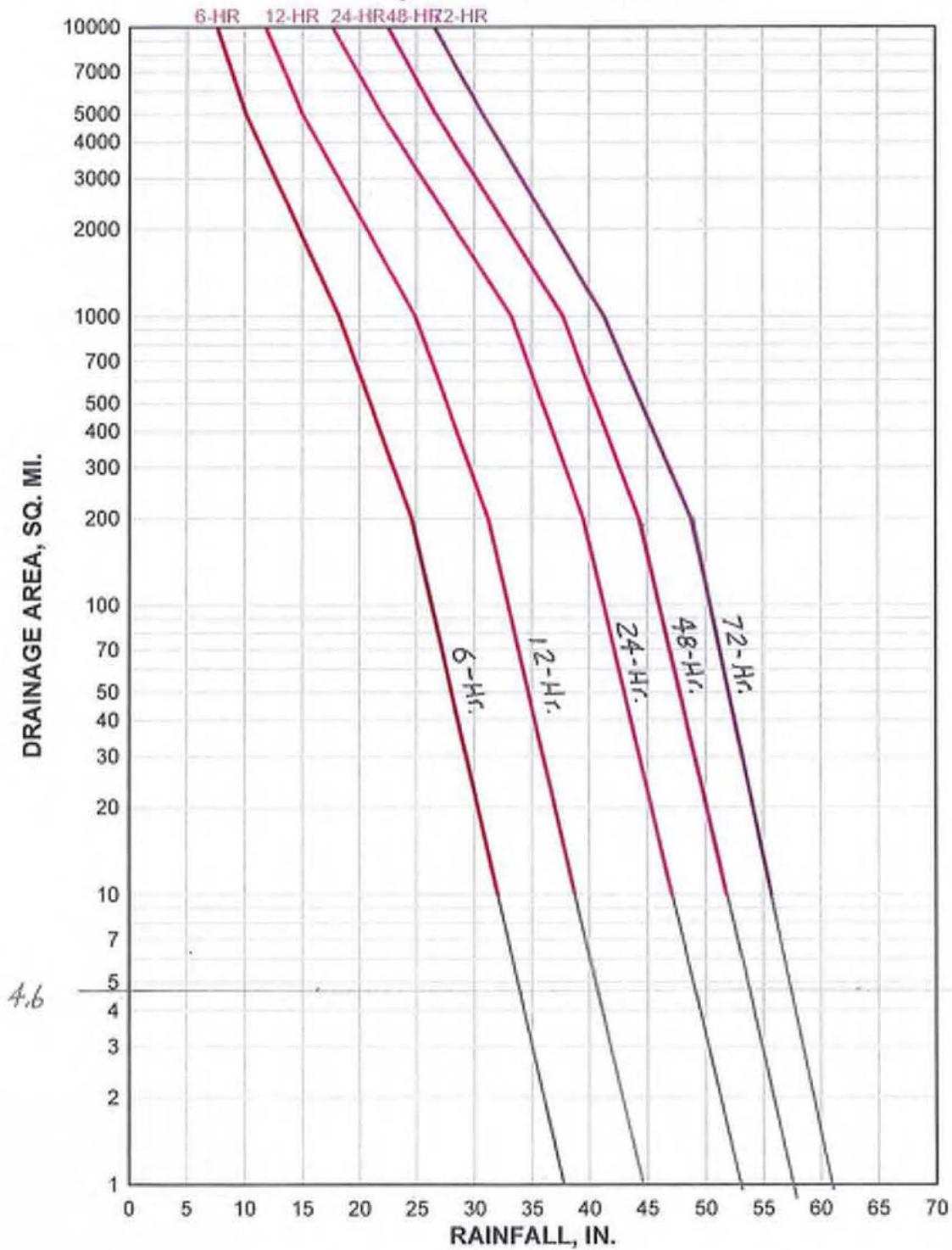
HYDROLOGIC CRITERIA FOR DAMS		
Classification		
Hazard, as defined in §299.14 of this title (relating to Hazard Classification Criteria)	Size, as defined in §299.13 of this title (relating to Size Classification Criteria)	Minimum Design Flood Hydrograph (expressed as a percentage of the probable maximum flood (PMF)).
Low	Small	25% PMF
	Intermediate	25% PMF to 50% PMF
	Large	50% to 75% PMF
Significant	Small	50% PMF
	Intermediate	50% PMF to 75% PMF
	Large	75% to PMF
High	Small	75% PMF
	Intermediate	75% to PMF
	Large	PMF
<p>When a range is given, the minimum flood hydrograph must be determined by straight-line interpolation within the given range. Interpolation must be based on either height of dam or maximum storage capacity, whichever results in the highest percentage of PMF. The interpolation for large, low-hazard dams for height must be between end points of 100 feet and 50% PMF and 200 feet and 75% PMF. The interpolation for large, low-hazard dams for maximum storage capacity must be between the end points of 50,000 acre-feet and 50% PMF and 300,000 acre-feet and 75% PMF. The interpolation for large, significant-hazard dams for height must be between end points of 100 feet and 75% PMF and 200 feet and PMF. The interpolation for large, significant-hazard for maximum storage capacity must be between the end points of 50,000 acre-feet and 75% PMF and 300,000 acre-feet and PMF.</p>		

PROBABLE MAXIMUM PERCIPITATION (PMP) from HMR 51 and 52								
Freq.	Drainage Area							
	4.6 mi <sup>2</sup>	1 mi <sup>2</sup>	10 mi <sup>2</sup>	100 mi <sup>2</sup>	200 mi <sup>2</sup>	1000 mi <sup>2</sup>	5000 mi <sup>2</sup>	10000 mi <sup>2</sup>
1-Hr	17.0 <u>1/</u>	19.40	16.00	11.25	9.31	5.24	2.33	1.75
2-Hr	22.5 <u>2/</u>							
3-Hr	26.2 <u>2/</u>							
6-Hr	33.5 <u>1/</u>		32.00		24.60	18.20	10.10	7.60
12-Hr	40.9 <u>1/</u>		38.70		31.20	24.90	15.00	11.80
24-Hr	49.0 <u>1/</u>		47.10		39.05	33.20	21.90	17.60
48-Hr	53.2 <u>1/</u>		51.80		44.30	37.70	26.60	22.50
72-Hr	57.2 <u>1/</u>		55.70		48.80	41.30	30.70	26.50

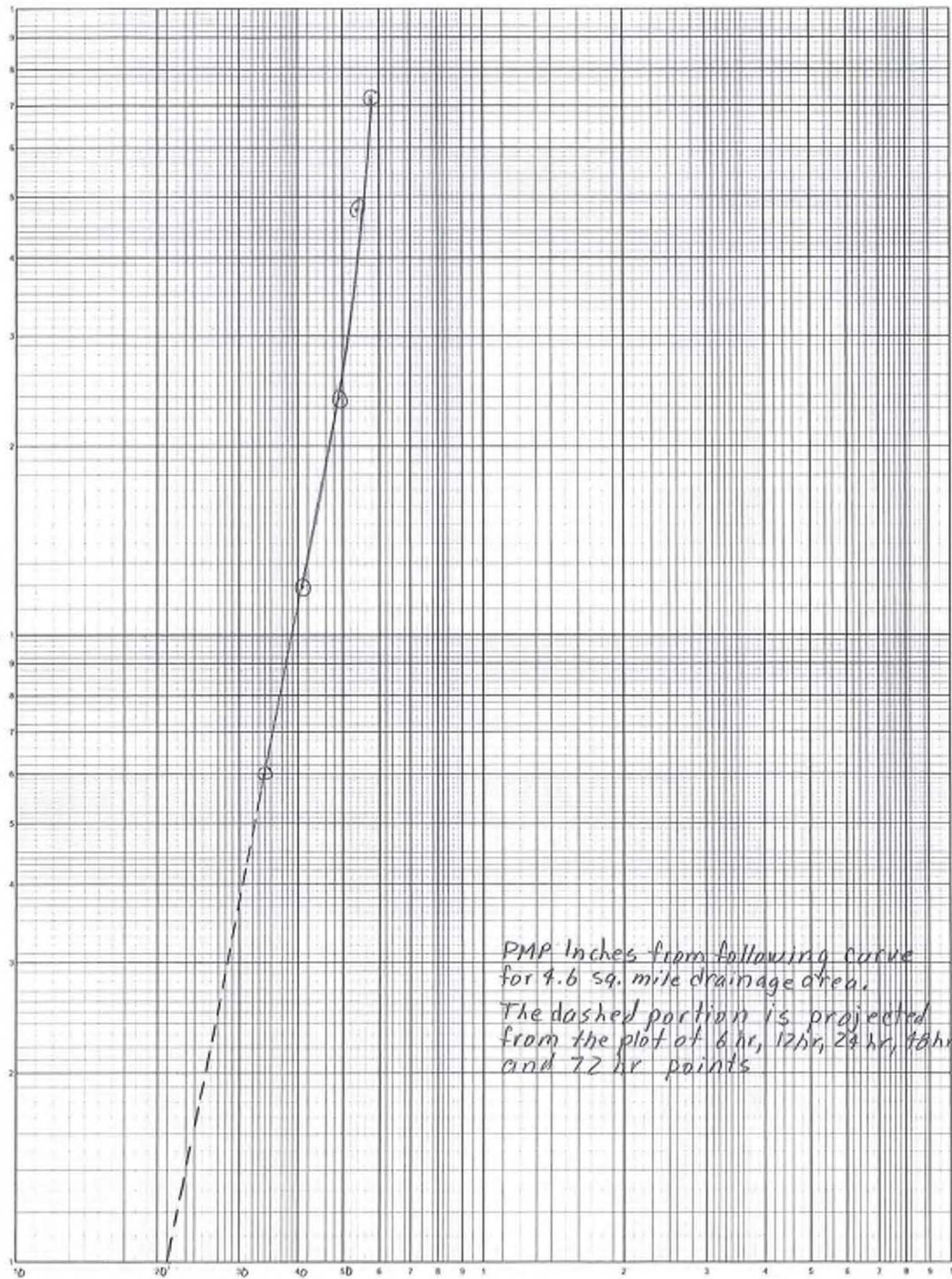
1/ Interpolated from log-linear plot of DA mi<sup>2</sup> vs rainfall inches for each freq.

2/ 1-Hr, 2-Hr & 3-Hr PMP's interpolated from log-log plot of freq vs. rainfall inches.

# PMP, RAINFALL VS. AREA



Duration, Hr.



PMP Inches from following curve for 4.6 sq. mile drainage area.  
The dashed portion is projected from the plot of 6 hr, 12hr, 24 hr, 48hr and 72 hr points

PMP, Inches

PMP Rainfall Conversion to 75% PMP

Freq.	PMP	PMF	75% PMF	75% PMP
1-Hr	21.2	19.95	14.96	16.5
2-Hr	25.4	23.84	17.88	19.44
3-Hr	28.2	26.63	19.97	21.52
6-Hr	33.9	32.32	24.24	25.8
12-Hr	40.7	39.11	29.33	30.9
24-Hr	49.1	47.5	35.63	37.21
48-Hr	53.9	52.3	39.23	40.82
72-Hr	57.5	55.9	41.93	43.52

**Appendix 5**  
**SITES Analysis**

# SITES Summary Table

	75%PMP 12hr	75%PMP 1hr	75%PMP 24hr	75%PMP 2hr	75%PMP 3hr	75%PMP 48hr
Site Identification	1	1	1	1	1	1
Watershed Runoff Curve Number	90.	90.	90.	90.	90.	90.
Total Watershed Drainage Area (Sq.Miles)	4.63	4.63	4.63	4.63	4.63	4.63
Watershed Time of Concentration (Hours)	3.20	3.20	3.20	3.20	3.20	3.20
SDH Rainfall Total (Inches)	N/A	N/A	N/A	N/A	N/A	N/A
SDH Rainfall Duration (Hours)	N/A	N/A	N/A	N/A	N/A	N/A
FBH or Storm Rainfall Total (Inches)	30.99	13.04	37.07	17.17	19.95	40.22
FBH or Storm Rainfall Duration (Hours)	12.0	1.0	24.0	2.0	3.0	48.0
SDH Inflow Peak (CFS)	N/A	N/A	N/A	N/A	N/A	N/A
FBH or Storm Inflow Peak (CFS)	14319.7	12706.0	10986.7	15382.9	14813.3	6380.7
Initial Reservoir Elevation (Feet)	192.00	192.00	192.00	192.00	192.00	192.00
Maximum WS SDH (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
Maximum WS FBH or Storm (Feet)	195.78	195.59	195.53	195.83	195.81	195.04
Storage at Max. WS FBH or Storm (Acre-Ft)	849.4	795.4	778.3	863.6	857.9	646.2
Top Dam (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
Storage, Top Dam (Acre-Ft)	N/A	N/A	N/A	N/A	N/A	N/A
Emb. Yardage (CY)	N/A	N/A	N/A	N/A	N/A	N/A
PSH Drawdown (Days)	N/A	N/A	N/A	N/A	N/A	N/A
378 Drawdown (Days)	N/A	N/A	N/A	N/A	N/A	N/A
PS Crest (Feet)	192.00	192.00	192.00	192.00	192.00	192.00
PS Number of Conduits	N/A	N/A	N/A	N/A	N/A	N/A
PS Conduit Diameter (Inches)	N/A	N/A	N/A	N/A	N/A	N/A
PS Conduit Height (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
PS Conduit Width (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
PS Conduit Area (Sq. Feet)	N/A	N/A	N/A	N/A	N/A	N/A
Storage, PS Crest (Acre-Ft)	N/A	N/A	N/A	N/A	N/A	N/A
PS Discharge at AS Crest (CFS)	2.0	2.0	2.0	2.0	2.0	2.0
PS Discharge for SDH (CFS)	N/A	N/A	N/A	N/A	N/A	N/A
PS Discharge FBH or Storm (CFS)	17.1	16.3	16.1	17.3	17.2	12.3
AS Crest (Feet)	192.50	192.50	192.50	192.50	192.50	192.50
Storage, AS Crest (Acre-Ft)	84.2	84.2	84.2	84.2	84.2	84.2
AS Width (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
AS Exit Slope (%)	N/A	N/A	N/A	N/A	N/A	N/A
AS Ret. Curve Index	N/A	N/A	N/A	N/A	N/A	N/A
AS Veg. Cover Factor	N/A	N/A	N/A	N/A	N/A	N/A
AS Maintenance Code	N/A	N/A	N/A	N/A	N/A	N/A
AS Max. Head SDH (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
AS Peak Discharge SDH/Storm (CFS)	N/A	N/A	N/A	N/A	N/A	N/A
AS Exit Velocity SDH or Storm (Ft/S)	N/A	N/A	N/A	N/A	N/A	N/A
AS Stress SDH or Storm (Lb./Sq.Ft.)	N/A	N/A	N/A	N/A	N/A	N/A
Hp FBH or Storm (Feet)	3.28	3.09	3.03	3.33	3.31	2.54
AS Peak Discharge FBH/Storm (CFS)	14179.	11704.	10959.	14814.	14551.	6368.
AS Integ. Dist. FBH or Storm (Feet)	N/A	N/A	N/A	N/A	N/A	N/A
Oe/B FBH or Storm (Acre-Ft/Ft)	N/A	N/A	N/A	N/A	N/A	N/A
Uncontrolled Drainage Area (Sq.Miles)	4.63	4.63	4.63	4.63	4.63	4.63
Number of Errors	0	0	0	0	0	0
Number of Warnings	0	0	0	0	0	0

# SITES

## Summary Table

	75%PMP 6hr	75%PMP 72hr	75%PMP 2hr-Rehab
Site Identification	1	1	1
Watershed Runoff Curve Number	90.	90.	90.
Total Watershed Drainage Area (Sq.Miles)	4.63	4.63	4.63
Watershed Time of Concentration (Hours)	3.20	3.20	3.20
SDH Rainfall Total (Inches)	N/A	N/A	N/A
SDH Rainfall Duration (Hours)	N/A	N/A	N/A
FBH or Storm Rainfall Total (Inches)	25.43	43.23	17.17
FBH or Storm Rainfall Duration (Hours)	6.0	72.0	2.0
SDH Inflow Peak (CFS)	N/A	N/A	N/A
FBH or Storm Inflow Peak (CFS)	14626.4	4573.9	15382.9
Initial Reservoir Elevation (Feet)	192.00	192.00	192.00
Maximum WS SDH (Feet)	N/A	N/A	N/A
Maximum WS FBH or Storm (Feet)	195.79	194.75	195.82
Storage at Max. WS FBH or Storm (Acre-Ft)	852.3	572.1	882.2
Top Dam (Feet)	N/A	N/A	N/A
Storage, Top Dam (Acre-Ft)	N/A	N/A	N/A
Emb. Yardage (CY)	N/A	N/A	N/A
PSH Drawdown (Days)	N/A	N/A	N/A
378 Drawdown (Days)	N/A	N/A	N/A
PS Crest (Feet)	192.00	192.00	192.00
PS Number of Conduits	N/A	N/A	N/A
PS Conduit Diameter (Inches)	N/A	N/A	N/A
PS Conduit Height (Feet)	N/A	N/A	N/A
PS Conduit Width (Feet)	N/A	N/A	N/A
PS Conduit Area (Sq. Feet)	N/A	N/A	N/A
Storage, PS Crest (Acre-Ft)	N/A	N/A	N/A
PS Discharge at AS Crest (CFS)	2.0	2.0	6.0
PS Discharge for SDH (CFS)	N/A	N/A	N/A
PS Discharge FBH or Storm (CFS)	17.1	11.0	165.7
AS Crest (Feet)	192.50	192.50	192.50
Storage, AS Crest (Acre-Ft)	84.2	84.2	99.5
AS Width (Feet)	N/A	N/A	N/A
AS Exit Slope (%)	N/A	N/A	N/A
AS Ret. Curve Index	N/A	N/A	N/A
AS Veg. Cover Factor	N/A	N/A	N/A
AS Maintenance Code	N/A	N/A	N/A
AS Max. Head SDH (Feet)	N/A	N/A	N/A
AS Peak Discharge SDH/Storm (CFS)	N/A	N/A	N/A
AS Exit Velocity SDH or Storm (Ft/S)	N/A	N/A	N/A
AS Stress SDH or Storm (Lb./Sq.Ft.)	N/A	N/A	N/A
Hp FBH or Storm (Feet)	3.29	2.25	3.32
AS Peak Discharge FBH/Storm (CFS)	14242.	4563.	14717.
AS Integ. Dist. FBH or Storm (Feet)	N/A	N/A	N/A
Oe/B FBH or Storm (Acre-Ft/Ft)	N/A	N/A	N/A
Uncontrolled Drainage Area (Sq.Miles)	4.63	4.63	4.63
Number of Errors	0	0	0
Number of Warnings	0	0	0

75%PMP 1hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:32

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 1-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 1.  
 RAINTABLE TCEQ1 1. TCEQ 1-hr  
 0 .5 1.  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCEQ1 13.04 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

1-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:32 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*  
 CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 1-hr

PRECIP. - STORM RF DURATION RF TABLE  
 13.04 1.00 TCEQ1

WSDATA - CN DA-SM TC/L -/H ORF  
 90.00 4.63 3.20 0.00 0.00

75%PMP 1hr.OUT

SITEDATA-	PERM POOL 0.00	CREST PS 192.00	FP SED 192.00	VALLEY FL 0.00	378? NO
	BASEFLOW 0.00	INITIAL EL 0.00	EXTRA VOL 0.00	SITE TYPE SIMULATION	
PSDATA -	NO. COND 0.00	COND L 0.00	DIA/W 0.00	-/H 0.00	
	PS N 0.000	KE 0.00	WEIR L 0.00	TW EL 0.00	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 192.00	
ASCRESTS -	AUX.1 0.00	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.Data -	REF.NO. 0	RETARD. Ci 0.00	TIE STATION 0.00	INLET LENGTH 0	
AUX.Data -	INLET N 0.000	SIDE SLOPE 0.00	EXIT N 0.000	EXIT SLOPE 0.000	ACTUAL AUX? NO
BTM WIDTH -	Bw1 0.00	Bw2 0.00	Bw3 0.00	Bw4 0.00	Bw5 0.00

1SITES

-----  
 XEQ 03/10/2014  
 VER 2005.1.7  
 TIME 08:20:32  
 SITE = 1 Warren Lake PASS= 1 WSID= SUBW= 1 PART= 2

CREST PS	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
AUX. CREST	192.50 FT	84.2 ACFT	177.00 AC	2.0 CFS
PS STORAGE	84.2 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.			
START ELEV	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
STORM HYD	D= 1.00 HR TC= 3.20 HR	P= 13.04 IN CN= 90.00	Q= 11.80 IN VOL= 2915.4 ACFT	DA= 4.63 SM
PEAK =	12706.0 CFS, AT 2.4 HRS.			

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 1 :  
 WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	192.00	0.00	0.00	0.00	0.00	160.00
2	192.50	2.00	2.00	0.00	84.25	177.00
3	193.00	115.00	4.00	111.00	176.75	193.00
4	193.50	376.00	6.00	370.00	278.00	212.00

	75%PMP 1hr.OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.59	793.6	279.6	3.09	709.3

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	16.	11704.	11721.

Inflow Hyd 1 PSH-Peak = 11720.50 CFS at 2.64 hrs., Location Point  
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

SITES.....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.1	195.6	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 1hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
1hr.D2C

OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
1hr.OUT

DATED 03/10/2014 08:20:32

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 1hr.DEC DATED 03/10/2014 08:20:32

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
1hr.DRG DATED 03/10/2014 08:20:32

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
1hr.DHY DATED 03/10/2014 08:20:32

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
1hr.DEM DATED 03/10/2014 08:20:32

75%PMP 2hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:35

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 2-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 2  
 RAINTABLE TCEQ2 2 TCEQ 2-hr  
 0 0.6 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCEQ2 17.17 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

2-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:35 SITE = 1 warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*

CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 2-hr

PRECIP. - STORM RF DURATION RF TABLE  
 17.17 2.00 TCEQ2

WSDATA - CN DA-SM TC/L -/H QRF  
 90.00 4.63 3.20 0.00 0.00



	75%PMP 2hr.OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.83	863.2	286.9	3.33	779.0

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	17.	14814.	14831.

Inflow Hyd 1 PSH-Peak = 14830.94 CFS at 3.05 hrs., Location Point HYDOUT 1 1

1SITES.....JOB NO. 1 COMPLETE.

- 0 SUBWATERSHED(S) ANALYZED.
- 1 STRUCTURE(S) ANALYZED.
- 1 HYDROGRAPHS ROUTED AT LOWEST SITE.
- 0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

SITES.....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.3	195.8	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 2hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
2hr.D2C

OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
2hr.OUT

DATED 03/10/2014 08:20:35

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 2hr.DEC DATED 03/10/2014 08:20:35

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
2hr.DRG DATED 03/10/2014 08:20:35

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
2hr.DHY DATED 03/10/2014 08:20:35

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
2hr.DEM DATED 03/10/2014 08:20:35

75%PMP 3hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:36

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 3-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 3  
 RAINTABLE TCEQ3 3 TCEQ 3-hr  
 0 0.5 0.75 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCEQ3 19.95 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

3-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:36 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*

CLIMATE AREA - NOT DEFINED DESIGN CLASS C  
 STORM DISTRIBUTION.....TCEQ 3-hr  
 PRECIP. - STORM RF DURATION RF TABLE  
 19.95 3.00 TCEQ3  
 WSDATA - CN DA-SM TC/L -/H QRF  
 90.00 4.63 3.20 0.00 0.00  
 Page 1

75%PMP 3hr.OUT

SITEDATA-	PERM POOL 0.00	CREST PS 192.00	FP SED 192.00	VALLEY FL 0.00	378? NO
	BASEFLOW 0.00	INITIAL EL 0.00	EXTRA VOL 0.00	SITE TYPE SIMULATION	
PSDATA -	NO. COND 0.00	COND L 0.00	DIA/W 0.00	-/H 0.00	
	PS N 0.000	KE 0.00	WEIR L 0.00	TW EL 0.00	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 192.00	
ASCRESTS -	AUX.1 0.00	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.Data -	REF.NO. 0	RETARD. Ci 0.00	TIE STATION 0.00	INLET LENGTH 0	
AUX.Data -	INLET N 0.000	SIDE SLOPE 0.00	EXIT N 0.000	EXIT SLOPE 0.000	ACTUAL AUX? NO
BTM WIDTH -	BW1 0.00	BW2 0.00	BW3 0.00	BW4 0.00	BW5 0.00

1SITES

-----  
 XEQ 03/10/2014  
 VER 2005.1.7  
 TIME 08:20:36

Warren Lake  
 SITE = 1 PASS= 1 WSID= SUBW= 1 PART= 2

CREST PS	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
AUX. CREST	192.50 FT	84.2 ACFT	177.00 AC	2.0 CFS
PS STORAGE	84.2 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.			
START ELEV	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
STORM HYD	D= 3.00 HR TC= 3.20 HR	P= 19.95 IN CN= 90.00	Q= 18.68 IN VOL= 4616.0 ACFT	DA= 4.63 SM
PEAK =	14813.3 CFS, AT 3.3 HRS.			

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 1 :  
 WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	192.00	0.00	0.00	0.00	0.00	160.00
2	192.50	2.00	2.00	0.00	84.25	177.00
3	193.00	115.00	4.00	111.00	176.75	193.00
4	193.50	376.00	6.00	370.00	278.00	212.00

	75%PMP 3hr.OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.81	857.3	286.3	3.31	773.1

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	17.	14551.	14568.

Inflow Hyd 1 PSH-Peak = 14568.37 CFS at 3.46 hrs., Location Point  
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	

PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.3	195.8	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 3hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
3hr.D2C

OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
3hr.OUT

DATED 03/10/2014 08:20:36

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 3hr.DEC DATED 03/10/2014 08:20:36

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
3hr.DRG DATED 03/10/2014 08:20:36

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
3hr.DHY DATED 03/10/2014 08:20:36

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
3hr.DEM DATED 03/10/2014 08:20:36

75%PMP 6hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:39

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 6-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 6  
 RAINTABLE TCEQ6 6 TCEQ 6-hr  
 0 0.6 0.8 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCEQ6 25.43 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

6-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:39 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*

CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 6-hr

PRECIP. - STORM RF DURATION RF TABLE  
 25.43 6.00 TCEQ6

WSDATA - CN DA-SM TC/L -/H QRF  
 90.00 4.63 3.20 0.00 0.00

75%PMP 6hr.OUT

SITEDATA-	PERM POOL 0.00	CREST PS 192.00	FP SED 192.00	VALLEY FL 0.00	378? NO
	BASEFLOW 0.00	INITIAL EL 0.00	EXTRA VOL 0.00	SITE TYPE SIMULATION	
PSDATA -	NO. COND 0.00	COND L 0.00	DIA/W 0.00	-/H 0.00	
	PS N 0.000	KE 0.00	WEIR L 0.00	TW EL 0.00	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 192.00	
ASCRESTS -	AUX.1 0.00	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.Data -	REF.NO. 0	RETARD. C 0.00	TIE STATION 0.00	INLET LENGTH 0	
AUX.Data -	INLET N 0.000	SIDE SLOPE 0.00	EXIT N 0.000	EXIT SLOPE 0.000	ACTUAL AUX? NO
BTM WIDTH -	BW1 0.00	BW2 0.00	BW3 0.00	BW4 0.00	BW5 0.00

1SITES

-----  
 XEQ 03/10/2014  
 VER 2005.1.7  
 TIME 08:20:39  
 SITE = 1      warren Lake      PASS= 1      WSID=      SUBW= 1      PART= 2

CREST PS	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
AUX. CREST	192.50 FT	84.2 ACFT	177.00 AC	2.0 CFS
PS STORAGE	84.2 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.			
START ELEV	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
STORM HYD	D= 6.00 HR TC= 3.20 HR	P= 25.43 IN CN= 90.00	Q= 24.14 IN VOL= 5967.5 ACFT	DA= 4.63 SM
PEAK =	14626.4 CFS, AT 3.3 HRS.			

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 1 :  
 WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	192.00	0.00	0.00	0.00	0.00	160.00
2	192.50	2.00	2.00	0.00	84.25	177.00
3	193.00	115.00	4.00	111.00	176.75	193.00
4	193.50	376.00	6.00	370.00	278.00	212.00

	75%PMP 6hr.OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.79	850.4	285.6	3.29	766.2

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	17.	14242.	14259.

Inflow Hyd 1 PSH-Peak = 14259.04 CFS at 3.46 hrs., Location Point  
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES.....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.3	195.8	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 6hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
6hr.D2C  
OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
6hr.OUT  
DATED 03/10/2014 08:20:39

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 6hr.DEC DATED 03/10/2014 08:20:39

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
6hr.DRG DATED 03/10/2014 08:20:39

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
6hr.DHY DATED 03/10/2014 08:20:39

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
6hr.DEM DATED 03/10/2014 08:20:39

75%PMP 12hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:31

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 12-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 12  
 RAINTABLE TCQ12 12 TCEQ 12-hr  
 0 0.7 0.85 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCQ12 30.99 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

12-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:31 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*  
 CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 12-hr

PRECIP. - STORM RF	DURATION	RF TABLE		
30.99	12.00	TCQ12		
WSDATA - CN	DA-SM	TC/L	-/H	ORF
90.00	4.63	3.20	0.00	0.00

75%PMP 12hr.OUT

SITEDATA-	PERM POOL 0.00	CREST PS 192.00	FP SED 192.00	VALLEY FL 0.00	378? NO
	BASEFLOW 0.00	INITIAL EL 0.00	EXTRA VOL 0.00	SITE TYPE SIMULATION	
PSDATA -	NO. COND 0.00	COND L 0.00	DIA/W 0.00	-/H 0.00	
	PS N 0.000	KE 0.00	WEIR L 0.00	TW EL 0.00	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 192.00	
ASCRESTS -	AUX.1 0.00	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.Data -	REF.NO. 0	RETARD. Ci 0.00	TIE STATION 0.00	INLET LENGTH 0	
AUX.Data -	INLET N 0.000	SIDE SLOPE 0.00	EXIT N 0.000	EXIT SLOPE 0.000	ACTUAL AUX? NO
BTM WIDTH -	BW1 0.00	BW2 0.00	BW3 0.00	BW4 0.00	BW5 0.00

1SITES

-----  
 XEQ 03/10/2014  
 VER 2005.1.7  
 TIME 08:20:31  
 SITE = 1      warren Lake      PASS= 1      WSID=      SUBW= 1      PART= 2

CREST PS	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
AUX. CREST	192.50 FT	84.2 ACFT	177.00 AC	2.0 CFS
PS STORAGE	84.2 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.			
START ELEV	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
STORM HYD	D= 12.00 HR TC= 3.20 HR	P= 30.99 IN CN= 90.00	Q= 29.70 IN VOL= 7339.7 ACFT	DA= 4.63 SM
PEAK =	14319.7 CFS, AT 4.7 HRS.			

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 1 :  
 WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE	
1 192.00	0.00	0.00	0.00	0.00	160.00	
2 192.50	2.00	2.00	0.00	84.25	177.00	
3 193.00	115.00	4.00	111.00	176.75	193.00	
4 193.50	376.00	6.00	370.00	278.00	212.00	

	75%PMP 12hr. OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.78	849.0	285.5	3.28	764.8

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	17.	14179.	14196.

Inflow Hyd 1 PSH-Peak = 14195.96 CFS at 4.69 hrs., Location Point HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

- 0 SUBWATERSHED(S) ANALYZED.
- 1 STRUCTURE(S) ANALYZED.
- 1 HYDROGRAPHS ROUTED AT LOWEST SITE.
- 0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX. CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.3	195.8	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 12hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
12hr.D2C  
OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
12hr.OUT  
DATED 03/10/2014 08:20:31

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 12hr.DEC DATED 03/10/2014 08:20:31

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
12hr.DRG DATED 03/10/2014 08:20:31

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
12hr.DHY DATED 03/10/2014 08:20:31

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
12hr.DEM DATED 03/10/2014 08:20:31

75%PMP 24hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:33

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 24-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM  
 RAINTABLE TCQ24 24 TCEQ 24-hr  
 0 0.8 0.9 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCQ24 37.07 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

24-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:33 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*

CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 24-hr

PRECIP. - STORM RF DURATION RF TABLE  
 37.07 24.00 TCQ24

WSDATA - CN DA-SM TC/L -/H QRF  
 90.00 4.63 3.20 0.00 0.00

75%PMP 24hr.OUT

SITEDATA- PERM POOL	0.00	CREST PS	192.00	FP SED	192.00	VALLEY FL	0.00	378?	NO
	BASEFLOW	INITIAL EL	0.00	EXTRA VOL	0.00	SITE TYPE	SIMULATION		
PSDATA - NO.	COND	COND L	0.00	DIA/W	0.00	-/H	0.00		
	PS N	KE	0.00	WEIR L	0.00	TW EL	0.00		
	2ND STG	ORF H	0.00	ORF L	0.00	START AUX.	192.00		
ASCRESTS - AUX.1	0.00	AUX.2	0.00	AUX.3	0.00	AUX.4	0.00		
AUX.Data - REF.NO.	0	RETARD. C <sub>i</sub>	0.00	TIE STATION	0.00	INLET LENGTH	0		
AUX.Data - INLET N	0.000	SIDE SLOPE	0.00	EXIT N	0.000	EXIT SLOPE	0.000	ACTUAL AUX?	NO
BTM WIDTH - BW1	0.00	BW2	0.00	BW3	0.00	BW4	0.00		

1SITES

-----  
 XEQ 03/10/2014  
 VER 2005.1.7  
 TIME 08:20:33  
 SITE = 1      warren Lake      PASS= 1      WSID=      SUBW= 1      PART= 2

CREST PS	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
AUX. CREST	192.50 FT	84.2 ACFT	177.00 AC	2.0 CFS
PS STORAGE	84.2 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.			
START ELEV	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
STORM HYD	D= 24.00 HR	P= 37.07 IN	Q= 35.77 IN	DA= 4.63 SM
	TC= 3.20 HR	CN= 90.00	VOL= 8840.9 ACFT	
PEAK =	10986.7 CFS, AT 7.9 HRS.			

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 1 :  
 WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
	ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE
1	192.00	0.00	0.00	0.00	0.00	160.00
2	192.50	2.00	2.00	0.00	84.25	177.00
3	193.00	115.00	4.00	111.00	176.75	193.00
4	193.50	376.00	6.00	370.00	278.00	212.00

	75%PMP 24hr. OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.53	776.9	277.8	3.03	692.6

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	16.	10959.	10975.

Inflow Hyd 1 PSH-Peak = 10974.82 CFS at 7.94 hrs., Location Point  
HYDOUT 1 1

1SITES.....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES.....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX. CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR. DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.0	195.5	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 24hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
24hr.D2C  
OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
24hr.OUT  
DATED 03/10/2014 08:20:33

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 24hr.DEC DATED 03/10/2014 08:20:33

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
24hr.DRG DATED 03/10/2014 08:20:33

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
24hr.DHY DATED 03/10/2014 08:20:33

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
24hr.DEM DATED 03/10/2014 08:20:33

75%PMP 48hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:37

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 48-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 48  
 RAINTABLE TCQ48 48 TCEQ 48-hr  
 0 0.85 0.925 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO,STORM QLI TCQ48 40.22 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

48-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:37 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*

CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 48-hr

PRECIP. - STORM RF DURATION RF TABLE  
 40.22 48.00 TCQ48  
 WSDATA - CN DA-SM TC/L -/H QRF  
 90.00 4.63 3.20 0.00 0.00  
 Page 1

75%PMP 48hr.OUT

SITEDATA-	PERM POOL 0.00	CREST PS 192.00	FP SED 192.00	VALLEY FL 0.00	378? NO
	BASEFLOW 0.00	INITIAL EL 0.00	EXTRA VOL 0.00	SITE TYPE SIMULATION	
PSDATA -	NO. COND 0.00	COND L 0.00	DIA/W 0.00	-/H 0.00	
	PS N 0.000	KE 0.00	WEIR L 0.00	TW EL 0.00	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 192.00	
ASCRESTS -	AUX.1 0.00	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.Data -	REF.NO. 0	RETARD. Ci 0.00	TIE STATION 0.00	INLET LENGTH 0	
AUX.Data -	INLET N 0.000	SIDE SLOPE 0.00	EXIT N 0.000	EXIT SLOPE 0.000	ACTUAL AUX? NO
BTM WIDTH -	BW1 0.00	BW2 0.00	BW3 0.00	BW4 0.00	BW5 0.00

ISITES

XEQ 03/10/2014  
VER 2005.1.7  
TIME 08:20:37

Warren Lake  
SITE = 1 PASS= 1 WSID= SUBW= 1 PART= 2

CREST PS	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
AUX. CREST	192.50 FT	84.2 ACFT	177.00 AC	2.0 CFS
PS STORAGE 84.2 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.				
START ELEV	192.00 FT	0.0 ACFT	160.00 AC	0.0 CFS
STORM HYD	D= 48.00 HR TC= 3.20 HR	P= 40.22 IN CN= 90.00	Q= 38.92 IN VOL= 9618.9 ACFT	DA= 4.63 SM
PEAK =	6380.7 CFS, AT 15.9 HRS.			

\*\*\*\*\*  
RATING TABLE DEVELOPED, SITE = 1 ;  
WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE	
1	192.00	0.00	0.00	0.00	160.00	
2	192.50	2.00	2.00	84.25	177.00	
3	193.00	115.00	4.00	176.75	193.00	
4	193.50	376.00	6.00	278.00	212.00	

	75%PMP 48hr. OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.04	645.6	261.3	2.54	561.3

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	12.	6368.	6380.

Inflow Hyd 1 PSH-Peak = 6380.19 CFS at 15.66 hrs., Location Point  
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	2.5	195.0	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 48hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
48hr.D2C  
OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
48hr.OUT

DATED 03/10/2014 08:20:37

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 48hr.DEC DATED 03/10/2014 08:20:37

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
48hr.DRG DATED 03/10/2014 08:20:37

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
48hr.DHY DATED 03/10/2014 08:20:37

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
48hr.DEM DATED 03/10/2014 08:20:37

75%PMP 72hr.OUT

\*\*\*\*\*  
 SITES XEQ 03/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 08:20:40

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* 72-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 160 0  
 192.5 177 2 0  
 193 193 4 111  
 193.5 212 6 370  
 194 232 8 1260  
 194.5 247 10 3118  
 195 260 12 6021  
 195.5 277 16 10641  
 196 292 18 16991  
 196.5 307 19 25138  
 197 322 20 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM  
 RAINTABLE TCQ72 72 TCEQ 72-hr  
 0 0.85 0.925 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO, STORM QLI TCQ72 43.23 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 03/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

72-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 03/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 08:20:40 SITE = 1 Warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*

CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 72-hr

PRECIP. - STORM RF DURATION RF TABLE  
 43.23 72.00 TCQ72

WSDATA - CN DA-SM TC/L -/H QRF  
 90.00 4.63 3.20 0.00 0.00



	75%PMP 72hr. OUT					
5	194.00	1268.00	8.00	1260.00	389.00	232.00
6	194.50	3128.00	10.00	3118.00	508.75	247.00
7	195.00	6033.00	12.00	6021.00	635.50	260.00
8	195.50	10657.00	16.00	10641.00	769.75	277.00
9	196.00	17009.00	18.00	16991.00	912.00	292.00
10	196.50	25157.00	19.00	25138.00	1061.75	307.00
11	197.00	34534.00	20.00	34514.00	1219.00	322.00

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	194.75	571.8	253.6	2.25	487.6

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	11.	4563.	4574.

Inflow Hyd 1 PSH-Peak = 4573.67 CFS at 23.78 hrs., Location Point  
HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR.* DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	2.2	194.8	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 72hr.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
FILES

INPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
72hr.D2C  
OUTPUT = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
72hr.OUT  
DATED 03/10/2014 08:20:40

FILE GEN. = m:\PUBLIC\Projects - Current\Ince Engineering\warren  
Lake\SITES\75%PMP 72hr.DEC DATED 03/10/2014 08:20:40

GRAPHICS FILES GENERATED

OPTION "L" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
72hr.DRG DATED 03/10/2014 08:20:40

OPTION "P" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
72hr.DHY DATED 03/10/2014 08:20:40

OPTION "E" = m:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
72hr.DEM DATED 03/10/2014 08:20:40

75%PMP 2hr-Rehab.OUT

\*\*\*\*\*  
 SITES XEQ 04/10/2014 WATER RESOURCE SITE ANALYSIS COMPUTER PROGRAM  
 VER 2005.1.7 (USER MANUAL - DATED DECEMBER 2005)  
 TIME 13:46:19

\*\*\*\*\* 80-80 LIST OF INPUT Data \*\*\*\*\*

SITES 01/01/2005 4.634375 I8  
 SAVMOV 0 101  
 SAVMOV 101 1 1  
 \* Modified embankment with new storage  
 \* 2-Hr 75% PMP  
 STRUCTURE 1 Warren Lake  
 192 196.36 0  
 192.5 201.45 6 0  
 193 206.55 18 111  
 193.5 211.65 29 370  
 194 216.74 35 1260  
 194.5 232.95 57 3118  
 195 249.17 97 6021  
 195.5 265.38 149 10641  
 196 281.59 175 16991  
 196.5 298.59 245 25138  
 197 315.6 322 34514  
 ENDTABLE  
 WSDATA 5C 1 AC 90 2966 3.2  
 STORM 2  
 RAINTABLE TCEQ2 2 TCEQ 2-hr  
 0 0.6 1  
 ENDTABLE  
 POOLDATA ELEV 192 192  
 GRAPHICS I  
 GO, STORM QLI TCEQ2 17.17 192  
 SAVMOV 2 101 1 1  
 ENDJOB

\*\*\*\*\*

1SITES XEQ 04/10/2014 ----- COMMENT PAGE -----  
 VER 2005.1.7 WSID =

Modified embankment with new storage  
 2-Hr 75% PMP

\*\*\*\*\* MESSAGE - DRAINAGE AREA FROM WSDATA CONTROL BEING CONVERTED FROM  
 ACRES TO SQUARE MILES FOR COMPUTATION PURPOSES.

1SITES -----  
 XEQ 04/10/2014 WSID=  
 VER 2005.1.7 SUBW= 1  
 TIME 13:46:19 SITE = 1 warren Lake PASS= 1 PART= 1

\*\*\*\*\* BASIC Data \*\*\*\*\*  
 CLIMATE AREA - NOT DEFINED DESIGN CLASS C

STORM DISTRIBUTION.....TCEQ 2-hr

PRECIP. - STORM RF DURATION RF TABLE  
 17.17 2.00 TCEQ2  
 Page 1

75%PMP 2hr-Rehab.OUT

WSDATA -	CN 90.00	DA-SM 4.63	TC/L 3.20	-/H 0.00	QRF 0.00
SITEDATA-	PERM POOL 0.00	CREST PS 192.00	FP SED 192.00	VALLEY FL 0.00	378? NO
	BASEFLOW 0.00	INITIAL EL 0.00	EXTRA VOL 0.00	SITE TYPE SIMULATION	
PSDATA -	NO. COND 0.00	COND L 0.00	DIA/W 0.00	-/H 0.00	
	PS N 0.000	KE 0.00	WEIR L 0.00	TW EL 0.00	
	2ND STG 0.00	ORF H 0.00	ORF L 0.00	START AUX. 192.00	
ASCRESTS -	AUX.1 0.00	AUX.2 0.00	AUX.3 0.00	AUX.4 0.00	AUX.5 0.00
AUX.Data -	REF.NO. 0	RETARD. Ci 0.00	TIE STATION 0.00	INLET LENGTH 0	
AUX.Data -	INLET N 0.000	SIDE SLOPE 0.00	EXIT N 0.000	EXIT SLOPE 0.000	ACTUAL AUX? NO
BTM WIDTH -	BW1 0.00	BW2 0.00	BW3 0.00	BW4 0.00	BW5 0.00

1SITES

-----  
 XEQ 04/10/2014  
 VER 2005.1.7  
 TIME 13:46:19  
 SITE = 1 Warren Lake PASS= 1 WSID= SUBW= 1 PART= 2

CREST PS	192.00 FT	0.0 ACFT	196.36 AC	0.0 CFS
SED ACCUM	192.00 FT	0.0 ACFT	196.36 AC	0.0 CFS
AUX. CREST	192.50 FT	99.5 ACFT	201.45 AC	6.0 CFS
PS STORAGE	99.5 ACFT, BETWEEN AUX. CREST AND SED. ACCUM ELEVATIONS.			
START ELEV	192.00 FT	0.0 ACFT	196.36 AC	0.0 CFS
STORM HYD	D= 2.00 HR	P= 17.17 IN	Q= 15.91 IN	DA= 4.63 SM
	TC= 3.20 HR	CN= 90.00	VOL= 3931.2 ACFT	
PEAK =	15382.9 CFS, AT 3.1 HRS.			

\*\*\*\*\*  
 RATING TABLE DEVELOPED, SITE = 1 :  
 WITH PS AND AUX. GIVEN - NO ASDATA RECORD GIVEN.

RATING TABLE NUMBER	2					
ELEV. FEET	Q-TOTAL CFS	Q-PS CFS	Q-AUX. CFS	VOLUME AC-FT	AREA ACRE	
1 192.00	0.00	0.00	0.00	0.00	196.36	

Page 2

75%PMP 2hr-Rehab.OUT

2	192.50	6.00	6.00	0.00	99.45	201.45
3	193.00	129.00	18.00	111.00	201.45	206.55
4	193.50	399.00	29.00	370.00	306.00	211.65
5	194.00	1295.00	35.00	1260.00	413.10	216.74
6	194.50	3175.00	57.00	3118.00	525.52	232.95
7	195.00	6118.00	97.00	6021.00	646.05	249.17
8	195.50	10790.00	149.00	10641.00	774.69	265.38
9	196.00	17166.00	175.00	16991.00	911.43	281.59
10	196.50	25383.00	245.00	25138.00	1056.48	298.59
11	197.00	34836.00	322.00	34514.00	1210.03	315.60

ROUTING OF STORM HYDROGRAPH STARTS AT ELEVATION 192.00

ROUTED RESULTS	BTM WIDTH FT	MAX ELEV FT	VOL-MAX ACFT	AREA-MAX AC	AUX.-HP FT	VOL-AUX. ACFT
STORM HYD	0.0	195.82	862.5	275.9	3.32	763.0

\*\*\*\*\* MESSAGE - ROUTING ONLY: NO AUXILIARY SPILLWAY ANALYSIS

PEAK - CFS DISCHARGE =	Q-PS	Q-AUX.	Q-TOT.
	166.	14717.	14883.

Inflow Hyd 1 PSH-Peak = 14882.85 CFS at 3.05 hrs., Location Point  
 HYDOUT 1 1

1SITES....JOB NO. 1 COMPLETE.

0 SUBWATERSHED(S) ANALYZED.

1 STRUCTURE(S) ANALYZED.

1 HYDROGRAPHS ROUTED AT LOWEST SITE.

0 TRIALS TO OBTAIN BOTTOM WIDTH FOR SPECIFIED STRESS OR VELOCITY.

\*\*\*\*\*

SITES....COMPUTATIONS COMPLETE

>>>	SITE ID	SUBWS ID	SUBWS DA (SQ MI)	CURVE NO.	TC (HRS)	TOTAL DA (SQ MI)	TYPE DESIGN	STRUC CLASS	<<<
	1	1	4.63	90.	3.20	4.63	TR60	C	
PASS NO.	DIA./WIDTH (IN/FT)	AUX.CREST ELEV (FT)	BTM. WIDTH (FT)	MAX. HP (FT)	MAX. ELEV (FT)	EMB. VOL. (CY)	INTEGR. DIST. (FT)	EXIT* VEL. (FT/SEC)	TYPE HYD
1	0.0	192.5	0.0	3.3	195.8	0.	0.	0.0	STORM HYD

\* INTEGRITY DIST. AND EXIT VEL. VALUES ARE BASED ON THE ROUTED HYDROGRAPH SHOWN UNDER TYPE HYD.

75%PMP 2hr-Rehab.OUT

SITES.....SUMMARY TABLE 1 COMPLETED.

NRCS SITES VERSION 2005.1.7 ,01/01/2005  
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DATED 04/10/2014 13:46:19

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GRAPHICS FILES GENERATED

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2hr-Rehab.DHY DATED 04/10/2014 13:46:19

OPTION "E" = M:\PUBLIC\Projects - Current\Ince Engineering\warren Lake\SITES\75%PMP  
2hr-Rehab.DEM DATED 04/10/2014 13:46:19

# Warren Lake and Dam Retrofit Project No Adverse Impact Report



2/27/2023

Prepared by John R Blount PE

Civil Solutions

Texas Registered Engineering Firm F-22913

4378 Varsity Ln. Houston Tx 77004

# Index

Project Description

History of Dam

Current Status of Dam

Regulatory Approvals Granted for the Project

Evaluation of Project Hydrology.

No Adverse Impact Statement

## Exhibits

A Original Dam Plans

B 2005 TCEQ Dam Sketch

C 2005 TCEQ Spillway Photos

D 2023 Civil Solutions Spillway Photos

E Regulatory Approval Documents

F TCEQ Dam Hydrology Submittals

## Project Description

The Katy Prairie Conservancy proposes to retrofit and enhance the existing Warren Lake dam, create a wetlands complex, and restore tallgrass prairie surrounding the lake and wetlands. This detention basin, incorporating green infrastructure, will increase the level of protection provided downstream by increasing the flood water capacity of the lake and surrounding land, adding approximately 856 acre-feet of storage during rainfall events. The value added to the region by simply preserving natural lands on the Katy Prairie offers many benefits, including flood mitigation. Yet, the further restoration of land provides an even more significant value to the region, as the restoration of tallgrass prairie increases the amount of organic matter in the soil and leads to deep root systems that provide increased water holding capacity and enhanced soil porosity. The retrofitting of the Warren Lake Dam and installation of green infrastructure on surrounding lands on the property will increase the dam's ability to retain floodwaters during heavy rainfall events, increase the available acre-feet of flood storage, and improve groundwater infiltration. This active restoration will reduce strain on existing drainage systems and flood infrastructure in Harris County, by retaining the water during storm events, and slowly releasing it over time.

Civil Solutions, a Houston based consulting engineering firm, was retained to prepare this report due to the unique qualifications of myself, Principal of Civil Solutions, John Blount PE. I served as the County Engineer of Harris County from January 2015 until my retirement after 34 years of service with Harris County in September of 2021. The County Engineers Office approved this project when plans were originally submitted.

## History of Dam

The Warren Lake Dam is reported to have been constructed in 1961 . Proposed Drawings are provided in Exhibit A and are Dated January 21, 1952. These drawings show a 2000-foot-long Dam with two earthen spillways 100 foot each on either side of the Dam. The proposed height is approximately 20 feet. The spillways were proposed to be approximately 5 foot below the top of the Dam. The calculated storage volume was proposed to be 640-acre feet. Jim Warren reports that a service outlet structure was added sometime in the 1980's or 1990's by the ranch manager at the time, likely due to continued spillway erosion.

In the 2005 TCEQ Dam Inspection Report, the agency states that the as-built Dam has normal capacity of 987-acre feet and a maximum storage volume of 2000-acre feet. Additionally, they report a normal water service elevation of 194.5 msl (no reference to datum provided). They also report a gravel lined 120-foot spillway, although their sketch labels it as 220 feet wide. The service outlet structure was blocked and underwater by 1.5 feet at the time of the inspection, causing the lake level to be 196 msl (no datum given). The picture of the spillway at the time ( see exhibit C ) shows it not passing flow which indicates its elevation to be higher than the reported lake level at the time.

## Current Status of the Dam

On February 20 2023 Civil Solutions visited the Warren Lake Dam to determine its current status. Since the TCEQ 2005 inspection substantial erosion and alterations have occurred at the spill way. This was due to massive flooding occurring during Harvey and the Tax Day Flood and attempts to keep the Dam from failing.

The surface outlet was fully exposed and the lake was down a minimum of 5 foot below the normal water service elevation of 194.5 msl based on the depth of the cut measured in the spillway (6 feet) and the fact that during the 2005 TCEQ inspection the spillway was dry when the lake was reported to be at 196' msl (see exhibit C)

A channel 6 foot deep with a top channel width of 30' and a bottom channel width of 27' was discovered cut into the existing spillway . This 6-foot loss of storge volume results in approximately 960-acre feet of stormwater storage being discharged, instead of retained, based on the normal pool surface area of 160 acres reported by the TCEQ. A channel this size is capable of discharging approximately 1330 cfs as opposed to the existing outlet control structure, if functioning, that would discharge approximately 70 cfs. The current condition of the Dam significantly undermines its ability to function as a wet detention pond.

## Regulatory Approvals Granted for the Project.

The project was approved by four levels of Government as required by their scope of regulatory control. Each of these agencies have a requirement that they cannot approve projects that have an adverse impact.

The project was approved by Harris County Flood Control District , a special purpose district , in November 2016 by approval of the proposed plans. The same set of plans were approved in the same month by Harris County Engineering Department, a department of the Local Government, Harris County. Additionally, a development permit was issued by Harris County in December of 2016 signifying its approval, contingent on all state and federal approvals being obtained.

The Texas Commission on Environmental Quality TCEQ , a state agency, granted final approval for the project in November 2017, as indicated by the letter they sent the Engineer of Record. The Army Corps of Engineers, a federal agency, approved the project in December of 2016 as indicated by the Nationwide Permit Verification letter sent in December of 2016 to the Katy Prairie Conservancy.

The approvals can be found in Exhibit E. This on its face value shows the project must have no adverse impact of the four levels of government could not have approved it.

Typically, Hydrology reports prepared by a registered professional engineer would be required for these reviews, and this project was no exception. In Exhibit F you will find the Hydrologic information submitted to the TCEQ to support their approval. The state is looking at the hydrology for two purposes, one to ensure no adverse impact and the other to insure adequacy of the design in the 51% Probable Maximum Flood. When looking at the documentation in Exhibit F you see the proposed dam will not reach peak discharge until a 3-hour event as opposed to the 2005 Dam configuration which peaks at a 2-hour event.

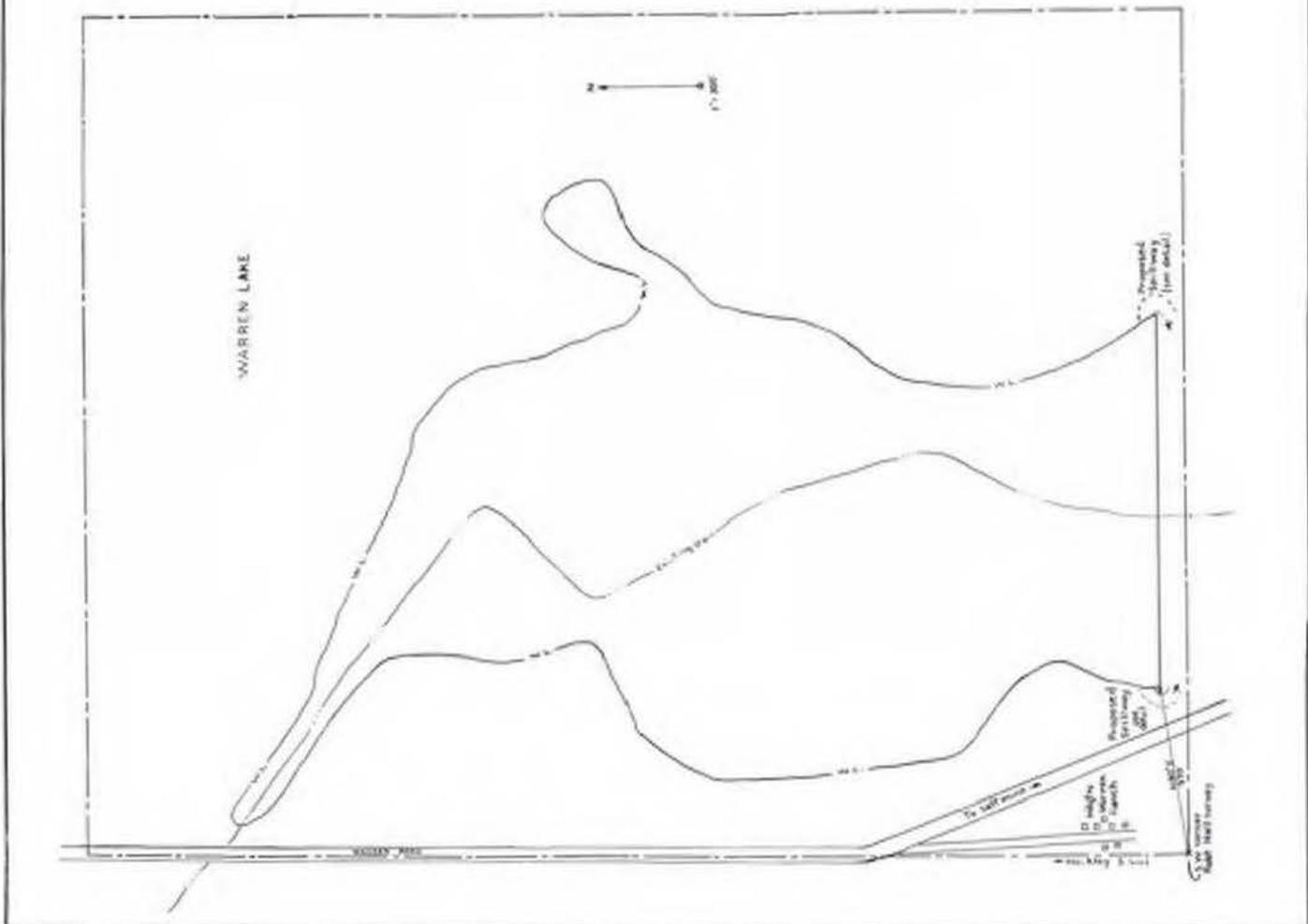
## Evaluation of Project Hydrology

Civil Solutions reviewed the Engineer of Record's analysis as well as the current condition of the Dam. We also evaluated the capacity of the eroded channel in the spillway, as well as the hydraulic capacity of the existing and proposed control structures. It should be noted that at the time of our visit it had not rained any significant amount in several days and the eroded spillway was passing a small flow. This indicates that the lake in its current condition is free flowing and provides no buffering and does not act as a wet detention, except in an event that exceeds the eroded channel, outlet control capacity and existing spillway capacity, if such a rain event is possible. This is unlike the Dam condition at the time of the 2005 TCEQ inspection. The proposed Project provides additional stormwater mitigation through enhanced prairie and wetland formation which further slows and mitigates storm water peak discharges.

### No Adverse Impact

It is my opinion that the proposed project will not adversely impact upstream, downstream or adjacent property owners . All adverse impacts of the project(impounding of storm water ) will occur on property the project owner controls. This statement is based on three factors, the first being the approval of the four levels of government having jurisdiction. Second, my review of the Engineer of Record's Hydrology submittal. Finally, my inspection of the current condition of the dam, calculations of the capacity of the eroded channel in the spillway, and current and proposed outlet control structures.

Exhibit A - Original Dam Plans



I certify that the foregoing correctly represents the results of surveys made by me on January 20, 1912, and that the application by the Warren Ranch Co., which accompanies it, is valid.  
 Surveyor  
 Brecken, Texas.

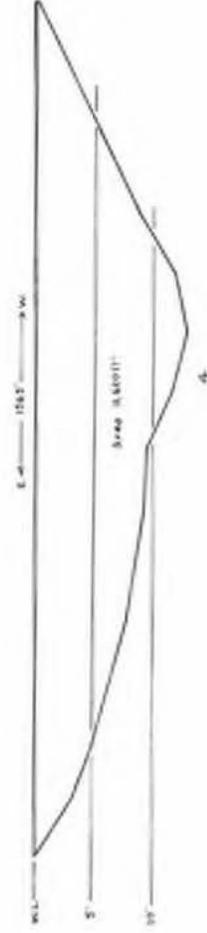
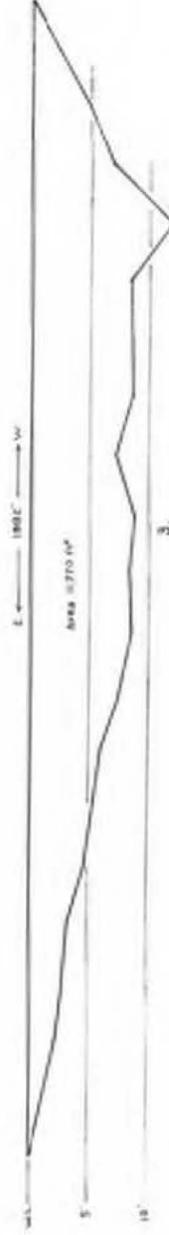
Accepted, in filing in the office of the Board of Water Engineers of Texas on the \_\_\_\_\_ day of \_\_\_\_\_ 1912.

\_\_\_\_\_  
 Chairman  
 Secretary

WARREN LAKE			
Scale shown	Drawing Date	Sheet	Checklist
		1 of 3	L.P.
Date of application:			



# LAKE CROSS SECTIONS



Cross Section No.	Area (sq. ft.)	Perimeter (ft.)	Section Length (ft.)	Volume (cu. ft.)	Volume (cu. yd.)
1	4,500	7,184	296	43,100	1,610
2	10,028	15,924	330	88,100	3,240
3	6,770	9,685	222	876,000	32,000
4	4,400	11,700	226	430,000	15,500
5	14,800				540

5 Cross section as is shown on sheet 2 as cellular profile

Exhibit B  
2005 TCEQ Dam Sketch

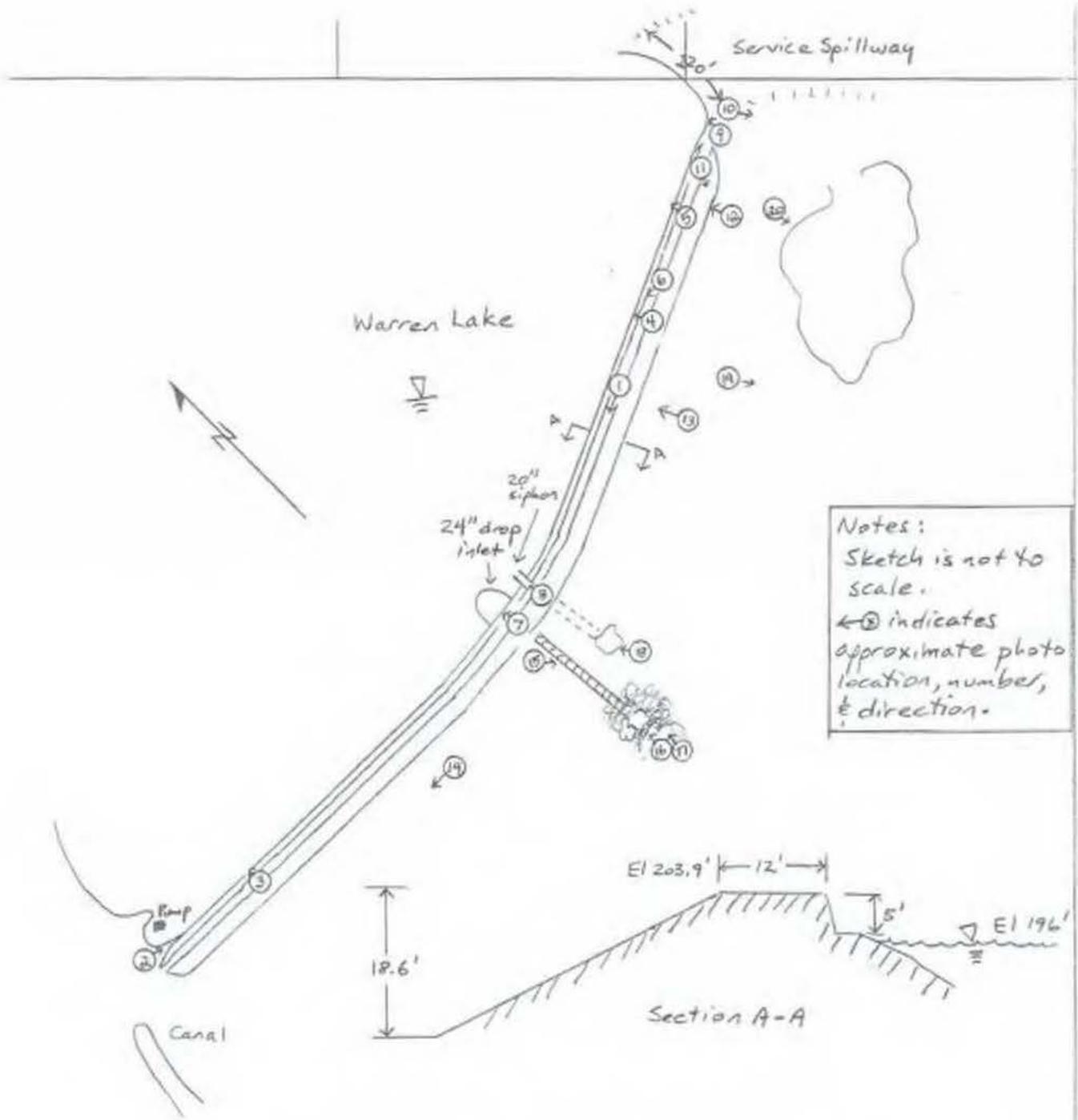


Figure 2. Warren Lake Dam & Vicinity

Exhibit C  
2005 TCEQ Spillway Photos



**Photo 9. Emergency Spillway Inlet**



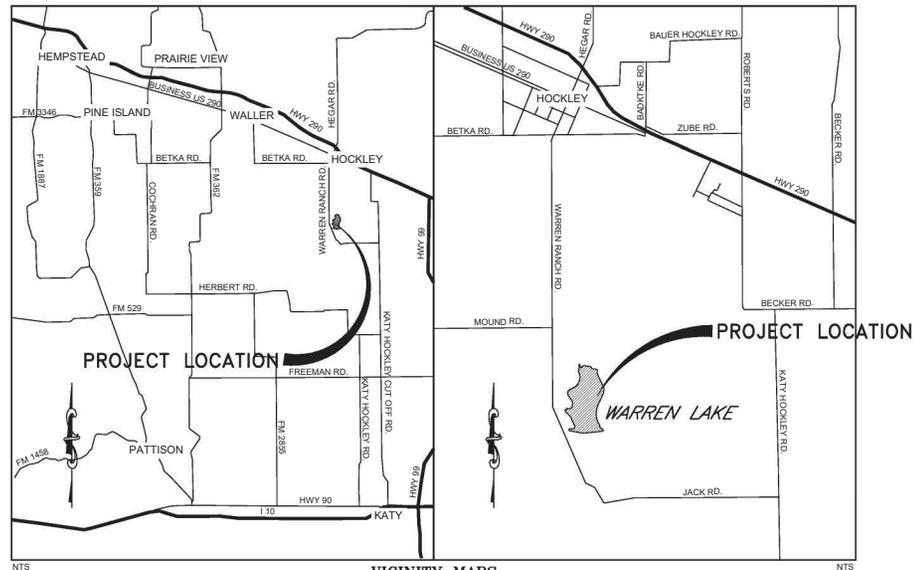
**Photo 10. Downstream Emergency Spillway**

Exhibit D  
2023 Civil Solutions Spillway Photos



Exhibit E  
Regulatory Approval Documents

REHABILITATION  
OF  
WARREN LAKE  
LOCATED ON  
*ROCK HOLLOW CREEK*  
PRESENTED FOR  
KATY PRAIRIE CONSERVANCY & WARREN RANCH  
LOCATED IN  
HARRIS COUNTY, TEXAS



VICINITY MAPS  
MARCH 2016



WARREN RANCH



INDEX OF DRAWINGS

- 1 EXPRESS SHEET
- 2 GENERAL PLAN
- 3 EXISTING CONDITIONS - PLAN AND PROFILE
- 4 PROPOSED MODIFICATIONS - PLAN AND PROFILE
- 5-7 EMBANKMENT SECTIONS
- 8 FOUNDATION TRENCH DRAIN DETAILS
- 9 PRIMARY AUXILIARY SPILLWAY - PLAN AND PROFILE
- 10 PRIMARY AUXILIARY SPILLWAY - CROSS SECTIONS
- 11 PRINCIPAL SPILLWAY - PLAN AND PROFILE
- 12 PRINCIPAL SPILLWAY - OUTLET DETAILS
- 13-15 PRINCIPAL SPILLWAY - INLET DETAILS
- 16 PRINCIPAL SPILLWAY - TRASH RACK
- 17 STORM WATER POLLUTION PREVENTION PLAN
- 18 STORM WATER POLLUTION PREVENTION PLAN DETAILS
- 19 FEMA FLOOD MAP
- 20 FLOODPLAIN CUT AND FILL VOLUME



**M&E CONSULTANTS**

Soil & Water Engineering Solutions  
F-4324

**1. PAVING** (FOR H.C. PUBLIC ROW ONLY)

DESIGN THICKNESS OF PAVING (IN.)	STABILIZED SUBGRADE DEPTH (IN.)	DESIGN STRENGTH OF CONCRETE (PSI)	STEEL SPACING LONG (IN.)	TRANS (IN.)

**DRIVEWAYS (in H.C. ROW ONLY)**

DRY	WIDTH	MATERIAL	COVERT	CURB LENGTH	W/ STREET	X- STREET

**2. RESIDENTIAL / SUBDIVISION DRAINAGE**

**DESIGN SYSTEM TYPE**

STORM SEWER  
 ROADSIDE DITCH  
 LOW IMPACT DEVELOPMENT (LID)

**DESIGN METHOD USED**

CITY OF HOUSTON YEAR FREQUENCY  
 OTHER

**3. COMMERCIAL / OTHER SITE DRAINAGE**

**PROPOSED DRAINAGE AREA**

NEW DEVELOPMENT AREA  
 RE-DEVELOPMENT AREA (AMOUNT INCREASED IMPERVIOUS AREA)  
 LOW IMPACT DEVELOPMENT (LID)

**PROPOSED DRAINAGE VOLUME**

.55 (CHANNEL)  
 .65 (STM SWR)  
 1.00 (RD. DITCH)  
 OTHER

**4. WATER AND WASTEWATER**

**COMMERCIAL PROJECTS**

DOES PROPERTY HAVE EXISTING AND/OR PROPOSED UTILITIES?  
 YES  NO

IF YES, CHECK THE BOX THAT APPLIES TO THIS PROJECT

PUBLIC WATER & SANITARY  
 PRIVATE WATER WELL & SEPTIC SYSTEM  
 PUBLIC WATER & PRIVATE SEPTIC SYSTEM  
 PRIVATE WATER WELL & PUBLIC SANITARY

**5. DESCRIPTION OF PROPERTY**

**A. ACREAGE:** .851283 ACRES  
**B. SUBDIVISION:**  
 SURVEY & ABSTRACT: JOHN WARREN RANCH ESTATE INC., R. HALL ABSTRACT 948  
 PROPOSED SLAT / REPLAT  
 RECORDED PLAT / REPLAT  
**PLAT NAME:** \_\_\_\_\_

**C. ADJACENT ROADS:** WARREN RANCH RD., HOUSTON

**VI. UNOBSTRUCTED VISIBILITY EASEMENT (U.V.E.)**

REQUIRED AND SHOWN ON SHEETS  
 NOT REQUIRED

**7. FLOOD CONTROL DISTRICT CRITERIA**

**I. DETENTION SUMMARY**

STORMWATER DETENTION BASIN AREA (ACRES)	STORMWATER DETENTION BASIN ROUTING TABLE

**8. FLOOD PLAIN STATUS**

**I. GENERAL INFORMATION**

FIRM PANEL(S) FOR PROPERTY: 48201 C 0380 L  
 FIRM PANEL(S) DATE: JUNE 18, 2007

**II. FLOOD PLAIN DETERMINATION BASED ON GROUND ELEVATION**

PROPERTY LES ENTIRELY ABOVE THE BASE FLOOD LEVEL AND IN SHADDED ZONE "X"  
 PROPERTY LES PARTIALLY OR ENTIRELY BELOW THE BASE FLOOD LEVEL

**9. WORK IN HCFCFD RIGHT-OF-WAY**

**I. TYPE OF WORK TO BE PERFORMED IN CHANNEL**

OUTFALL  
 UTILITY CROSSING  
 ROADWAY BRIDGE / CULVERT CROSSING  
 RAIL ACTIVITY  
 REHABILITATION OF CHANNEL MAINTENANCE  
 TEMPORARY CHANNEL  
 OTHER

**10. PERMITS REQUIRED**

DOES THE PROPERTY HAVE ANY VIOLATIONS? IF SO PLEASE PROVIDE ALL VIOLATION NUMBERS: \_\_\_\_\_

**11. CURB RAMPS**

ARE CURB RAMPS THAT CONNECT TO PUBLIC STREETS PROPOSED IN THIS SET OF PLANS?  YES  NO

**12. LANDSCAPING**

REQUIRED AND SHOWN ON SHEETS  
 NOT REQUIRED

# HARRIS COUNTY ENGINEERING DEPARTMENT REVIEW SHEET

DATE	SHEET NO.	DESCRIPTION	P.E. INITIAL	H.C. APPROVED DATE

HARRIS COUNTY PROJECT NO. **1611100094** SHEET NUMBER **1** OF **20**



**ENGINEER'S CERTIFICATION**

I, **BRENT STREET**, A LICENSED PROFESSIONAL ENGINEER IN THE STATE OF TEXAS, DO HEREBY CERTIFY THAT THE INFORMATION PRESENTED ON THIS SHEET IS TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND THAT I AM NOT VIOLATING ANY PROVISION OF THE CURRENT TEXAS ENGINEERING PRACTICE ACT AND RULES CONCERNING THE PRACTICE OF ENGINEERING AND PROFESSIONAL ENGINEERING JURISDICTION.

ANY VIOLATIONS WILL BE FORWARDED TO THE HARRIS COUNTY DISTRICT ATTORNEY'S OFFICE FOR PROSECUTION. THE COMPLETED PROJECT CONSISTS OF DRAWING SHEETS THRU **20**

DATE: **11/16/2016**

**NO HCFCFD ROW**

THE PROJECT WAS REVIEWED, HOWEVER, THIS DOES NOT MEAN THE OTHER PROJECT, INCLUDING ALL APPROVED DATA AND CALCULATIONS HAVE BEEN COMPLETELY CHECKED AND VERIFIED. THESE DRAWINGS ARE ISSUED, DATED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED TO PRACTICE IN THE STATE OF TEXAS, WHICH THEREFORE CONFERS THE ENGINEER'S RESPONSIBILITY AND ACCOUNTABILITY. THIS DOES NOT RELIEVE ANY PARTY FROM COMPLYING WITH APPROPRIATE FEDERAL, STATE AND LOCAL ORDINANCES, RULES, LAWS AND REGULATIONS AND ANY OTHER LOCALLY ADOPTED REGULATION OR ORDINANCE RELATED TO LAND DEVELOPMENT. IF THE CITY SIGNATURES ARE REQUIRED BY JURISDICTION, COUNTY PERMITS WILL NOT BE ISSUED UNTIL SUCH SIGNATURES ARE OBTAINED. THESE SIGNATURES ARE VALID FOR A MAXIMUM OF TWO YEARS.

**HARRIS COUNTY FLOOD CONTROL DISTRICT**

INTRODUCED NO OBJECTION

FOR ITEMS LOCATED OUTSIDE OF HCFCFD RIGHT-OF-WAY APPROVED: \_\_\_\_\_ DATE: \_\_\_\_\_

FOR ITEMS LOCATED WITHIN EXISTING HCFCFD RIGHT-OF-WAY APPROVED: \_\_\_\_\_ DATE: \_\_\_\_\_

FOR ITEMS LOCATED WITHIN PROPOSED HCFCFD RIGHT-OF-WAY APPROVED: \_\_\_\_\_ DATE: \_\_\_\_\_

ADDITIONAL COMMENTS: \_\_\_\_\_

AS ACCEPTED BY THE FOLLOWING GROUPS FOR THE PURPOSES LISTED BELOW:

**ENGINEERING DIVISION**

BY: \_\_\_\_\_ DATE: \_\_\_\_\_

AS TO LOCATION OF ITEMS IN COUNTY RIGHT-OF-WAY: \_\_\_\_\_ DATE: \_\_\_\_\_

AS TO PRIVATE ROW/DRAINAGE ONLY: \_\_\_\_\_ DATE: \_\_\_\_\_

AS TO STORM WATER QUALITY: \_\_\_\_\_ DATE: \_\_\_\_\_

ADDITIONAL COMMENTS: \_\_\_\_\_

**HCED SIGNATURE BLOCK**

PROJECT NAME: **WARREN LAKE REHABILITATION PROJECT**  
 ADDRESS: **9903 DEER TRAIL DR., HOUSTON, TX 77038**

**STORM WATER QUALITY**

**I. SWPPP CONSTRUCTION MEASURES** (Complete for ALL projects)

DISTURBS >1 AC. SITE PLAN & DETAILS ON SHEETS(S) 17 & 18  
 DISTURBS <1 AC. N/A

**II. APPLICABILITY FOR PERMANENT FEATURES** (Must be completed on all projects)

EXEMPT: NEW DEVELOPMENT  
 PROJECT IS ON A PARCEL LESS THAN 5 ACRES. (must be verified with plot)  
 EXEMPT: REDEVELOPMENT  
 PROJECT DOES NOT MEET THE DEFINITION OF SIGNIFICANT REDEVELOPMENT (Part A, Sec. 2.41 of Regulations of Harris County, Texas for Stormwater Quality Management)  
 EXEMPT: GRAND FATHERED BY AN EXISTING DRAINAGE SYSTEM PRIOR TO OCT. 2001. (FOR VERIFICATION: PROVIDE ORIGINAL DRAINAGE AREA MAP INCLUDING CALCULATIONS)

**GENERAL:**

PROJECT'S SWQ REQUIREMENTS LIE IN AN INCORPORATED CITY OF \_\_\_\_\_

STORM WATER QUALITY PERMIT REQUIREMENT FOR THIS PROJECT IS COVERED BY PROJECT TITLE: \_\_\_\_\_ HARRIS COUNTY PROJECT NO. \_\_\_\_\_ & SWQ PERMIT NO. \_\_\_\_\_

**STORMWATER QUALITY MANAGEMENT PLAN:**

SITE PLAN ON SHEET(S) \_\_\_\_\_

**III. PERMANENT SWQ FEATURES** (COMPLETE IF NOT EXEMPT)

VEGETATIVE CONTROLS USED: (FILTER STRIP, GRASS SWALE, URBAN FORESTRY) DETAILS AND CALCULATIONS APPEAR ON SHEET(S) \_\_\_\_\_

POND STRUCTURE USED (WET, DRY, WETLANDS) DETAILS AND CALCULATIONS APPEAR ON SHEET(S) \_\_\_\_\_

HYDRODYNAMIC TYPE SEPARATOR MODEL: \_\_\_\_\_

OTHER(S): \_\_\_\_\_



DESIGNED BY: BTS  
 DRAWN BY: GMK  
 CHECKED BY: BTS  
 FILE NAME: WL\_RED.DWG  
 DATE PLOTTED: 3/4/2016

PRINCIPAL SPILLWAY - PLAN AND PROFILE  
 WARREN LAKE REHABILITATION  
 KATY PRAIRIE CONSERVATION & WARREN RANCH  
 IN  
 HARRIS COUNTY, TEXAS

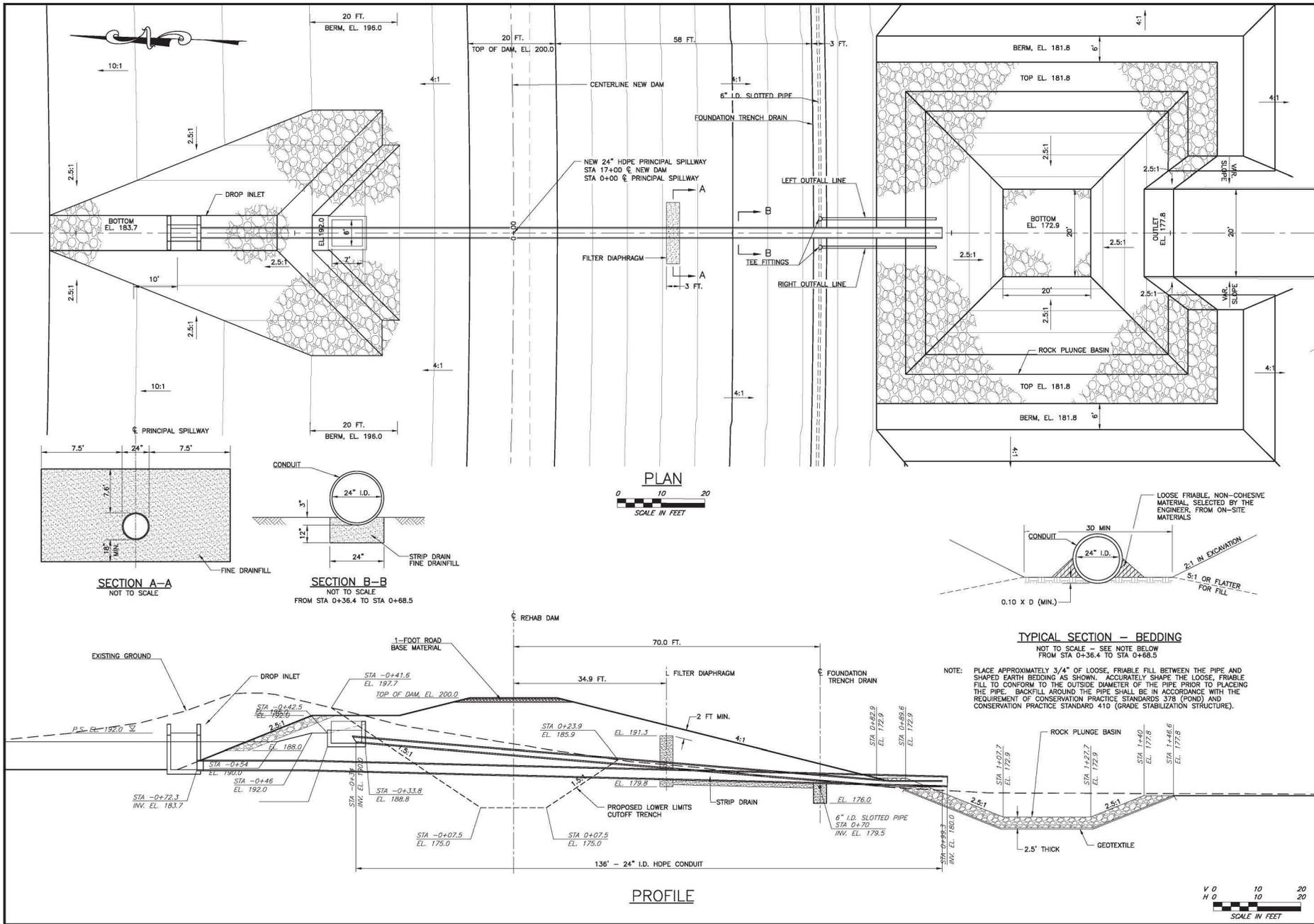


**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 P.O. BOX 9  
 HEDENHEIMER, TX 76533  
 (254) 953-9103, 9104 (FAX)



REVISIONS DATE  
 SHEET

11





# Harris County Engineering Department

10555 NORTHWEST FREEWAY, SUITE 120, HOUSTON, TX 77062 - OFFICE 713-274-3900

## PERMIT FOR CIVIL SITE WORK (FILL, DETENTION, UTILITY, PAVING, UNENCLOSED STRUCTURES)

<b>Date Issued:</b> 12/12/2016	<b>Expiration Date:</b> 6/10/2017
<b>Issued To:</b> Katy Prairie Conservancy & Warren Ranch	<b>Project Name:</b> Rehabilitation of Warren Lake
<b>Owner:</b> Katy Prairie Conservancy & Warren Ranch	<b>Permit No.:</b> 1611100094-SITE-001
<b>Applicant:</b> M & E Consultants LLC	<b>Permit Class Code:</b> CLASS II
<b>Contact:</b> Trent Street	
<b>Contact Email:</b> tstreet@mande-pe.com	
<b>Contact Phone:</b> (254) 983-9103	

<b>Property Information</b>					
<b>Address:</b> 15025 Warren Ranch Road	<b>Bldg:</b>	<b>Suite:</b>	<b>Trailer:</b>		
<b>City:</b> Hockley	<b>State:</b> TX	<b>Zip:</b> 77447			
<b>Subdivision:</b>	<b>Section:</b>	<b>Lot:</b>	<b>Block:</b>	<b>Reserve:</b>	
<b>Abstract No.:</b> 349	<b>Survey Name:</b>				

### REQUIRED INSPECTION(S)

IT IS YOUR RESPONSIBILITY TO CALL FOR ALL REQUIRED INSPECTIONS

(\* All Inspections designated with an asterisk must be passed before permanent power will be released.

- 1 Commercial Final Inspection-Development

### PRE-INSPECTION DOCUMENT(S)

ALL PRE-INSPECTION DOCUMENTS MUST BE RECEIVED AND APPROVED BEFORE INSPECTIONS CAN BE REQUESTED

- 1 As-Built-Certificate Required

### SPECIAL REQUIREMENT(S)

- 1 Class II Permit Issued, Refer To Plans and Final Elevation Certificate

Permit Manager

Main Line HCPID 713-274-3900

Schedule Inspections 713-274-3800

Fire Code Inspections 281-436-8000

Authorized work must start before expiration date. This permit and inspection record on site must be posted on site. A copy approved plans must be kept on site. The County Engineer may make scheduled or unscheduled inspections. Permittee is responsible to request inspections required by this permit. Noncompliance to Harris County regulations may result in suspension or revocation of this permit. Revisions to approved plans will require review, approval and recordation. Fees for this permit are non-refundable and non-transferable. The granting of this permit does not imply this development can be insured by the National Flood Insurance Administration or that it will be free from flooding. By issuing this permit Harris County does not authorize, and is it not responsible for any violation of or non-compliance with deed restrictions or covenants applicable to this site.

Fax 713-437-5764

1/11/2017 7:05:37 AM

www.hcpid.org/permits/



# Harris County Engineering Department

10555 NORTHWEST FREEWAY, HOUSTON, TX 77092 - OFFICE 713-274-3900

## INSPECTION RECORD - POST THIS CARD ON SITE

### Property Information

### Project Detail

#### Commercial Property

<b>Project Name:</b>	Rehabilitation of Warren Lake	<b>Project No:</b>	1611100094
<b>Property Owner:</b>	Katy Prairie Conservancy & Warren Ranch	<b>Suite:</b>	
<b>Address:</b>	15025 Warren Ranch RD	<b>Zip:</b>	77447
<b>City:</b>	Hockley	<b>State:</b>	TX
<b>Applicant/DBA:</b>	M & E Consultants LLC	<b>Email:</b>	
		<b>Contact No:</b>	(254) 983-9103

### REQUIRED INSPECTION(S)

IT IS YOUR RESPONSIBILITY TO CALL FOR REQUIRED INSPECTIONS

(\* All Inspections below designated with an Asterisk must be passed before permanent power will be released

Permit Number	Inspection Description	Inspector Name & Signature	Pass/Fail	Date
611100094-SITE-001	*Commercial Final Inspection-Development			

### CERTIFICATE OF COMPLIANCE

Date	Inspection Category	Inspector	Signature	Pass/Fail

Main Line HCPID 713-274-3900

Schedule Inspections 713-274-3800

Fire Code Inspections 281-436-8000

Fax 713-437-5764

This Card is your record of inspections and must be signed off by all required departments to receive your Fire Marshal's final inspection and Certificate of Compliance. This card must be kept onsite and available to the inspector at all times and during inspections. Protect this card from weather. The approved plans must be available during inspections. Inspections must be completed in the listed order and the Certificate of Compliance will not be issued until all other required inspections are completed and approved. Authorized work must start before expiration date. This permit and inspection card on site must be posted on site. A copy approved plans must be kept on site. The County Engineer may make

Bryan W. Shaw, Ph.D., P.E., *Chairman*  
Toby Baker, *Commissioner*  
Jon Niermann, *Commissioner*  
Richard A. Hyde, P.E., *Executive Director*



## TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

*Protecting Texas by Reducing and Preventing Pollution*

November 8, 2017

Trent Street, PE  
President  
M&E Consultants  
PO Box 9  
Heidenheimer, TX 76533

Re: Warren Lake Dam  
TX03398  
Plan and Specifications Approval

Dear Mr. Trent,

TCEQ received your November 3, 2017 submittal in response to our October 19, 2017 Comment Letter for the proposed improvements of the above referenced dam. Thank you for addressing all our comments.

According to the provisions of the Texas Administrative Code (TAC) Chapter 299, the final construction plans and specifications for the referenced project are hereby approved on behalf of the Executive Director. You are reminded of the following sections pertaining to construction:

- § 299.23 Requires the continuous maintenance of construction records.
- § 299.24 Requires this office to be notified promptly of the date construction actually begins and for high and significant hazard dams, to be sent monthly progress reports.
- § 299.25 Requires continuous daily inspections by owner's engineer or by a qualified inspector under supervision of the owner's engineer.
- § 299.25 Requires construction plans to be according to the approved plans and specifications.
- § 299.26 Requires significant changes to the approved plans and specifications be approved by this office.
- § 299.29 Requires the submission of the engineer's notification of completion within 45 calendar days after the work is substantially complete.
- § 299.30 Provides for the submission of record drawings with permanent reference mark(s) within six months after final completion of construction.

If you have any questions or need additional information, please do not hesitate to contact me at (512) 239-1351, [david.trujillo@tceq.texas.gov](mailto:david.trujillo@tceq.texas.gov), or Johnny Cosgrove, P.E. at (512) 239-4307.

Sincerely,

A handwritten signature in black ink, appearing to read "David N. Trujillo".

David N. Trujillo, P.E.  
Dam Safety Engineer  
Critical Infrastructure Division, MC 177



REPLY TO  
ATTENTION OF:

Evaluation Branch

**DEPARTMENT OF THE ARMY**  
GALVESTON DISTRICT, CORPS OF ENGINEERS  
P. O. BOX 1229  
GALVESTON, TEXAS 77553-1229

December 21, 2016

SUBJECT: Permit No. SWG-2016-01024; Nationwide Permit Verification

Ms. Mary Anne Piacentini  
Katy Prairie Conservancy  
5615 Kirby Drive  
Houston, Texas 77005

Dear Ms. Piacentini:

This is in reference to your request, dated December 6, 2016, discharge approximately 51,000 cubic yards of fill material to replace an existing failing levee, and install associated appurtenances, such as outfalls. Additionally, you are authorized to perform mechanized land clearing and grading to remove approximately 120 acres of invasive species from existing wetlands and to create deep pools within the existing lakebed. The project site is located on the Katy prairie, east of the Warren Ranch headquarters, 3 miles south of Hockley, in Harris County, Texas.

This request is verified by Nationwide Permit (NWP) 3, NWP 7, and NWP 27 pursuant to Section 404 of the Clean Water Act (CWA). This NWP verification is valid provided the activity is compliant with the enclosed plans, in 18 sheets, and the NWP General/Regional Conditions. In addition, the activity must be in compliance with the Texas Commission on Environmental Quality's Best Management Practice Guidelines, which can be found at <http://bit.ly/1xPybPm>. A hard copy can be provided to you upon request.

NWP 3 authorizes the repair, rehabilitation or replacement of any previously authorized, currently serviceable structure or fill, provided that the structure or fill is not to be put to uses differing from those uses specified or contemplated for it in the original permit or most recently authorized modification.

NWP 7 authorizes activities related to the construction or modification of outfall structures and associated intake structures, where the effluent from the outfall is authorized, conditionally authorized, or specifically exempted by, or that are otherwise in compliance with regulations issued under the National Pollutant Discharge Elimination System Program.

NWP 27 authorizes activities in waters of the United States associated with the restoration, enhancement, and establishment of tidal and non-tidal wetlands and riparian areas, the restoration and enhancement of non-tidal streams and other non-tidal open waters, and the rehabilitation or enhancement of tidal streams, tidal wetlands, and tidal open waters, provided those activities result in net increases in aquatic resource functions and services

These NWP verifications are valid until the NWPs are modified, reissued or revoked. All of the existing NWPs are scheduled to be modified, reissued or revoked prior to March 19, 2017. It is incumbent upon you to remain informed of changes to the NWPs. We will issue a public notice when the NWPs are reissued. Furthermore, if you commence or

are under contract to commence this activity before the date that the relevant NWP's are modified or revoked, you will have 12 months from the date of the modification or revocation of the NWP's to complete the activity under the present terms and conditions of these NWP's.

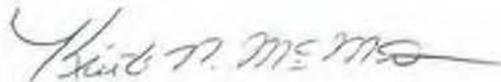
The impacts to waters of the United States (U.S.) associated with this NWP verification are based on a preliminary jurisdictional determination (JD) for your subject site. If you wish, you may request an approved JD (which may be appealed), by submitting a written request to us within 30 days from the date of this letter. Please note that if you request an approved JD and then decide to appeal it, the appeal will not be accepted if any work has started in waters of the U.S. or that would alter the hydrology of waters of the U.S.

Corps determinations are conducted to identify the limits of the Corps CWA jurisdiction for particular sites. This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are U.S. Department of Agriculture (USDA) program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

Corps determinations are conducted to identify the limits of the Corps CWA jurisdiction for particular sites. This determination may not be valid for the wetland conservation provisions of the Food Security Act of 1985, as amended. If you or your tenant are U.S. Department of Agriculture (USDA) program participants, or anticipate participation in USDA programs, you should request a certified wetland determination from the local office of the Natural Resources Conservation Service prior to starting work.

If you have any questions regarding this verification, please contact Mr. Steve Walls at the letterhead address or by telephone at 409-766-3125. Please notify the Chief of the Compliance Branch in the Galveston District Regulatory Division, in writing, at the letterhead address, upon completion of the authorized project.

FOR THE DISTRICT COMMANDER:



Kristi N. McMillan  
Leader, Central Evaluation Unit

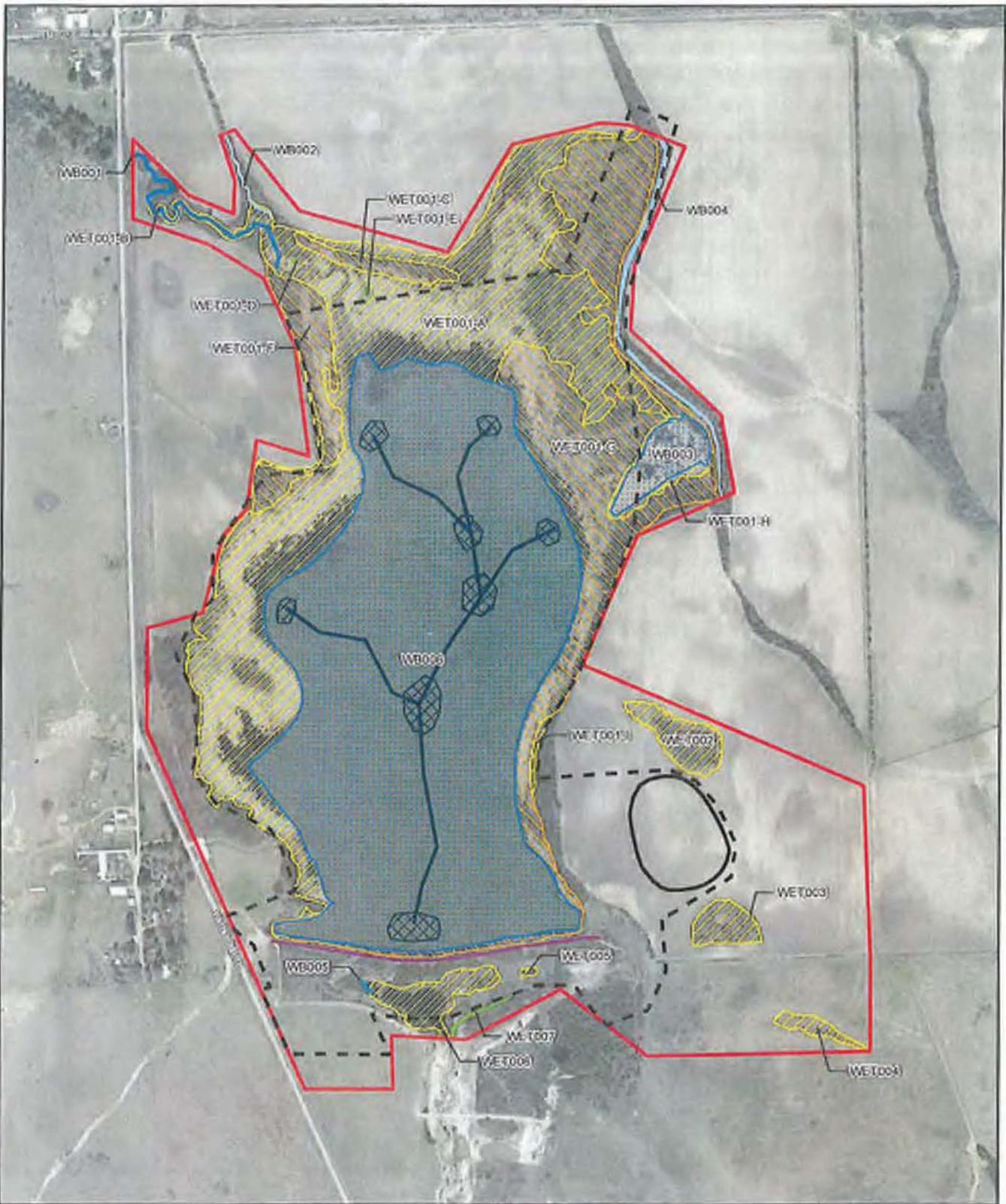
Enclosures

Copies Furnished:

Permit Distribution List

Austin Richards, SWCA, Inc., 10245 West Little York Road, Suite 600, Houston, Texas  
77040





Path: S:\Projects\2016\Warren Lake\Map\SWG-2016-01024\Warren Lake Site Layout PCN Map.dwg

**SWCA**  
SOUTHWESTERN CONSULTANTS

32145 E. Loop West, Suite 600  
Houston, Texas 77040  
(281) 417-3227 phone  
(281) 417-3337 fax  
www.swca.com

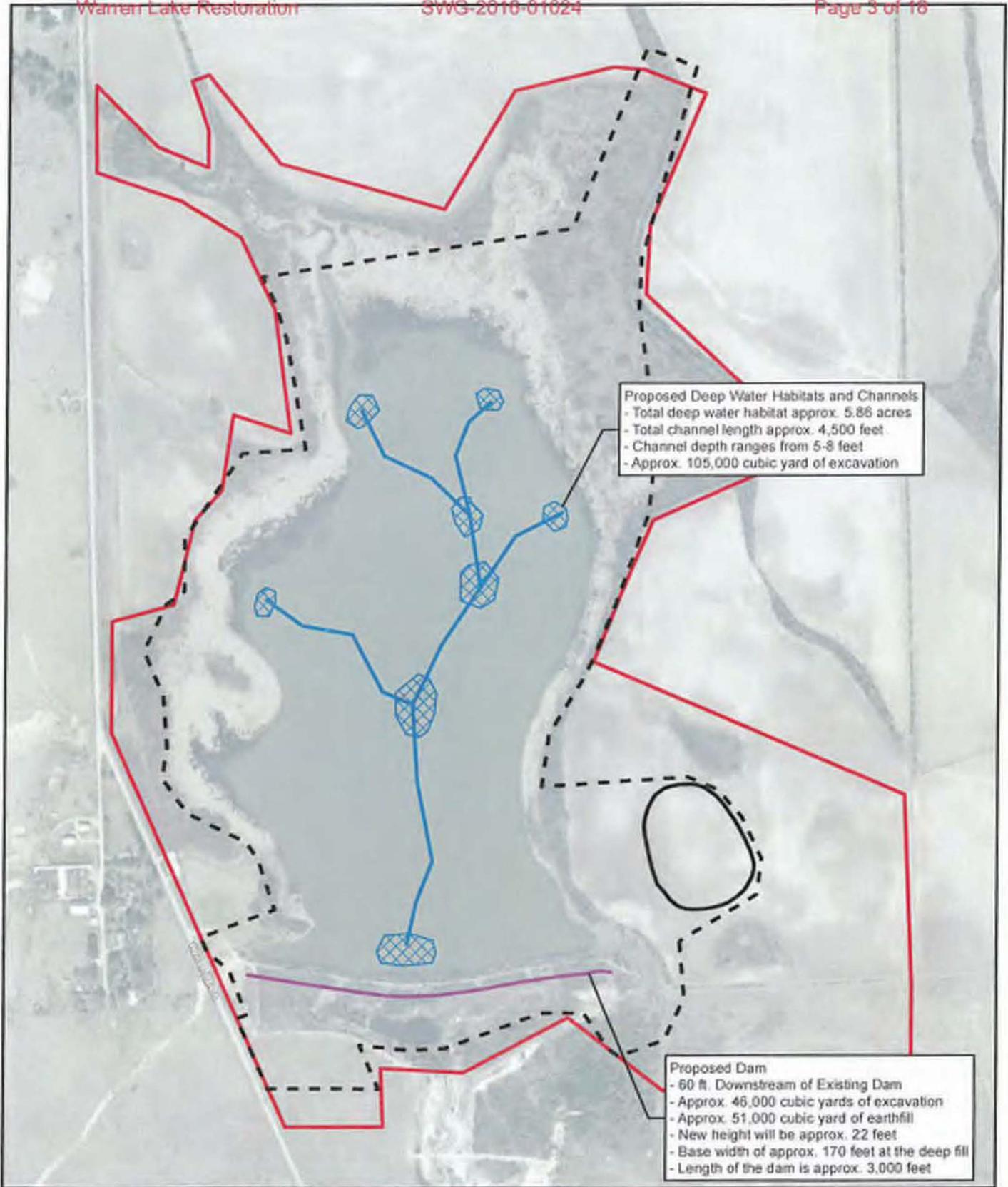
**WARREN LAKE RESTORATION PROJECT**  
SITE LAYOUT PCN MAP  
HARRIS COUNTY, TEXAS

- Project Boundary
- Work Limits
- Borrow Pit
- Existing Dam
- Deep Water Channel
- Deep Water Habitat
- Ephemeral Waterbody
- Intermittent Waterbody
- Perennial Waterbody
- Emergent Wetland
- Forested Wetland
- Scrub-Shrub Wetland

Background:	ESPC Visual Inventory (2014)
Date:	1-20-2016
Created By:	JL
Approved By:	AR
SWCA Project No.:	33311
Date Studied:	December 01, 2015

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FIGURE 2



**Proposed Deep Water Habitats and Channels**  
 - Total deep water habitat approx. 5.86 acres  
 - Total channel length approx. 4,500 feet  
 - Channel depth ranges from 5-8 feet  
 - Approx. 105,000 cubic yard of excavation

**Proposed Dam**  
 - 60 ft. Downstream of Existing Dam  
 - Approx. 46,000 cubic yards of excavation  
 - Approx. 51,000 cubic yard of earthfill  
 - New height will be approx. 22 feet  
 - Base width of approx. 170 feet at the deep fill  
 - Length of the dam is approx. 3,000 feet

Table 2: Proposed Ditch / Channel Locations (SWCA) - Warren Lake, TX - Riverbank

**SWCA**  
 ENVIRONMENTAL CONSULTANTS

10245 WIND LANE SUITE 100, SUITE 100  
 HOUSTON, TEXAS 77040  
 (281) 617-3217 phone  
 (281) 617-3217 fax  
 www.swca.com

**WARREN LAKE RESTORATION PROJECT**  
 SITE PLAN  
 HARRIS COUNTY, TEXAS

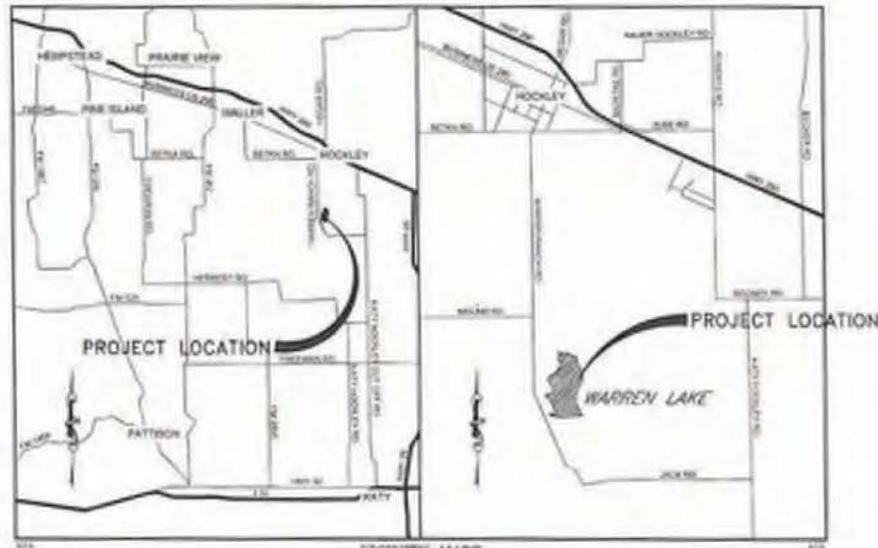
Project Boundary	Deep Water Channel
Work Limits	Deep Water Habitat
Proposed Dam	Borrow Pit

Background:	ESRI World Imagery (2010)
Scale:	1:5,000
Created By:	JD
Approved By:	AF
SWCA Project No.:	20101
Date Produced:	December 08, 2010

NAD 1983 StatePlane Texas South Central FIPS 4204 Feet



REHABILITATION  
OF  
WARREN LAKE  
LOCATED ON  
ROCK HOLLOW CREEK  
PRESENTED FOR  
KATY PRAIRIE CONSERVANCY & WARREN RANCH  
LOCATED IN  
HARRIS COUNTY, TEXAS



VICINITY MAPS  
MARCH 2016

INDEX OF DRAWINGS

- 1 GENERAL PLAN
- 2 EXISTING CONDITIONS - PLAN AND PROFILE
- 3 PROPOSED MODIFICATIONS - PLAN AND PROFILE
- 4-6 EMBANKMENT SECTIONS
- 7 FOUNDATION TRENCH DRAIN DETAILS
- 8 PRIMARY ALIGNMENT SPILLWAY - PLAN AND PROFILE
- 9 PRIMARY ALIGNMENT SPILLWAY - CROSS SECTIONS
- 10 PRINCIPAL SPILLWAY - PLAN AND PROFILE
- 11 PRINCIPAL SPILLWAY - OUTLET DETAILS
- 12-14 PRINCIPAL SPILLWAY - INLET DETAILS
- 15 PRINCIPAL SPILLWAY - TRAIN RACK
- 16 STORMWATER POLLUTION PREVENTION PLAN
- 17 STORMWATER POLLUTION PREVENTION PLAN DETAILS

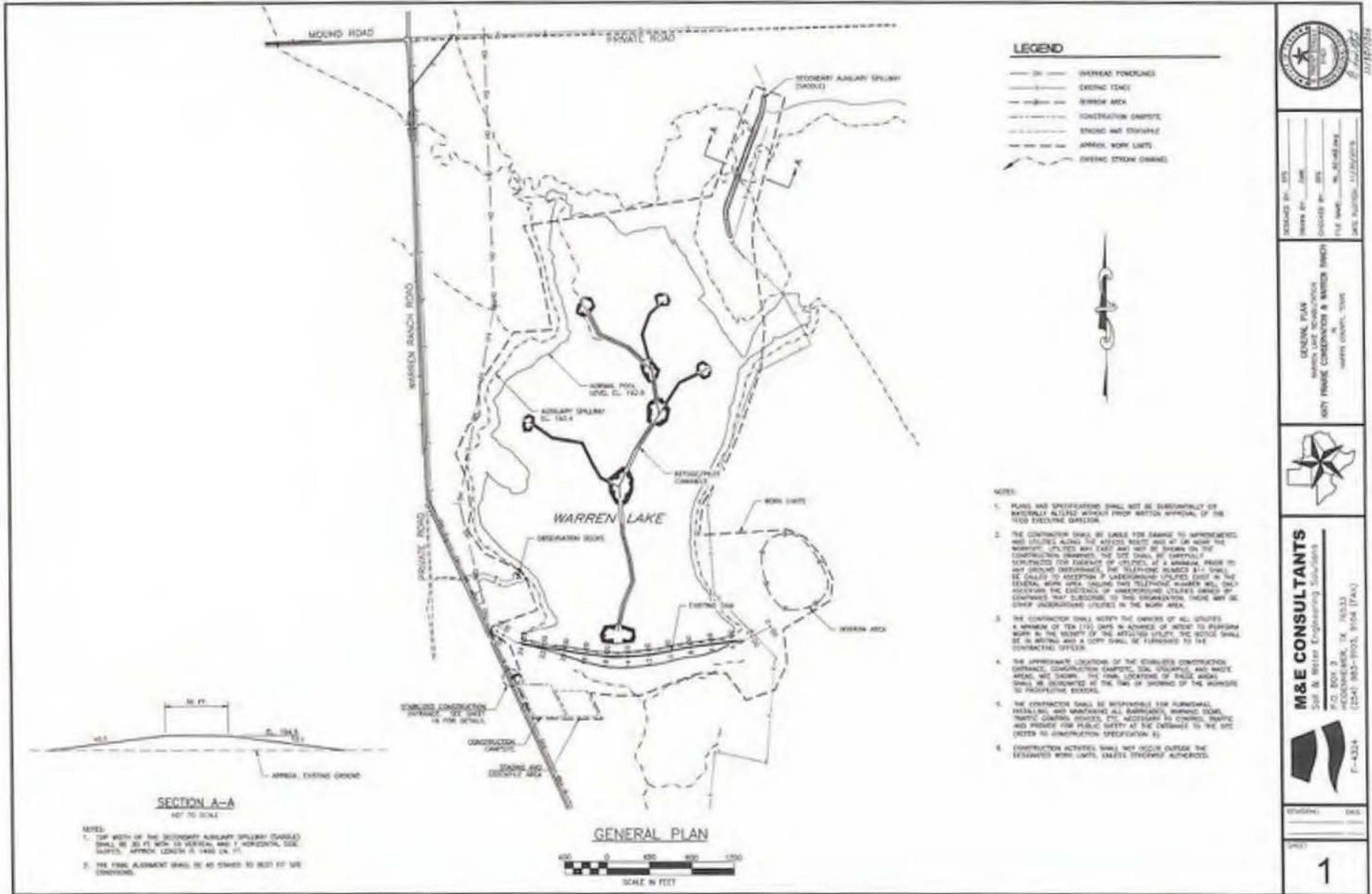


WARREN RANCH



**M&E CONSULTANTS**

Soil & Water Engineering Solutions  
F-4324



DESIGNED BY: [Signature]  
 DRAWN BY: [Signature]  
 CHECKED BY: [Signature]  
 DATE: 11/20/16

DESIGNED FOR:  
 KATY PRAIRIE CONSERVANCY & WARREN LAKE RESTORATION  
 WARREN LAKE, TEXAS

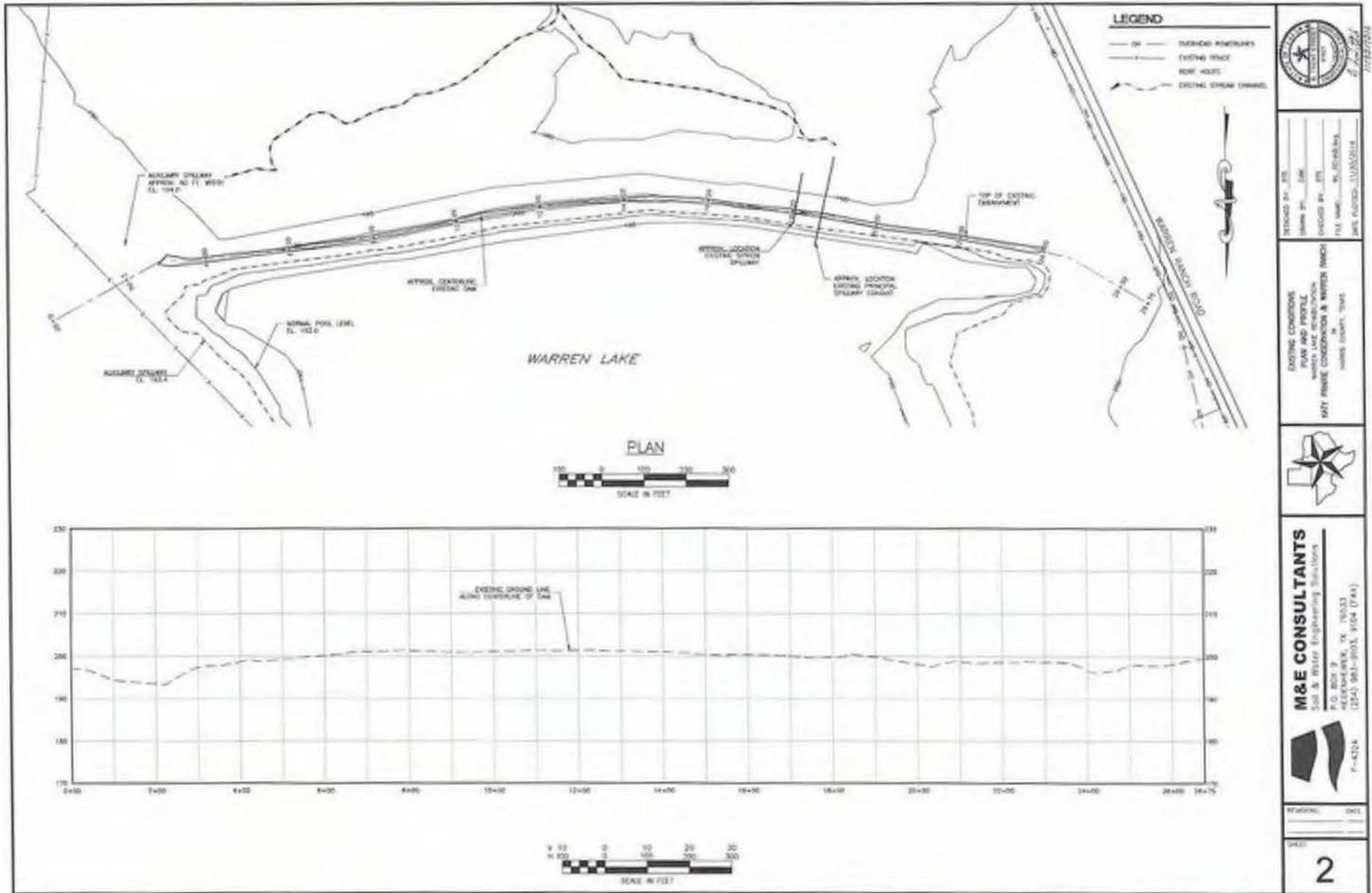


**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 300 BOYD ST.  
 HOUSTON, TX 77053  
 (281) 963-1005, 9704 (TX)



Sheet No. 065

1



DRAWING NO. SWG-2016-01024  
 SHEET NO. 7 OF 18  
 CHECKED BY: [Signature]  
 FILE NAME: SWG-2016-01024-07.dwg  
 DATE PLOTTED: 11/20/2016

EXISTING CONDITIONS  
 PLAN AND PROFILE  
 WITH AND WITHOUT  
 KATY PRAIRIE CONSERVANCY & WARREN LAKE  
 MAINTENANCE TRAIL



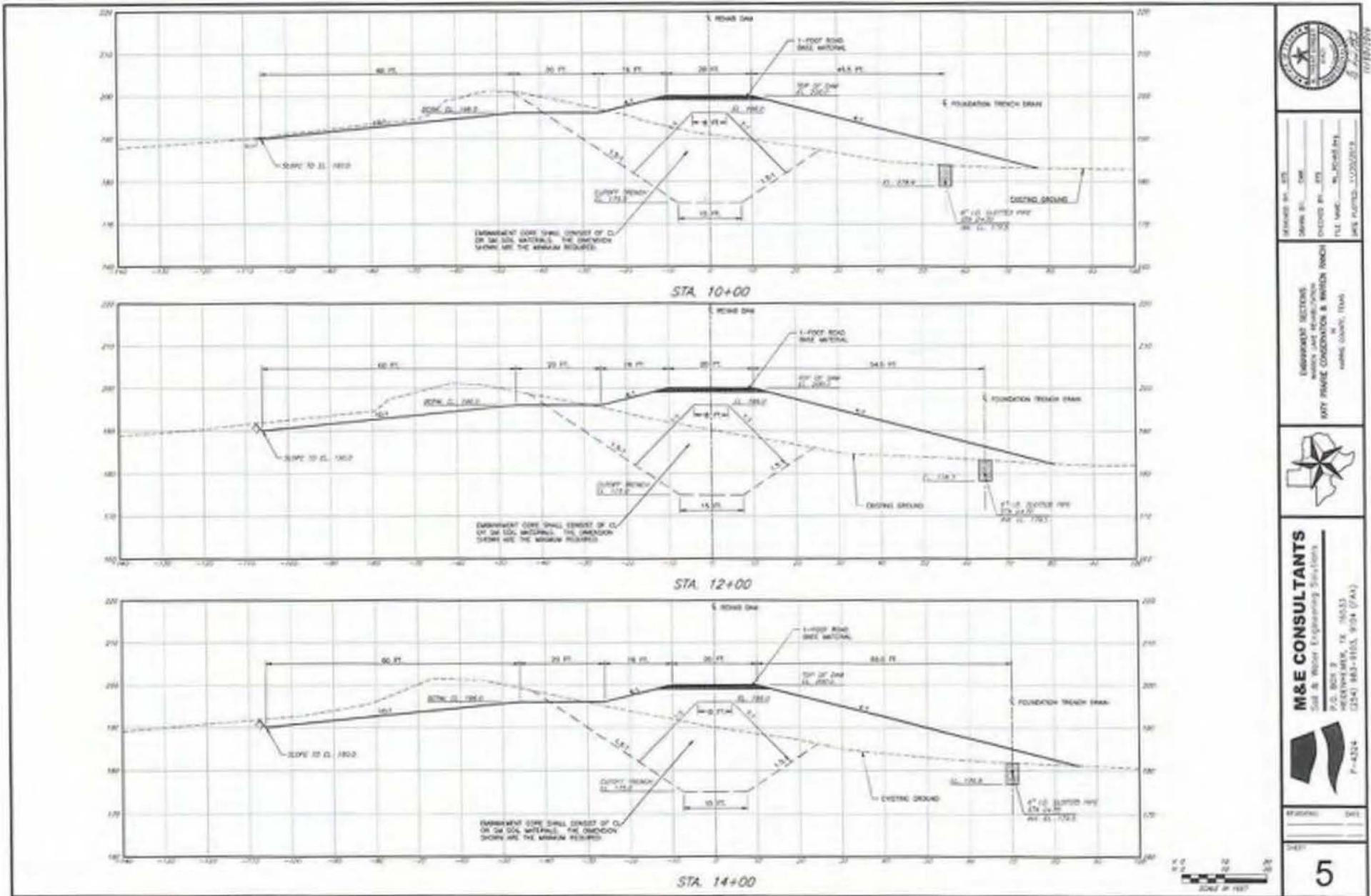
**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 P.O. Box 9  
 ABERNATHY, TX 76033  
 (254) 963-9905, 9104 (744)  
 E-4254



DRAWING: SWG-2016-01024-07.dwg  
 SHEET: 7 OF 18







DRAWING NO. 10222  
 SHEET NO. 10222  
 PROJECT NO. SWG-2016-01024  
 DATE PLOTTED: 11/27/2016

EMBANKMENT SECTIONS  
 WARREN LAKE RESTORATION  
 KATY PRAIRIE CONSERVANCY & WARREN LAKE  
 WARREN COUNTY, TEXAS

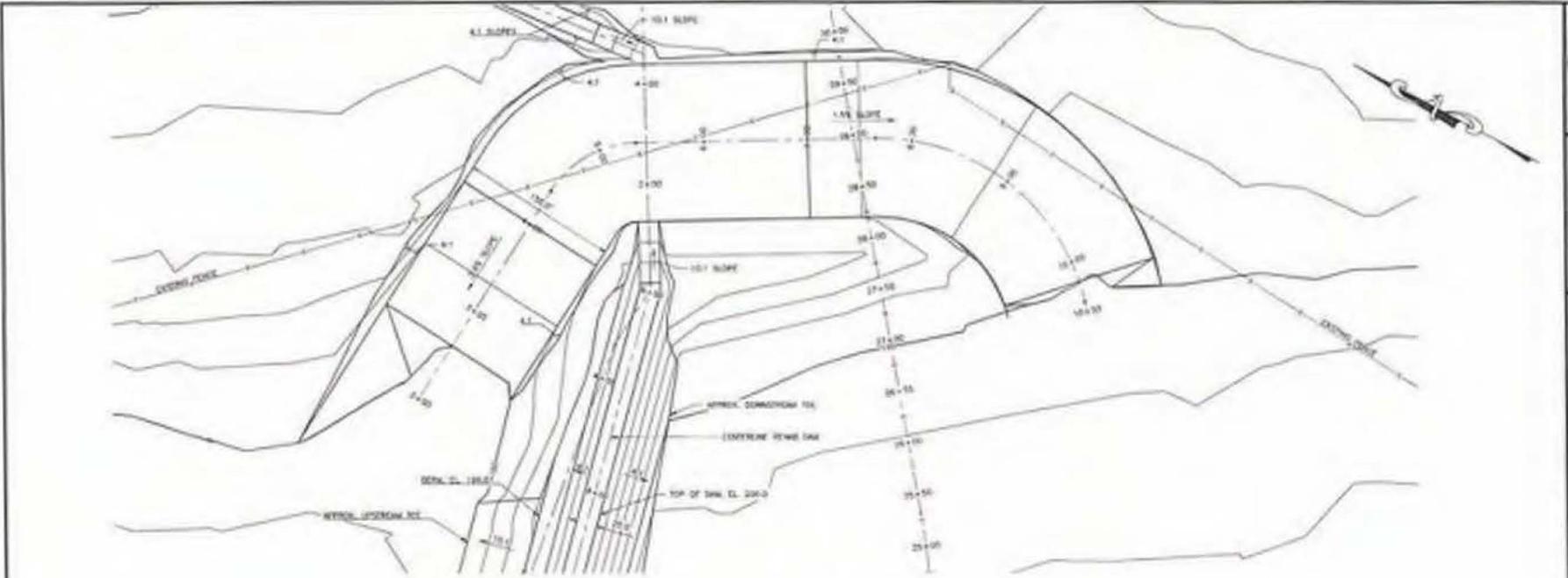


**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 905.808.9100  
 1400 WESTMARK, TX 75433  
 (254) 883-8105, 9304 (7/14)  
 P-4324

DRAWING NO. 10222  
 SHEET NO. 10222  
**5**







PLAN  
SCALE: 1" = 50'



PROFILE  
SCALE: 1" = 50'



DESIGNED BY: [Name]  
DRAWN BY: [Name]  
CHECKED BY: [Name]  
FILE NAME: [Name]  
DATE PLOTTED: [Date]

PRIMARY AGENCY: [Agency Name]  
PROJECT NAME: [Project Name]  
PROJECT LOCATION: [Location]  
PROJECT NUMBER: [Number]

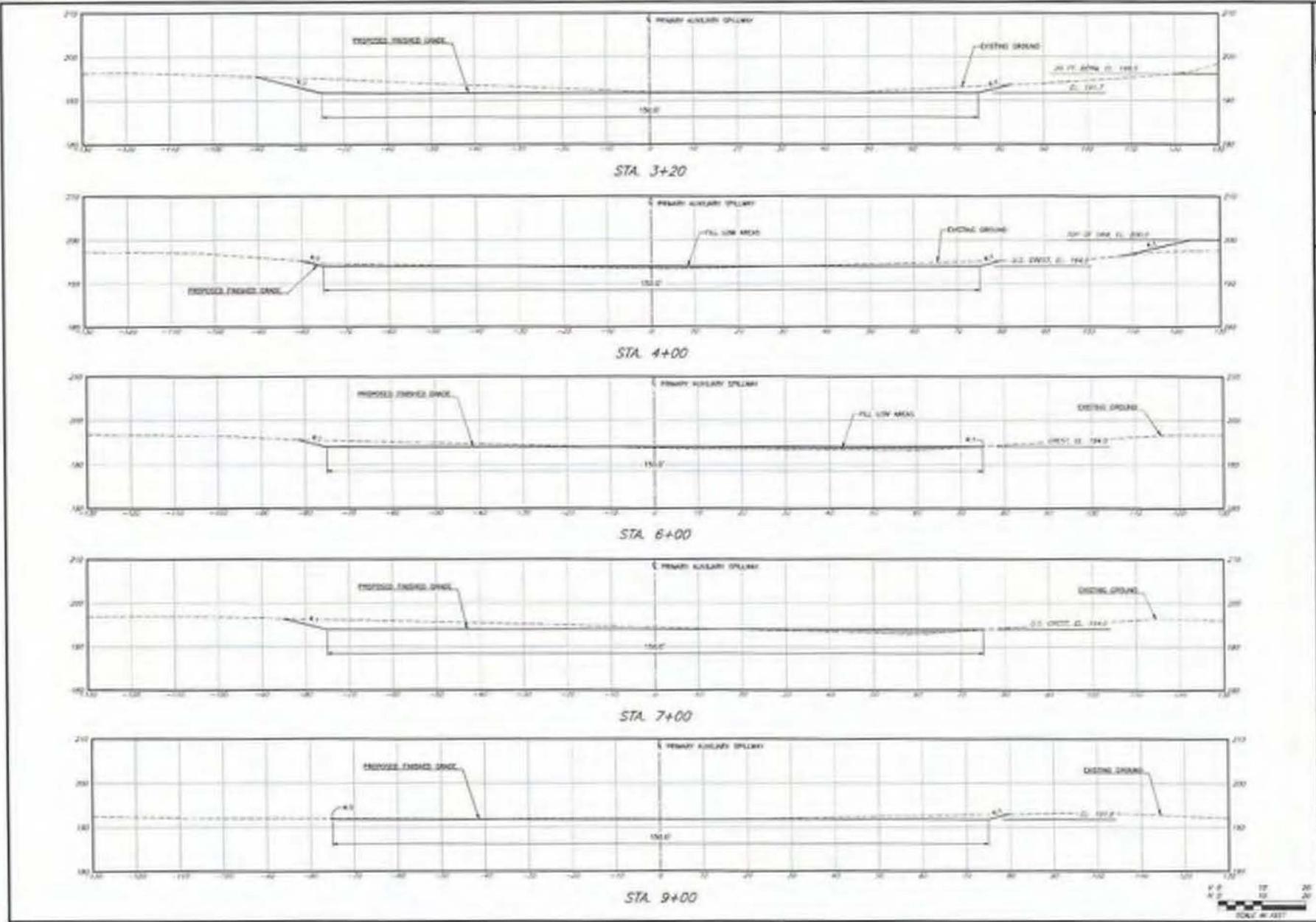


**M&E CONSULTANTS**  
Soil & Water Engineering Solutions  
P.O. BOX 9  
HEBER SPRING, TX 78853  
(254) 842-9700, 814 (FAX)

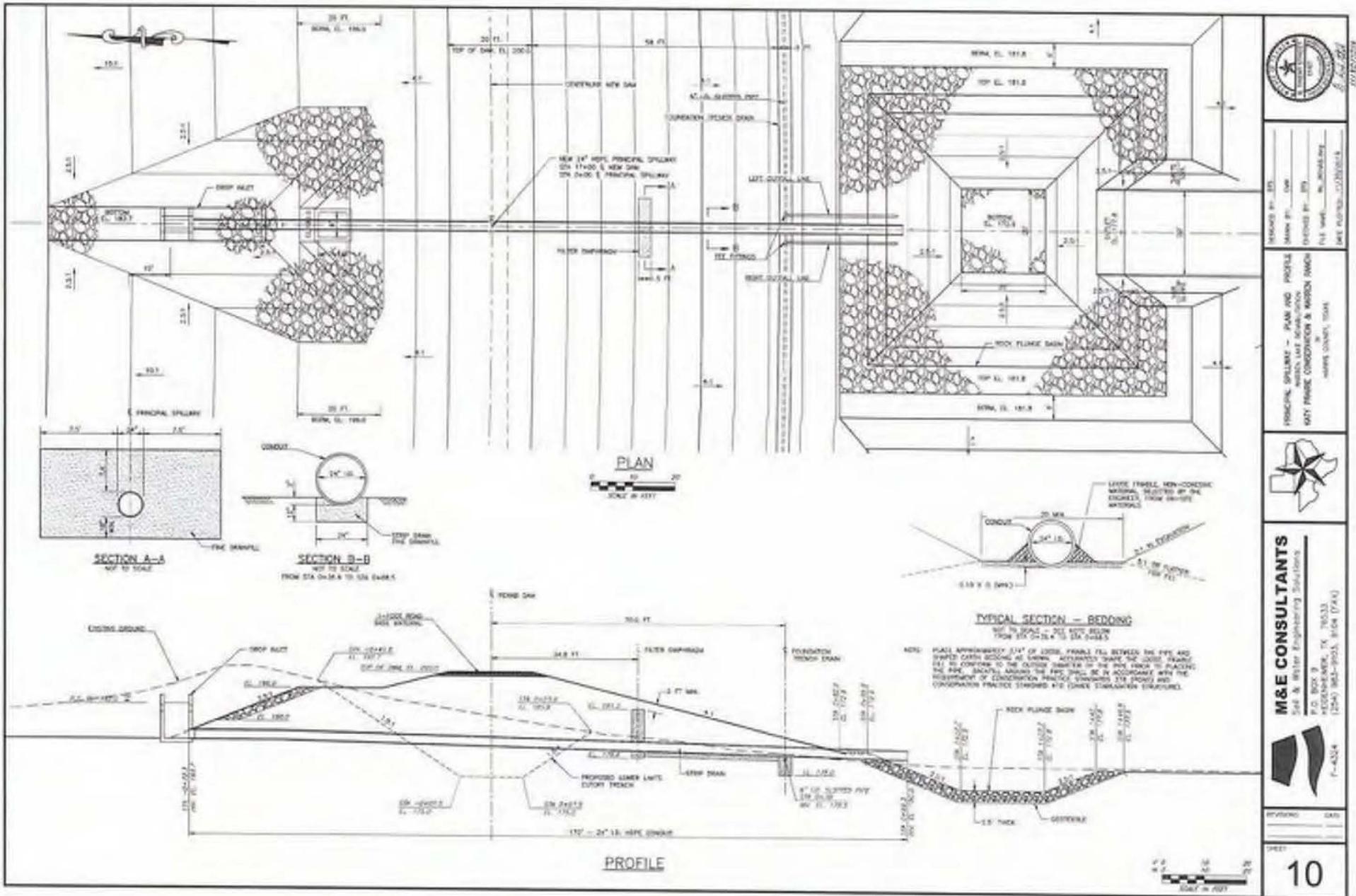


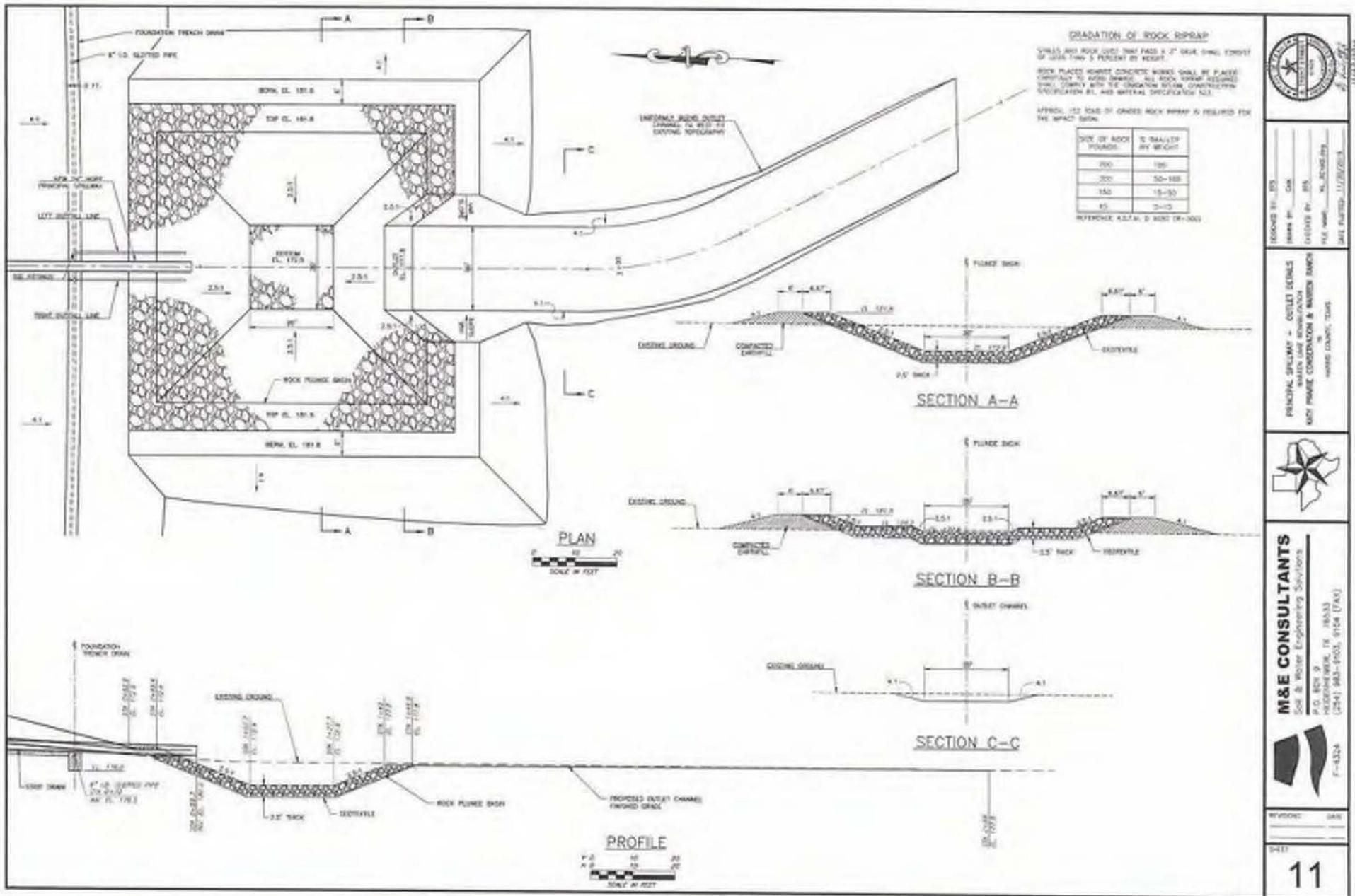
REVISION: [Number]

SHEET  
**8**



	DESIGNED BY: <u>          </u> DRAWN BY: <u>          </u> CHECKED BY: <u>          </u> FILE NAME: <u>          </u> DATE PLOTTED: <u>          </u>
	PRIMARY AUXILIARY SPILLWAY CROSS SECTIONS WARREN LAKE RESTORATION KATY PRAIRIE CONSERVATION & NODON FACILITY WARREN CREEK, TEXAS
	<b>M&amp;E CONSULTANTS</b> Soil & Water Engineering Solutions P.O. BOX 9 HEEDENBACH, TX 78043 (214) 982-9900, 904 (TX)
SHEET: <u>          </u> OF: <u>          </u>	9





DESIGNED BY: JRS  
 DRAWN BY: GAK  
 CHECKED BY: JRS  
 FILE NAME: NLS-2016-01024  
 DATE PLOTTED: 11/28/2016

PERSONAL SEALING - OUTLET DETAILS  
 WATER USE RESTRICTIONS  
 MUST MAINTAIN COORDINATION & MAINTENANCE  
 WARREN DAMS, TEXAS



**M&E CONSULTANTS**  
 Soil & Water Engineering Solutions  
 P.O. BOX 9  
 HOUSTON, TEXAS 77033  
 (281) 963-1900, 9104 (FAX)  
 F-0224



REVISION: GAK

DATE:

11





### Nationwide Permit General Conditions

The following general conditions must be followed in order for any authorization by an NWP to be valid:

#### **1. Navigation.**

- (a) No activity may cause more than a minimal adverse effect on navigation.
- (b) Any safety lights and signals prescribed by the U.S. Coast Guard, through regulations or otherwise, must be installed and maintained at the permittee's expense on authorized facilities in navigable waters of the United States.
- (c) The permittee understands and agrees that, if future operations by the United States require the removal, relocation, or other alteration, of the structure or work herein authorized, or if, in the opinion of the Secretary of the Army or his authorized representative, said structure or work shall cause unreasonable obstruction to the free navigation of the navigable waters, the permittee will be required, upon due notice from the Corps of Engineers, to remove, relocate, or alter the structural work or obstructions caused thereby, without expense to the United States. No claim shall be made against the United States on account of any such removal or alteration.

**2. Aquatic Life Movements.** No activity may substantially disrupt the necessary life cycle movements of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the area, unless the activity's primary purpose is to impound water. All permanent and temporary crossings of waterbodies shall be suitably culverted, bridged, or otherwise designed and constructed to maintain low flows to sustain the movement of those aquatic species.

**3. Spawning Areas.** Activities in spawning areas during spawning seasons must be avoided to the maximum extent practicable. Activities that result in the physical destruction (e.g., through excavation, fill, or downstream smothering by substantial turbidity) of an important spawning area are not authorized.

**4. Migratory Bird Breeding Areas.** Activities in waters of the United States that serve as breeding areas for migratory birds must be avoided to the maximum extent practicable.

**5. Shellfish Beds.** No activity may occur in areas of concentrated shellfish populations, unless the activity is directly related to a shellfish harvesting activity authorized by NWPs 4 and 48, or is a shellfish seeding or habitat restoration activity authorized by NWP 27.

**6. Suitable Material.** No activity may use unsuitable material (e.g., trash, debris, car bodies, asphalt, etc.). Material used for construction or discharged must be free from toxic pollutants in toxic amounts (see Section 307 of the Clean Water Act).

**7. Water Supply Intakes.** No activity may occur in the proximity of a public water supply intake, except where the activity is for the repair or improvement of public water supply intake structures or adjacent bank stabilization.

**8. Adverse Effects From Impoundments.** If the activity creates an impoundment of water, adverse effects to the aquatic system due to accelerating the passage of water, and/or restricting its flow must be minimized to the maximum extent practicable.

**9. Management of Water Flows.** To the maximum extent practicable, the pre-construction course, condition, capacity, and location of open waters must be maintained for each activity, including stream channelization and storm water management activities, except as provided below. The activity must be constructed to withstand expected high flows. The activity must not restrict or impede the passage of normal or high flows, unless the primary purpose of the activity is to impound water or manage high flows. The activity may alter the pre-construction course, condition, capacity, and location of open waters if it benefits the aquatic environment (e.g., stream restoration or relocation activities).

**10. Fills Within 100-Year Floodplains.** The activity must comply with applicable FEMA approved state or local floodplain management requirements.

**11. Equipment.** Heavy equipment working in wetlands or mudflats must be placed on mats, or other measures must be taken to minimize soil disturbance.

**12. Soil Erosion and Sediment Controls.** Appropriate soil erosion and sediment controls must be used and maintained in effective operating condition during construction, and all exposed soil and other fills, as well as any work below the ordinary high water mark or high tide line, must be permanently stabilized at the earliest practicable date. Permittees are encouraged to perform work within waters of the United States during periods of low-flow or no-flow.

**13. Removal of Temporary Fills.** Temporary fills must be removed in their entirety and the affected areas returned to pre-construction elevations. The affected areas must be re-vegetated, as appropriate.

**14. Proper Maintenance.** Any authorized structure or fill shall be properly maintained, including maintenance to ensure public safety and compliance with applicable NWP general conditions, as well as any activity-specific conditions added by the district engineer to an NWP authorization.

**15. Single and Complete Project.** The activity must be a single and complete project. The same NWP cannot be used more than once for the same single and complete project.

**16. Wild and Scenic Rivers.** No activity may occur in a component of the National Wild and Scenic River System, or in a river officially designated by Congress as a "study river" for possible inclusion in the system while the river is in an official study status, unless the appropriate Federal agency with direct management responsibility for such river, has determined in writing that the proposed activity will not adversely affect the Wild and Scenic River

designation or study status. Information on Wild and Scenic Rivers may be obtained from the appropriate Federal land management agency responsible for the designated Wild and Scenic River or study river (e.g., National Park Service, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service).

**17. Tribal Rights.** No activity or its operation may impair reserved tribal rights, including, but not limited to, reserved water rights and treaty fishing and hunting rights.

**18. Endangered Species.**

(a) No activity is authorized under any NWP which is likely to directly or indirectly jeopardize the continued existence of a threatened or endangered species or a species proposed for such designation, as identified under the Federal Endangered Species Act (ESA), or which will directly or indirectly destroy or adversely modify the critical habitat of such species. No activity is authorized under any NWP which "may affect" a listed species or critical habitat, unless Section 7 consultation addressing the effects of the proposed activity has been completed.

(b) Federal agencies should follow their own procedures for complying with the requirements of the ESA. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address ESA compliance for the NWP activity, or whether additional ESA consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, and shall not begin work on the activity until notified by the district engineer that the requirements of the ESA have been satisfied and that the activity is authorized. For activities that might affect Federally-listed endangered or threatened species or designated critical habitat, the pre-construction notification must include the name(s) of the endangered or threatened species that might be affected by the proposed work or that utilize the designated critical habitat that might be affected by the proposed work. The district engineer will determine whether the proposed activity "may affect" or will have "no effect" to listed species and designated critical habitat and will notify the non-Federal applicant of the Corps' determination within 45 days of receipt of a complete preconstruction notification. In cases where the non-Federal applicant has identified listed species or critical habitat that might be affected or is in the vicinity of the project, and has so notified the Corps, the applicant shall not begin work until the Corps has provided notification the proposed activities will have "no effect" on listed species or critical habitat, or until Section 7 consultation has been completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(d) As a result of formal or informal consultation with the FWS or NMFS the district engineer may add species-specific regional endangered species conditions to the NWP.

(e) Authorization of an activity by a NWP does not authorize the "take" of a threatened or endangered species as defined under the ESA. In the absence of separate authorization (e.g., an ESA Section 10 Permit, a Biological Opinion with "incidental take" provisions, etc.) from the U.S. FWS or the NMFS, The Endangered Species Act prohibits any person subject to the jurisdiction of the United States to take a listed species, where "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. The word "harm" in the definition of "take" means an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

(f) Information on the location of threatened and endangered species and their critical habitat can be obtained directly from the offices of the U.S. FWS and NMFS or their World Wide Web pages at <http://www.fws.gov/> or <http://www.fws.gov/ipac> and <http://www.noaa.gov/fisheries.html> respectively.

**19. Migratory Birds and Bald and Golden Eagles.** The permittee is responsible for obtaining any "take" permits required under the U.S. Fish and Wildlife Service's regulations governing compliance with the Migratory Bird Treaty Act or the Bald and Golden Eagle Protection Act. The permittee should contact the appropriate local office of the U.S. Fish and Wildlife Service to determine if such "take" permits are required for a particular activity.

## **20. Historic Properties.**

(a) In cases where the district engineer determines that the activity may affect properties listed, or eligible for listing, in the National Register of Historic Places, the activity is not authorized, until the requirements of Section 106 of the National Historic Preservation Act (NHPA) have been satisfied.

(b) Federal permittees should follow their own procedures for complying with the requirements of Section 106 of the National Historic Preservation Act. Federal permittees must provide the district engineer with the appropriate documentation to demonstrate compliance with those requirements. The district engineer will review the documentation and determine whether it is sufficient to address section 106 compliance for the NWP activity, or whether additional section 106 consultation is necessary.

(c) Non-federal permittees must submit a pre-construction notification to the district engineer if the authorized activity may have the potential to cause effects to any historic properties listed on, determined to be eligible for listing on, or potentially eligible for listing on the National Register of Historic Places, including previously unidentified properties. For such activities, the pre-construction notification must state which historic properties may be affected by the proposed work or include a vicinity map indicating the location of the historic properties or the potential for the presence of historic properties. Assistance regarding

information on the location of or potential for the presence of historic resources can be sought from the State Historic Preservation Officer or Tribal Historic Preservation Officer, as appropriate, and the National Register of Historic Places (see 33 CFR 330.4(g)). When reviewing pre-construction notifications, district engineers will comply with the current procedures for addressing the requirements of Section 106 of the National Historic Preservation Act. The district engineer shall make a reasonable and good faith effort to carry out appropriate identification efforts, which may include background research, consultation, oral history interviews, sample field investigation, and field survey. Based on the information submitted and these efforts, the district engineer shall determine whether the proposed activity has the potential to cause an effect on the historic properties. Where the non-Federal applicant has identified historic properties on which the activity may have the potential to cause effects and so notified the Corps, the non-Federal applicant shall not begin the activity until notified by the district engineer either that the activity has no potential to cause effects or that consultation under Section 106 of the NHPA has been completed.

(d) The district engineer will notify the prospective permittee within 45 days of receipt of a complete pre-construction notification whether NHPA Section 106 consultation is required. Section 106 consultation is not required when the Corps determines that the activity does not have the potential to cause effects on historic properties (see 36 CFR §800.3(a)). If NHPA section 106 consultation is required and will occur, the district engineer will notify the non-Federal applicant that he or she cannot begin work until Section 106 consultation is completed. If the non-Federal applicant has not heard back from the Corps within 45 days, the applicant must still wait for notification from the Corps.

(e) Prospective permittees should be aware that section 110k of the NHPA (16 U.S.C. 470h-2(k)) prevents the Corps from granting a permit or other assistance to an applicant who, with intent to avoid the requirements of Section 106 of the NHPA, has intentionally significantly adversely affected a historic property to which the permit would relate, or having legal power to prevent it, allowed such significant adverse effect to occur, unless the Corps, after consultation with the Advisory Council on Historic Preservation (ACHP), determines that circumstances justify granting such assistance despite the adverse effect created or permitted by the applicant. If circumstances justify granting the assistance, the Corps is required to notify the ACHP and provide documentation specifying the circumstances, the degree of damage to the integrity of any historic properties affected, and proposed mitigation. This documentation must include any views obtained from the applicant, SHPO/THPO, appropriate Indian tribes if the undertaking occurs on or affects historic properties on tribal lands or affects properties of interest to those tribes, and other parties known to have a legitimate interest in the impacts to the permitted activity on historic properties.

**21. Discovery of Previously Unknown Remains and Artifacts.** If you discover any previously unknown historic, cultural or archeological remains and artifacts while accomplishing the activity authorized by this permit, you must immediately notify the district engineer of what you have found, and to the maximum extent practicable, avoid construction activities that may affect the remains and artifacts until the required coordination has been completed. The district engineer will initiate the Federal, Tribal and state coordination required to determine if the items

or remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

**22. Designated Critical Resource Waters.** Critical resource waters include, NOAA managed marine sanctuaries and marine monuments, and National Estuarine Research Reserves. The district engineer may designate, after notice and opportunity for public comment, additional waters officially designated by a state as having particular environmental or ecological significance, such as outstanding national resource waters or state natural heritage sites. The district engineer may also designate additional critical resource waters after notice and opportunity for public comment.

(a) Discharges of dredged or fill material into waters of the United States are not authorized by NWP's 7, 12, 14, 16, 17, 21, 29, 31, 35, 39, 40, 42, 43, 44, 49, 50, 51, and 52 for any activity within, or directly affecting, critical resource waters, including wetlands adjacent to such waters.

(b) For NWP's 3, 8, 10, 13, 15, 18, 19, 22, 23, 25, 27, 28, 30, 33, 34, 36, 37, and 38, notification is required in accordance with general condition 31, for any activity proposed in the designated critical resource waters including wetlands adjacent to those waters. The district engineer may authorize activities under these NWP's only after it is determined that the impacts to the critical resource waters will be no more than minimal.

**23. Mitigation.** The district engineer will consider the following factors when determining appropriate and practicable mitigation necessary to ensure that adverse effects on the aquatic environment are minimal:

(a) The activity must be designed and constructed to avoid and minimize adverse effects, both temporary and permanent, to waters of the United States to the maximum extent practicable at the project site (i.e., on site).

(b) Mitigation in all its forms (avoiding, minimizing, rectifying, reducing, or compensating for resource losses) will be required to the extent necessary to ensure that the adverse effects to the aquatic environment are minimal.

(c) Compensatory mitigation at a minimum one-for-one ratio will be required for all wetland losses that exceed 1/10-acre and require pre-construction notification, unless the district engineer determines in writing that either some other form of mitigation would be more environmentally appropriate or the adverse effects of the proposed activity are minimal, and provides a project-specific waiver of this requirement. For wetland losses of 1/10-acre or less that require pre-construction notification, the district engineer may determine on a case-by-case basis that compensatory mitigation is required to ensure that the activity results in minimal adverse effects on the aquatic environment. Compensatory mitigation projects provided to offset losses of aquatic resources must comply with the applicable provisions of 33 CFR part 332.

(1) The prospective permittee is responsible for proposing an appropriate compensatory mitigation option if compensatory mitigation is necessary to ensure that the activity results in minimal adverse effects on the aquatic environment.

(2) Since the likelihood of success is greater and the impacts to potentially valuable uplands are reduced, wetland restoration should be the first compensatory mitigation option considered.

(3) If permittee-responsible mitigation is the proposed option, the prospective permittee is responsible for submitting a mitigation plan. A conceptual or detailed mitigation plan may be used by the district engineer to make the decision on the NWP verification request, but a final mitigation plan that addresses the applicable requirements of 33 CFR 332.4(c)(2) – (14) must be approved by the district engineer before the permittee begins work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation (see 33 CFR 332.3(k)(3)).

(4) If mitigation bank or in-lieu fee program credits are the proposed option, the mitigation plan only needs to address the baseline conditions at the impact site and the number of credits to be provided.

(5) Compensatory mitigation requirements (e.g., resource type and amount to be provided as compensatory mitigation, site protection, ecological performance standards, monitoring requirements) may be addressed through conditions added to the NWP authorization, instead of components of a compensatory mitigation plan.

(d) For losses of streams or other open waters that require pre-construction notification, the district engineer may require compensatory mitigation, such as stream rehabilitation, enhancement, or preservation, to ensure that the activity results in minimal adverse effects on the aquatic environment.

(e) Compensatory mitigation will not be used to increase the acreage losses allowed by the acreage limits of the NWPs. For example, if an NWP has an acreage limit of 1/2-acre, it cannot be used to authorize any project resulting in the loss of greater than 1/2-acre of waters of the United States, even if compensatory mitigation is provided that replaces or restores some of the lost waters. However, compensatory mitigation can and should be used, as necessary, to ensure that a project already meeting the established acreage limits also satisfies the minimal impact requirement associated with the NWPs.

(f) Compensatory mitigation plans for projects in or near streams or other open waters will normally include a requirement for the restoration or establishment, maintenance, and legal protection (e.g., conservation easements) of riparian areas next to open waters. In some cases, riparian areas may be the only compensatory mitigation required. Riparian areas should consist of native species. The width of the required riparian area will address documented water quality or aquatic habitat loss concerns. Normally, the riparian area will be 25 to 50 feet wide on each side of the stream, but the district engineer may require slightly wider riparian

areas to address documented water quality or habitat loss concerns. If it is not possible to establish a riparian area on both sides of a stream, or if the waterbody is a lake or coastal waters, then restoring or establishing a riparian area along a single bank or shoreline may be sufficient. Where both wetlands and open waters exist on the project site, the district engineer will determine the appropriate compensatory mitigation (e.g., riparian areas and/or wetlands compensation) based on what is best for the aquatic environment on a watershed basis. In cases where riparian areas are determined to be the most appropriate form of compensatory mitigation, the district engineer may waive or reduce the requirement to provide wetland compensatory mitigation for wetland losses.

(g) Permittees may propose the use of mitigation banks, in-lieu fee programs, or separate permittee-responsible mitigation. For activities resulting in the loss of marine or estuarine resources, permittee-responsible compensatory mitigation may be environmentally preferable if there are no mitigation banks or in-lieu fee programs in the area that have marine or estuarine credits available for sale or transfer to the permittee. For permittee-responsible mitigation, the special conditions of the NWP verification must clearly indicate the party or parties responsible for the implementation and performance of the compensatory mitigation project, and, if required, its long-term management.

(h) Where certain functions and services of waters of the United States are permanently adversely affected, such as the conversion of a forested or scrub-shrub wetland to an herbaceous wetland in a permanently maintained utility line right-of-way, mitigation may be required to reduce the adverse effects of the project to the minimal level.

**24. Safety of Impoundment Structures.** To ensure that all impoundment structures are safely designed, the district engineer may require non-Federal applicants to demonstrate that the structures comply with established state dam safety criteria or have been designed by qualified persons. The district engineer may also require documentation that the design has been independently reviewed by similarly qualified persons, and appropriate modifications made to ensure safety.

**25. Water Quality.** Where States and authorized Tribes, or EPA where applicable, have not previously certified compliance of an NWP with CWA Section 401, individual 401 Water Quality Certification must be obtained or waived (see 33 CFR 330.4(c)). The district engineer or State or Tribe may require additional water quality management measures to ensure that the authorized activity does not result in more than minimal degradation of water quality.

**26. Coastal Zone Management.** In coastal states where an NWP has not previously received a state coastal zone management consistency concurrence, an individual state coastal zone management consistency concurrence must be obtained, or a presumption of concurrence must occur (see 33 CFR 330.4(d)). The district engineer or a State may require additional measures to ensure that the authorized activity is consistent with state coastal zone management requirements.

**27. Regional and Case-By-Case Conditions.** The activity must comply with any regional conditions that may have been added by the Division Engineer (see 33 CFR 330.4(e)) and with any case specific conditions added by the Corps or by the state, Indian Tribe, or U.S. EPA in its section 401 Water Quality Certification, or by the state in its Coastal Zone Management Act consistency determination.

**28. Use of Multiple Nationwide Permits.** The use of more than one NWP for a single and complete project is prohibited, except when the acreage loss of waters of the United States authorized by the NWP does not exceed the acreage limit of the NWP with the highest specified acreage limit. For example, if a road crossing over tidal waters is constructed under NWP 14, with associated bank stabilization authorized by NWP 13, the maximum acreage loss of waters of the United States for the total project cannot exceed 1/3-acre.

**29. Transfer of Nationwide Permit Verifications.** If the permittee sells the property associated with a nationwide permit verification, the permittee may transfer the nationwide permit verification to the new owner by submitting a letter to the appropriate Corps district office to validate the transfer. A copy of the nationwide permit verification must be attached to the letter, and the letter must contain the following statement and signature:

“When the structures or work authorized by this nationwide permit are still in existence at the time the property is transferred, the terms and conditions of this nationwide permit, including any special conditions, will continue to be binding on the new owner(s) of the property. To validate the transfer of this nationwide permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.”

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(Transferee)

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(Date)

**30. Compliance Certification.** Each permittee who receives an NWP verification letter from the Corps must provide a signed certification documenting completion of the authorized activity and any required compensatory mitigation. The success of any required permittee responsible mitigation, including the achievement of ecological performance standards, will be addressed separately by the district engineer. The Corps will provide the permittee the certification document with the NWP verification letter. The certification document will include:

(a) A statement that the authorized work was done in accordance with the NWP authorization, including any general, regional, or activity-specific conditions;

(b) A statement that the implementation of any required compensatory mitigation was completed in accordance with the permit conditions. If credits from a mitigation bank or in-lieu fee program are used to satisfy the compensatory mitigation requirements, the certification must include the documentation required by 33 CFR 332.3(1)(3) to confirm that the permittee secured the appropriate number and resource type of credits; and

- (c) The signature of the permittee certifying the completion of the work and mitigation.

### 31. Pre-Construction Notification.

(a) Timing. Where required by the terms of the NWP, the prospective permittee must notify the district engineer by submitting a pre-construction notification (PCN) as early as possible. The district engineer must determine if the PCN is complete within 30 calendar days of the date of receipt and, if the PCN is determined to be incomplete, notify the prospective permittee within that 30 day period to request the additional information necessary to make the PCN complete. The request must specify the information needed to make the PCN complete. As a general rule, district engineers will request additional information necessary to make the PCN complete only once. However, if the prospective permittee does not provide all of the requested information, then the district engineer will notify the prospective permittee that the PCN is still incomplete and the PCN review process will not commence until all of the requested information has been received by the district engineer. The prospective permittee shall not begin the activity until either:

(1) He or she is notified in writing by the district engineer that the activity may proceed under the NWP with any special conditions imposed by the district or division engineer; or

(2) 45 calendar days have passed from the district engineer's receipt of the complete PCN and the prospective permittee has not received written notice from the district or division engineer. However, if the permittee was required to notify the Corps pursuant to general condition 18 that listed species or critical habitat might be affected or in the vicinity of the project, or to notify the Corps pursuant to general condition 20 that the activity may have the potential to cause effects to historic properties, the permittee cannot begin the activity until receiving written notification from the Corps that there is "no effect" on listed species or "no potential to cause effects" on historic properties, or that any consultation required under Section 7 of the Endangered Species Act (see 33 CFR 330.4(f)) and/or Section 106 of the National Historic Preservation (see 33 CFR 330.4(g)) has been completed. Also, work cannot begin under NWPs 21, 49, or 50 until the permittee has received written approval from the Corps. If the proposed activity requires a written waiver to exceed specified limits of an NWP, the permittee may not begin the activity until the district engineer issues the waiver. If the district or division engineer notifies the permittee in writing that an individual permit is required within 45 calendar days of receipt of a complete PCN, the permittee cannot begin the activity until an individual permit has been obtained. Subsequently, the permittee's right to proceed under the NWP may be modified, suspended, or revoked only in accordance with the procedure set forth in 33 CFR 330.5(d)(2).

(b) Contents of Pre-Construction Notification: The PCN must be in writing and include the following information:

- (1) Name, address and telephone numbers of the prospective permittee;

(2) Location of the proposed project;

(3) A description of the proposed project; the project's purpose; direct and indirect adverse environmental effects the project would cause, including the anticipated amount of loss of water of the United States expected to result from the NWP activity, in acres, linear feet, or other appropriate unit of measure; any other NWP(s), regional general permit(s), or individual permit(s) used or intended to be used to authorize any part of the proposed project or any related activity. The description should be sufficiently detailed to allow the district engineer to determine that the adverse effects of the project will be minimal and to determine the need for compensatory mitigation. Sketches should be provided when necessary to show that the activity complies with the terms of the NWP. (Sketches usually clarify the project and when provided results in a quicker decision. Sketches should contain sufficient detail to provide an illustrative description of the proposed activity (e.g., a conceptual plan), but do not need to be detailed engineering plans);

(4) The PCN must include a delineation of wetlands, other special aquatic sites, and other waters, such as lakes and ponds, and perennial, intermittent, and ephemeral streams, on the project site. Wetland delineations must be prepared in accordance with the current method required by the Corps. The permittee may ask the Corps to delineate the special aquatic sites and other waters on the project site, but there may be a delay if the Corps does the delineation, especially if the project site is large or contains many waters of the United States. Furthermore, the 45 day period will not start until the delineation has been submitted to or completed by the Corps, as appropriate;

(5) If the proposed activity will result in the loss of greater than 1/10-acre of wetlands and a PCN is required, the prospective permittee must submit a statement describing how the mitigation requirement will be satisfied, or explaining why the adverse effects are minimal and why compensatory mitigation should not be required. As an alternative, the prospective permittee may submit a conceptual or detailed mitigation plan.

(6) If any listed species or designated critical habitat might be affected or is in the vicinity of the project, or if the project is located in designated critical habitat, for non-Federal applicants the PCN must include the name(s) of those endangered or threatened species that might be affected by the proposed work or utilize the designated critical habitat that may be affected by the proposed work. Federal applicants must provide documentation demonstrating compliance with the Endangered Species Act; and

(7) For an activity that may affect a historic property listed on, determined to be eligible for listing on, or potentially eligible for listing on, the National Register of Historic Places, for non-Federal applicants the PCN must state which historic property may be affected by the proposed work or include a vicinity map indicating the location of the historic property. Federal applicants must provide documentation demonstrating compliance with Section 106 of the National Historic Preservation Act.

(c) Form of Pre-Construction Notification: The standard individual permit application form (Form ENG 4345) may be used, but the completed application form must clearly indicate that it is a PCN and must include all of the information required in paragraphs (b)(1) through (7) of this general condition. A letter containing the required information may also be used.

(d) Agency Coordination:

(1) The district engineer will consider any comments from Federal and state agencies concerning the proposed activity's compliance with the terms and conditions of the NWP's and the need for mitigation to reduce the project's adverse environmental effects to a minimal level.

(2) For all NWP activities that require pre-construction notification and result in the loss of greater than 1/2-acre of waters of the United States, for NWP 21, 29, 39, 40, 42, 43, 44, 50, 51, and 52 activities that require pre-construction notification and will result in the loss of greater than 300 linear feet of stream bed, and for all NWP 48 activities that require pre-construction notification, the district engineer will immediately provide (e.g., via e-mail, facsimile transmission, overnight mail, or other expeditious manner) a copy of the complete PCN to the appropriate Federal or state offices (U.S. FWS, state natural resource or water quality agency, EPA, State Historic Preservation Officer (SHPO) or Tribal Historic Preservation Office (THPO), and, if appropriate, the NMFS). With the exception of NWP 37, these agencies will have 10 calendar days from the date the material is transmitted to telephone or fax the district engineer notice that they intend to provide substantive, site-specific comments. The comments must explain why the agency believes the adverse effects will be more than minimal. If so contacted by an agency, the district engineer will wait an additional 15 calendar days before making a decision on the pre-construction notification. The district engineer will fully consider agency comments received within the specified time frame concerning the proposed activity's compliance with the terms and conditions of the NWP's, including the need for mitigation to ensure the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The district engineer will provide no response to the resource agency, except as provided below. The district engineer will indicate in the administrative record associated with each pre-construction notification that the resource agencies' concerns were considered. For NWP 37, the emergency watershed protection and rehabilitation activity may proceed immediately in cases where there is an unacceptable hazard to life or a significant loss of property or economic hardship will occur. The district engineer will consider any comments received to decide whether the NWP 37 authorization should be modified, suspended, or revoked in accordance with the procedures at 33 CFR 330.5.

(3) In cases of where the prospective permittee is not a Federal agency, the district engineer will provide a response to NMFS within 30 calendar days of receipt of any Essential Fish Habitat conservation recommendations, as required by Section 305(b)(4)(B) of the Magnuson-Stevens Fishery Conservation and Management Act.

(4) Applicants are encouraged to provide the Corps with either electronic files or multiple copies of pre-construction notifications to expedite agency coordination.

### District Engineer's Decision

1. In reviewing the PCN for the proposed activity, the district engineer will determine whether the activity authorized by the NWP will result in more than minimal individual or cumulative adverse environmental effects or may be contrary to the public interest. For a linear project, this determination will include an evaluation of the individual crossings to determine whether they individually satisfy the terms and conditions of the NWP(s), as well as the cumulative effects caused by all of the crossings authorized by NWP. If an applicant requests a waiver of the 300 linear foot limit on impacts to intermittent or ephemeral streams or of an otherwise applicable limit, as provided for in NWPs 13, 21, 29, 36, 39, 40, 42, 43, 44, 50, 51 or 52, the district engineer will only grant the waiver upon a written determination that the NWP activity will result in minimal adverse effects. When making minimal effects determinations the district engineer will consider the direct and indirect effects caused by the NWP activity. The district engineer will also consider site specific factors, such as the environmental setting in the vicinity of the NWP activity, the type of resource that will be affected by the NWP activity, the functions provided by the aquatic resources that will be affected by the NWP activity, the degree or magnitude to which the aquatic resources perform those functions, the extent that aquatic resource functions will be lost as a result of the NWP activity (e.g., partial or complete loss), the duration of the adverse effects (temporary or permanent), the importance of the aquatic resource functions to the region (e.g., watershed or ecoregion), and mitigation required by the district engineer. If an appropriate functional assessment method is available and practicable to use, that assessment method may be used by the district engineer to assist in the minimal adverse effects determination. The district engineer may add case-specific special conditions to the NWP authorization to address site-specific environmental concerns.

2. If the proposed activity requires a PCN and will result in a loss of greater than 1/10-acre of wetlands, the prospective permittee should submit a mitigation proposal with the PCN. Applicants may also propose compensatory mitigation for projects with smaller impacts. The district engineer will consider any proposed compensatory mitigation the applicant has included in the proposal in determining whether the net adverse environmental effects to the aquatic environment of the proposed activity are minimal. The compensatory mitigation proposal may be either conceptual or detailed. If the district engineer determines that the activity complies with the terms and conditions of the NWP and that the adverse effects on the aquatic environment are minimal, after considering mitigation, the district engineer will notify the permittee and include any activity-specific conditions in the NWP verification the district engineer deems necessary. Conditions for compensatory mitigation requirements must comply with the appropriate provisions at 33 CFR 332.3(k). The district engineer must approve the final mitigation plan before the permittee commences work in waters of the United States, unless the district engineer determines that prior approval of the final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation. If the prospective permittee elects to submit a compensatory mitigation plan with the PCN, the district engineer will expeditiously review the proposed compensatory mitigation plan. The district engineer must review the proposed compensatory mitigation plan within 45 calendar days of receiving a complete PCN and determine whether the proposed mitigation would ensure no more than minimal adverse effects on the aquatic environment. If the net adverse effects of the project on the aquatic environment (after consideration of the compensatory mitigation proposal) are

determined by the district engineer to be minimal, the district engineer will provide a timely written response to the applicant. The response will state that the project can proceed under the terms and conditions of the NWP, including any activity-specific conditions added to the NWP authorization by the district engineer.

3. If the district engineer determines that the adverse effects of the proposed work are more than minimal, then the district engineer will notify the applicant either:

- (a) that the project does not qualify for authorization under the NWP and instruct the applicant on the procedures to seek authorization under an individual permit;
- (b) that the project is authorized under the NWP subject to the applicant's submission of a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level; or
- (c) that the project is authorized under the NWP with specific modifications or conditions. Where the district engineer determines that mitigation is required to ensure no more than minimal adverse effects occur to the aquatic environment, the activity will be authorized within the 45-day PCN period, with activity-specific conditions that state the mitigation requirements. The authorization will include the necessary conceptual or detailed mitigation or a requirement that the applicant submit a mitigation plan that would reduce the adverse effects on the aquatic environment to the minimal level. When mitigation is required, no work in waters of the United States may occur until the district engineer has approved a specific mitigation plan or has determined that prior approval of a final mitigation plan is not practicable or not necessary to ensure timely completion of the required compensatory mitigation.

**NATIONWIDE PERMIT (NWP) REGIONAL CONDITIONS  
FOR THE STATE OF TEXAS**

**The following regional conditions apply within the entire State of Texas:**

1. Compensatory mitigation is required at a minimum one-for-one ratio for all special aquatic site losses that exceed 1/10 acre and require pre-construction notification (PCN), and for all losses to streams that exceed 300 linear feet and require PCN, unless the appropriate District Engineer determines in writing that some other form of mitigation would be more environmentally appropriate and provides a project-specific waiver of this requirement.
  
2. For all discharges proposed for authorization under nationwide permits (NWP) 3, 6, 7, 12, 14, 18, 19, 25, 27, 29, 39, 40, 41, 42, 43, 44, 51, and 52, into the following habitat types or specific areas, the applicant shall notify the appropriate District Engineer in accordance with the NWP General Condition 31, Pre-Construction Notification (PCN). The Corps of Engineers (Corps), except for the Tulsa District, will coordinate with the resource agencies as specified in NWP General Condition 31(d) (PCN). The habitat types or areas are:
  - a. Pitcher Plant Bogs: Wetlands typically characterized by an organic surface soil layer and include vegetation such as pitcher plants (Sarracenia sp.), sundews (Drosera sp.), and sphagnum moss (Sphagnum sp.).
  
  - b. Bald Cypress-Tupelo Swamps: Wetlands comprised predominantly of bald cypress trees (Taxodium distichum), and water tupelo trees (Nyssa aquatica), that are occasionally or regularly flooded by fresh water. Common associates include red maple (Acer rubrum), swamp privet (Forestiera acuminata), green ash (Fraxinus pennsylvanica) and water elm (Planera aquatica). Associated herbaceous species include lizard's tail (Saururus cernuus), water mermaid weed (Proserpinaca spp.), buttonbush (Cephalanthus occidentalis) and smartweed (Polygonum spp.). (Eyre, F. H. Forest Cover Types of the United States and Canada. 1980. Society of American Foresters, 5400 Grosvenor Lane, Bethesda, Maryland 20814-2198. Library of Congress Catalog Card No. 80-54185)
  
3. For all activities proposed for authorization under NWP 12 that involve a discharge of fill material associated with mechanized land clearing in a forested wetland, the applicant shall notify the appropriate District Engineer in accordance with the NWP General Condition 31 (Pre-Construction Notification) prior to commencing the activity.
  
4. For all activities proposed for authorization under NWP 16, the applicant shall notify the appropriate District Engineer in accordance with the NWP General Condition 31 (Pre-Construction Notification), and work cannot begin under NWP 16 until the applicant has received written approval from the Corps.

**The following regional conditions apply only within the Fort Worth District in the State of Texas:**

5. For all discharges proposed for authorization under all NWPs, into the area of Caddo Lake within Texas that is designated as a "Wetland of International Importance" under the Ramsar Convention, the applicant shall notify the Fort Worth District Engineer in accordance with the NWP General Condition 31. The Corps will coordinate with the resource agencies as specified in NWP General Condition 31(d) (Pre-Construction Notification).
6. For all discharges proposed for authorization under NWP 43 that occur in forested wetlands, the applicant shall notify the Fort Worth District Engineer in accordance with the General Condition 31 (Pre-Construction Notification).
7. For all discharges proposed for authorization under any nationwide permit in Dallas, Denton, and Tarrant Counties that are within the study area of the "Final Regional Environmental Impact Statement (EIS), Trinity River and Tributaries" (May 1986), the applicant shall meet the criteria and follow the guidelines specified in Section III of the Record of Decision for the Regional EIS, including the hydraulic impact requirements. A copy of these guidelines is available upon request from the Fort Worth District and at the District website [www.swf.usace.army.mil](http://www.swf.usace.army.mil) (select "Permits").
8. Federal Projects. The applicant shall notify the Fort Worth District Engineer in accordance with the NWP General Condition 31, Pre-Construction Notification (PCN) for any regulated activity where the applicant is proposing work that would result in the modification or alteration of any completed Corps of Engineer projects that are either locally or federally maintained and for work that would occur within the conservation pool or flowage easement of any Corps of Engineers lake project. PCN's cannot be deemed complete until such time as the Corps has made a determination relative to 33 USC Section 408, 33 CFR Part 208, Section 208.10, 33 CFR Part 320, Section 320.4.
9. Invasive and Exotic Species. Best management practices are required where practicable to reduce the risk of transferring invasive plant and animal species to or from project sites. Information concerning state specific lists and threats can be found at: <http://www.invasivespeciesinfo.gov/unitedstates/tx.shtml>. Best management practices can be found at: <http://www.invasivespeciesinfo.gov/toolkit/prevention.shtml>. Known zebra mussel waters within can be found at: <http://nas.er.usgs.gov/queries/zmbyst.asp>.
10. For all discharges proposed for authorization under NWPs 51 and 52, the Corps will provide the PCN to the US Fish and Wildlife Service as specified in NWP General Condition 31(d)(2) for its review and comments.

**The following regional conditions apply only within the Galveston District in the State of Texas:**

11. Nationwide permit (NWP) 12 shall not be used to authorize discharges within 500 feet of vegetated shallows and coral reefs; as defined by 40 CFR 230.43 and 230.44 respectfully. Examples include, but not limited to: seagrass beds, oyster reefs, and coral reefs.
12. For all 3-D seismic testing activities proposed for authorization under NWP 6, the applicant shall notify the Galveston District Engineer in accordance with the NWP General Condition 31 (Pre-Construction Notification). The pre-construction notification must state the time period for which the temporary fill is proposed, and must include a restoration plan for the special aquatic sites. 3-D seismic testing will not be authorized under NWP 6 within the Cowardin Marine System, Subtidal Subsystem; as defined by the U.S. Fish and Wildlife, Classification of Wetlands and Deepwater Habitats of the United States, December 1979/Reprinted 1992.
13. All NWPs, except NWP 3, shall not be used to authorize discharges into mangrove marshes. Mangrove marshes are dominated by mangroves (Avicennia sp. and Rhizophora sp.). (Preliminary Guide to Wetlands of the Gulf Coastal Plain. 1978. Technical Report - U.S. Army Engineer Waterways Experiment Station: Y-78-5. P.O. Box 631, Vicksburg, Miss. 39180.)
14. All NWPs, except NWP 3, shall not be used to authorize discharges into the following waters of the United States within the coastal zone of Texas: Coastal Dune Swales, "wetlands and other waters of the United States that are formed as depressions within and among multiple beach ridge barriers, dune complexes, or dune areas adjacent to beaches fronting the tidal waters of the Gulf of Mexico and adjacent to the tidal waters of bays and estuaries. Coastal dune swales are generally comprised either of impermeable muds that act as reservoirs which collect precipitation or of groundwater nourished wetlands in sandy soils. As such, they generally have a high fresh to brackish water table. Vegetation species characteristically found in coastal dune swales include but are not limited to marshhay cordgrass (Spartina patens), gulfdune paspalum (Paspalum monostachyum), bulrush (Scirpus spp.), seashore paspalum (Paspalum vaginatum), common reed (Phragmites australis), groundsel bush (Baccharis halimifolia), rattlebush (Sesbania drummondii), camphor weed (Pluchea camphorata), smartweed (Polygonum spp.), water hyssop (Bacopa monnieri), cattail (Typha spp.), umbrella sedge (Cyperus spp.), softrush (Juncus spp.), sedge (Carex spp.), beakrush (Rhynchospora spp.), frog-fruit (Phylla spp.), duckweed (Lemna spp.), buttonweed (Diodia virginiana), mist flower (Eupatorium coelestinum), creeping spotflower (Acmella oppositifolia var. repens), pennywort (Hydrocotyle spp.), and bushy bluestem (Andropogon glomeratus)."  
(U.S. Fish and Wildlife Service, Houston, Texas, and the Texas General Land Office, Austin, Texas).

15. For all discharges and work proposed in tidal waters under NWPs 14 and 18 the applicant shall notify the Galveston District Engineer in accordance with the NWP General Condition 31 (Pre-Construction Notification). The Corps will coordinate with the National Marine Fisheries Service in accordance with NWP General Condition 31(d) (Pre-Construction Notification).

16. For all work in the San Jacinto River Waste Pits (SJWP) Area of Concern (AOC), authorized under a NWP, requires a waiver from the Galveston District Engineer. The applicant shall notify the Galveston District Engineer (DE) in accordance with the NWP General Condition 31, Pre-Construction Notification (PCN). This PCN shall be used to review the project to determine if it will result in more than minimal effects to the region, and does not lessen the restriction provided by any General Condition of the NWPs. The applicant must receive written approval, including a waiver from the Galveston DE prior to starting work in jurisdictional areas of waters of the United States.

17. The use of NWP 51 and 52 are administratively denied, within the Galveston District boundaries.

**The following regional conditions apply only within the Albuquerque District in the State of Texas:**

18. Nationwide Permit No. 23 – Approved Categorical Exclusions. Notification to the District Engineer in accordance with General Condition 31 (Pre-Construction Notification) is required for all proposed activities under nationwide permit 23.

19. Nationwide Permit No. 27 – Aquatic Habitat Restoration, Establishment, and Enhancement Activities. For all proposed activities under Nationwide Permit 27 that require Pre-Construction Notification, a monitoring plan commensurate with the scale of the proposed restoration project and the potential for risk to the aquatic environment must be submitted to the Corps. (See “Guidelines for Nationwide Permit 27 Submittals” at <http://www.spa.usace.army.mil/reg/>).

20. Nationwide Permits No. 29 – Residential Developments, and No. 39 – Commercial and Institutional Developments. These permits do not authorize channelization or relocation of any intermittent or perennial water course regardless of size or rate of flow, except when, as determined by the Albuquerque District, the proposed channelization would impact a previously channelized stream reach, or the relocation would result in a net increase in functions of the aquatic ecosystem within the watershed.

21. Activities in Special Aquatic Sites, Including Wetlands. Notification to the District Engineer in accordance with General Condition 31 (Pre-Construction Notification) is required for all proposed impacts that exceed 1/10 acre in special aquatic sites, including wetlands.

22. Activities in Intermittent and Perennial Streams. Notification to the District Engineer in accordance with General Condition 31 (Pre-Construction Notification) is required for all proposed activities that involve fills greater than 1/10 acre in perennial or intermittent streams and is not covered by other notification requirements.

23. Springs. All nationwide permits require preconstruction notification pursuant to General Condition 31 for discharges of dredged or fill material within 100 feet of the point of groundwater discharge of natural springs. A spring source is defined as any location where ground water emanates from a point in the ground and a jurisdictional nexus to another water of the United States. For purposes of this regional condition, springs do not include seeps or other discharges which lack a jurisdictional nexus to another water of the United States.

24. Suitable Fill. Use of broken concrete or used tires formed into bales as fill or bank stabilization material requires notification to the District Engineer in accordance with General Condition 31 (Pre-Construction Notification). Applicants must demonstrate that soft engineering methods utilizing native or non-manmade materials are not practicable (with respect to environment, cost, existing technology, and logistics), before broken concrete or used tires as bales are allowed as suitable fill.

Exhibit F  
TCEQ Dam Hydrology Submittals

TX DAM\_TX0 3398 - ~~CONF~~ - ~~10206~~ - ~~CONF~~  
ce  
Existing condition  
Correspondence



Texas Dam Safety Program, MC 174  
Field Operations Support Division, Office of Compliance and Enforcement  
Texas Commission on Environmental Quality  
P.O. Box 13087  
Austin, TX 78711

**CONFIDENTIAL**

**INFORMATION SHEET: EXISTING DAM**

(PLEASE PRINT OR TYPE)

Reference 30 Texas Administrative Code, Chapter 299, Dams and Reservoirs

**SECTION 1: OWNER INFORMATION**

Owner's Name Mary Anne Piacentini Title Executive Director

Organization Katy Prairie Conservancy, Warren Ranch

Mary Anne Piacentini (Signature of Owner) 6 February 2017 (Date)

Owner's Address 5615 Kirby Drive, Suite 867

City Houston State TX Zip Code 77005-2458

Phone Number ( 713 ) 523-6135 Emergency Contact Phone ( 281 ) 851-8762

Fax Number ( 713 ) 583-0683 E-mail maryanne@katyprairie.org

Owner Code (Please check one):  Federal (F)  Local Government (L)  Utility (U)  Private (P)  State (S)  
 Other (O) please specify: \_\_\_\_\_

Year Built 1961 Year Modified Unknown

Dam and Reservoir Use (Please check one):  Augmentation  Diversion  Domestic  Erosion Control  
 Evaporation  Flood Control  Fish  Hydroelectric  Industrial  
 Irrigation  Mining  Municipal  Pollution Control  Recreation  Stock Water  
 Settling Ponds  Tailings  Waste Disposal  Other, please specify: \_\_\_\_\_

Engineering Firm M&E Consultants

Project Engineer B. Trent Street Texas PE. License Number 61421

Engineering Firm Address P.O. Box 9

City Heidenheimer State TX Zip Code 76533

Phone ( 254 ) 983-9103 Fax ( 254 ) 983-9104

E-mail tstreet@mande-pe.com

**RECEIVED**

**FEB 09 2018**

**SECTION 2: GENERAL INFORMATION**

Name of Dam Warren Lake Dam

Other Name(s) of Dam None

Reservoir Name Warren Lake

Location 3 mile south of Hockley, TX Latitude 29.9768N Longitude 95.8429W

County Harris Stream Name Rock Hollow Creek

River Basin San Jacinto Coastal Basin Topographic Map No. USGS Map Name: Warren Lake

Distance & Direction from Nearest City or Town 3 mile south of Hockley, TX

Last Inspection Date Feb. 23, 2011 Inspected by (name of company or agency) TCEQ

TX Number 03398 Water Rights Number Unknown

Date of Emergency Action Plan (EAP), if one exists None

Describe the current operating condition of dam The embankment is covered with brush and debris. The upstream slope has significant wave erosion and the service spillways are inoperable.

**TCEQ  
CENTRAL FILE ROOM**

*If you have questions on how to fill out this form or about the Dam Safety Program, please contact us at 512-239-5195. Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512-239-3282.*

25/1/15

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**SECTION 3: INFORMATION ON DAM**

**Classification**

Size Classification:  Large  Medium  Small

Hazard Classification: [REDACTED]

Number of People at Risk 0 Study Year 2009

**Type of Dam:**  Concrete  Gravity  Earthfill  Rockfill  Masonry  Other (specify) \_\_\_\_\_

**Dam Structure** (dimensions to nearest tenth of foot, volume to nearest acre-foot or cubic yard, areas to nearest acre):

Spillway Height 13.4 ft (natural surface of ground to bottom of emergency spillway at longitudinal centerline)

Embankment Height 17.7 ft (natural surface of ground to crest of dam at centerline)

Structural Height 18.0 ft (bottom of cutoff trench to crest of dam at centerline)

Length of Dam 2,100 ft Crest Width Varies from 8' to 12' ft

Normal Pool Elevation 192.0 ft-MSL Principal Spillway Elevation 192.0 ft-MSL

Emergency Spillway Elevation 193.4 ft-MSL Top of Dam Elevation 197.7 ft-MSL

Embankment Volume approx. 70,000 cu yd

Maximum Impoundment Capacity 1,950.0 ac-ft (at top of dam)

Normal Reservoir Capacity 597.8 ac-ft (at normal or conservation pool)

Reservoir Surface Area 160.3 acres (at normal or conservation pool)

**Outlet**

Outlet Diameter: 24  in  ft (check one)

Type: CMP

**Principal Spillway**

Type:  Natural  Riprap  Concrete  CMP  RCP  Other 36' smooth steel mated w/24" CMP at outlet

Width (Diam.): 3 ft Capacity: None (blocked with brush)

**Emergency Spillway**

Type:  Natural  Riprap  Concrete  CMP  RCP  Other

Width (Diam.): 1800' and 110' ft Capacity: 9,677 cfs

Total Spillway Capacity: 23,000 cfs (crest of the dam)

Note: The primary spw. is ridge along the watershed boundary, approx. 1,800 feet flow width.

**SECTION 4: HYDROLOGIC INFORMATION**

Required Hydrologic Criteria (% PMF) 51 % PMF Passing 100

PMF Study Year 2015

Drainage Area: 2,966 acres, or \_\_\_\_\_ sq mi

Curve Number (AMC III condition) 90

Time of Concentration 3.2 hr

Peak Discharge 9,677 cfs

Peak Stage 196.40 ft-MSL

Storm Duration Causing Peak Stage 2 hr



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*Existing condition*

## HYDROLOGIC AND HYDRAULIC (H&H) EVALUATION SUMMARY

(Please complete all sections, unless otherwise specified)

Name of Dam: Warren Lake Dam  
 TCEQ Dam Safety Project No.: TX03398  
 County: Harris  
 Year to Build: 1961  
 Maximum Record Precipitation (in): 9.55  
 Record Area (county or city): Harris Co.  
 Duration (hr): 24 Hr.  
 Date of Record (MM/DD/YY): 10/07/49  
 Source Ref. (FEMA, National Weather Service, etc.): 2008-2009 Texas Almanac

Downstream Dam Toe 180.0 (ft-MSL)      Normal Reservoir Capacity 597.8 (ac-ft)  
 Normal Pool 192.0 (ft-MSL)      Maximum Reservoir Capacity 1,950.0 (ac-ft)  
 Principal Spillway 192.0 (ft-MSL)      Reservoir Surface Area 160.3 (ac)  
 Emergency Spillway 193.4 (ft-MSL)      Drainage Area 2,966 (ac)  
 Top of Dam 197.7 (lowest pt. in dam CL) (ft-MSL)      Outlet Diameter or Cross-Section 24 (in)

Storm Duration	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Stage (ft-MSL)	% PMF Passing	Comments (if needed)
1 hr	8,571	7,394	195.15	51	
2 hr	10,427	9,677	195.40	51	
3 hr	10,053	9,703	195.40	51	
6 hr	9,853	9,343	195.36	51	
12 hr	9,750	9,576	195.35	51	
24 hr	7,537	7,521	195.16	51	
48 hr	4,383	4,385	194.72	51	
72 hr	3,140	3,139	194.50	51	

To the best of my knowledge, I certify the above data are correct. I will supply the hydrologic and hydraulic reports to the Texas Commission on Environmental Quality upon request.



(P. E. Seal)

*B. Trent Street*

(Signature)

2/3/2017

(Date)



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 Proposed conditions

## INFORMATION SHEET: PROPOSED NEW CONSTRUCTION, MODIFICATION, REPAIR, ALTERATION, OR REMOVAL OF A DAM

(PLEASE PRINT OR TYPE)

Reference 30 Texas Administrative Code, Chapter 299, Dams and Reservoirs

PLEASE CHECK ONE:  New  Modification  Repair  Removal  Alteration

### SECTION 1: OWNER INFORMATION

Owner's Name Mary Anne Piacentini Title Executive Director  
 Organization Katy Prairie Conservancy and Warren Ranch

I have authorized the submittal of the final construction plans and specifications to the TCEQ Dam Safety Program according to 30 TAC Chapter 299.

Mary Anne Piacentini (Signature of Owner) 6 February 2017 (Date)

Owner's Address 5615 Kirby Drive, Suite 867

City Houston State TX Zip Code 77005-2458

Phone Number ( 713 ) 523-6135 Emergency Contact Phone ( 281 ) 851-8762

Fax Number ( 713 ) 583-0683 E-mail maryanne@katyprairie.org

Owner Code (Please check one):  Federal (F)  Local Government (L)  Utility (U)  Private (P)  State (S)  
 Other (O) please specify: \_\_\_\_\_

Dam and Reservoir Use (Please check one):  Augmentation  Diversion  Domestic  Erosion Control  
 Evaporation  Flood Control  Fire Control  Fish  Hydroelectric  Industrial  
 Irrigation  Mining  Municipal  Pollution Control  Recreation  Stock Water  
 Settling Ponds  Tailings  Waste Disposal  Other, please specify: \_\_\_\_\_

Engineering Firm M&E Consultants

Project Engineer B. Trent Street Texas PE. License Number 61421

Engineering Firm Address P.O. Box 9

City Heidenheimer State TX Zip Code 76533

Phone ( 254 ) 983-9103 Fax ( 254 ) 983-9104

E-mail tstreet@mande-pe.com

### SECTION 2: GENERAL INFORMATION

Name of Dam Warren Lake Dam

Other Name(s) of Dam None

Reservoir Name Warren Lake

Location 3 miles south of Hockley, TX Latitude 29.9768N Longitude 95.8429W

County Harris Stream Name Rock Hollow Creek

River Basin San Jacinto Coastal Basin Topographic Map No. USGS Map Name: Warren Lake

Distance and Direction from Nearest City or Town 3 mile south of Hockley, TX

TX Number 03398 Water Rights Number Unknown

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**SECTION 3: INFORMATION ON DAM**

**Classification**

Size Classification:  Large  Medium  Small

Hazard Classification: [REDACTED]

Number of People at Risk 0 Study Year 2009

**Type of Dam:**  Concrete  Gravity  Earthfill  Rockfill  Masonry  Other (specify) \_\_\_\_\_

**Dam Structure** (dimensions to nearest tenth of foot, volume to nearest acre-foot or cubic yard, areas to nearest acre):

Spillway Height 15.4 ft (natural surface of ground to bottom of emergency spillway at longitudinal centerline)

Embankment Height 22.0 ft (natural surface of ground to crest of dam at centerline)

Structural Height 25.0 ft (bottom of cutoff trench to crest of dam at centerline)

Length of Dam 3,020 ft Crest Width 20 ft

Normal Pool Elevation 192.0 ft-MSL Principal Spillway Elevation 192.0 ft-MSL

Emergency Spillway Elevation 194.0 and 194.5 ft-MSL Top of Dam Elevation 200.0 ft-MSL

Embankment Volume 74,550 cu yd

Maximum Impoundment Capacity 614.1 ac-ft (at top of dam)

Normal Reservoir Capacity 217.0 ac-ft (at normal or conservation pool)

Reservoir Surface Area 162.3 acres (at normal or conservation pool)

**Outlet**

Outlet Diameter: 24  in  ft (check one)

Type: HDPE

**Principal Spillway**

Type:  Natural  Riprap  Concrete  CMP  RCP  Other

Width (Diam.): 2 ft Capacity: 56 cfs

**Emergency Spillway**

Type:  Natural  Riprap  Concrete  CMP  RCP  Other

Width (Diam.): 1,400 and 150 ft Capacity: 14,149 cfs

Total Spillway Capacity: 22,900 cfs (crest of the dam)

**SECTION 4: HYDROLOGIC INFORMATION**

Required Hydrologic Criteria (% PMF) 51 % PMF Passing 100

PMF Study Year 2015

Drainage Area: 2,966 acres, or \_\_\_\_\_ sq mi

Curve Number (AMC III condition) 90

Time of Concentration 3.2 hr

Peak Discharge 14,149 cfs

Peak Stage 197.0 ft-MSL

Storm Duration Causing Peak Stage 3 hr



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## INFORMATION SHEET: PROPOSED NEW CONSTRUCTION, MODIFICATION, REPAIR, ALTERATION, OR REMOVAL OF A DAM

(PLEASE PRINT OR TYPE)

Reference 30 Texas Administrative Code, Chapter 299, Dams and Reservoirs

PLEASE CHECK ONE:  New  Modification  Repair  Removal  Alteration**SECTION 1: OWNER INFORMATION**Owner's Name Mary Anne Piacentini Title Executive DirectorOrganization Katy Prairie Conservancy and Warren Ranch

I have authorized the submittal of the final construction plans and specifications to the TCEQ Dam Safety Program according to 30 TAC Chapter 299.

(Signature of Owner)

2.1.2016

(Date)

Owner's Address 3015 Richmond Ave.City Houston State TX Zip Code 77098-3114Phone Number ( 713 ) 523-6135 Emergency Contact Phone ( ) \_\_\_\_\_Fax Number ( 713 ) 523-6145 E-mail maryanne@katyprairie.orgOwner Code (Please check one):  Federal (F)  Local Government (L)  Utility (U)  Private (P)  State (S)  
 Other (O) please specify: \_\_\_\_\_

Dam and Reservoir Use (Please check one):  Augmentation  Diversion  Domestic  Erosion Control  
 Evaporation  Flood Control  Fire Control  Fish  Hydroelectric  Industrial  
 Irrigation  Mining  Municipal  Pollution Control  Recreation  Stock Water  
 Settling Ponds  Tailings  Waste Disposal  Other, please specify: \_\_\_\_\_

Engineering Firm M&E ConsultantsProject Engineer B. Trent Street Texas P.E. License Number 61421Engineering Firm Address P.O. Box 9City Heidenheimer State TX Zip Code 76533Phone ( 254 ) 983-9103 Fax ( 254 ) 983-9104E-mail tstreet@vvm.com**RECEIVED****FEB 09 2018****TCEQ  
CENTRAL FILE ROOM****SECTION 2: GENERAL INFORMATION**Name of Dam Warren Lake DamOther Name(s) of Dam NoneReservoir Name Warren LakeLocation 3 miles south of Hockley, TX Latitude 29.9768N Longitude 95.8429WCounty Harris Stream Name Rock Hollow CreekRiver Basin San Jacinto Coastal Basin Topographic Map No. USGS Map Name: Warren LakeDistance and Direction from Nearest City or Town 3 mile south of Hockley, TXTX Number 03398 Water Rights Number Unknown

If you have questions on how to fill out this form or about the Dam Safety Program, please contact us at 512-239-5195. Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512-239-3282.

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**SECTION 3: INFORMATION ON DAM**

**Classification**

Size Classification:  Large  Medium  Small  
Hazard Classification: [REDACTED]  
Number of People at Risk 0 Study Year 2009

**Type of Dam:**  Concrete  Gravity  Earthfill  Rockfill  Masonry  Other (specify) \_\_\_\_\_

**Dam Structure** (dimensions to nearest tenth of foot, volume to nearest acre-foot or cubic yard, areas to nearest acre):

Spillway Height 15.4 ft (natural surface of ground to bottom of emergency spillway at longitudinal centerline)  
Embankment Height 22.0 ft (natural surface of ground to crest of dam at centerline)  
Structural Height 25.0 ft (bottom of cutoff trench to crest of dam at centerline)  
Length of Dam 3,020 ft Crest Width 20 ft  
Normal Pool Elevation 192.0 ft-MSL Principal Spillway Elevation 192.0 ft-MSL  
Emergency Spillway Elevation 194.0 and 194.5 ft-MSL Top of Dam Elevation 200.0 ft-MSL  
Embankment Volume 74,550 cu yd  
Maximum Impoundment Capacity 3014 ac-ft (at top of dam)  
Normal Reservoir Capacity 609 ac-ft (at normal or conservation pool)  
Reservoir Surface Area 162.3 acres (at normal or conservation pool)

**Outlet**

Outlet Diameter: 24  in  ft (check one)  
Type: HDPE

**Principal Spillway**

Type:  Natural  Riprap  Concrete  CMP  RCP  Other  
Width (Diam.): 2 ft Capacity: 56 cfs

**Emergency Spillway**

Type:  Natural  Riprap  Concrete  CMP  RCP  Other  
Width (Diam.): 1,400 and 150 ft Capacity: 14,149 cfs  
Total Spillway Capacity: 58,154 cfs (crest of the dam)

**SECTION 4: HYDROLOGIC INFORMATION**

Required Hydrologic Criteria (% PMF) 51 % PMF Passing 100  
PMF Study Year 2016  
Drainage Area: 2,966 acres, or \_\_\_\_\_ sq mi  
Curve Number (AMC III condition) 90  
Time of Concentration 3.2 hr  
Peak Discharge 14,149 cfs  
Peak Stage 196.96 ft-MSL  
Storm Duration Causing Peak Stage 3 hr



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## HYDROLOGIC AND HYDRAULIC (H&H) EVALUATION SUMMARY

(Please complete all sections, unless otherwise specified)

Name of Dam: Warren Lake Dam

TCEQ Dam Safety Project No.: TX03398

County: Harris

Year to Build: 1961

Maximum Record Precipitation (in): 9.55

Record Area (county or city): Harris Co.

Duration (hr): 24 Hr.

Date of Record (MM/DD/YY): 10/07/49

Source Ref. (FEMA, National Weather Service, etc.): 2008-2009 Texas Almanac

Downstream Dam Toe <u>178.0</u> (ft-MSL)	Normal Reservoir Capacity <u>597.8</u> (ac-ft)
Normal Pool <u>192.0</u> (ft-MSL)	Maximum Reservoir Capacity <u>1,950.0</u> (ac-ft)
Principal Spillway <u>192.0</u> (ft-MSL)	Reservoir Surface Area <u>160.3</u> (ac)
Emergency Spillway <u>193.4</u> (ft-MSL)	Drainage Area <u>2,966</u> (ac)
Top of Dam <u>197.7 (lowest pt. in dam CL)</u> (ft-MSL)	Outlet Diameter or Cross-Section <u>24</u> (in)

Storm Duration	Peak Inflow (cfs)	Peak Outflow (cfs)	Peak Stage (ft-MSL)	% PMF Passing	Comments (if needed)
1 hr	8,571	6,469	196.18	51	
2 hr	10,427	9,084	196.47	51	
3 hr	10,053	9,410	196.50	51	
6 hr	9,853	8,990	196.46	51	
12 hr	9,750	9,502	196.51	51	
24 hr	7,537	7,517	196.30	51	
48 hr	4,383	4,381	195.93	51	
72 hr	3,140	3,140	195.76	51	

To the best of my knowledge, I certify the above data are correct. I will supply the hydrologic and hydraulic reports to the Texas Commission on Environmental Quality upon request.



(P. E. Seal)

B. Trent Street

(Signature)

2-16-2016

(Date)

# Supporting Documents and Justifications

## Methodology and Approach

To estimate the benefits provided by a retrofitting of Warren Lake Dam with green infrastructure enhancements, we looked at a reduction in flood risk downstream. This was done by identifying structures downstream of Warren Lake Dam that were at risk of flooding during 10, 50, 100, and 500-year events. Our assumptions were based on the fact that the Warren Lake Dam was a main contributor to Cypress Creek; identifying structures at risk between the dam's outflows and the confluence of Dry Creek. This process yielded 90 structures (at a minimum) that would benefit from a retrofitting of Warren Lake Dam.

Structures were identified that were adjacent to Cypress Creek, had reported structural damage during hurricane Harvey, and were located within a FEMA designated floodplain<sup>1</sup>.

Once these structures were identified, structure locations were identified in the Harris County Flood Insurance Study and flood elevations were recorded. Structure First Floor Elevations were estimated for each structure using Harris County Lidar data and GIS.

Once current risk was established, we then estimated the reduction in risk from retrofitting the Warren Lake Dam with green infrastructure approaches, which will yield an additional 856 acre-feet of storage.

Hydrologic research has not been conducted on Warren Lake area to allow for detailed modeling of downstream flood risk reduction. Flood risk reductions were conservatively estimated by calculating the avoided depth created by the 856 acre-feet of additional storage, spread across the entirety of the 500 Year floodplain from Warren Lake to the impacted parcels. This calculation yielded the following reduced flood elevations:

- 10-year flood elevations were reduced by 2.5 inches (0.208 feet)
- 50-year flood elevations were reduced by 2 inches (0.166 feet)
- 100-year flood elevations were reduced by 1 inch (0.083 feet)
- 500-year flood elevations were reduced by 0.5 inches (0.042 feet)

## Mitigation Type:

The Floodwater Diversion and Storage mitigation action was chosen as it most closely aligned with the goals of this project.

## Cost Estimation Info

### Project Useful Life

This project is estimated to have a useful life of 50 years, in line with the recommended useful life for Major Infrastructure (minor localized flood reduction projects).

---

<sup>1</sup> Determined using "FEMA Floodplains NFHL 2015" data, retrieved from: <http://www.h-gac.com/rds/gis-data/gis-datasets.aspx>

## Mitigation Project Cost

Initially, the total project costs of \$6,491,492.73 was divided amongst the 90 structures, for an average cost of \$72,128. Refinements to the costs led to an overall reduction in project costs, leading to a reduced project cost of \$6,197,495.71. Due to the large scale of the BCA, we adjusted project costs of 5 structures to bring the total project cost down. Structure IDs 1267770020022, 1290250010002, 1303340010004, and 1303350010001 were adjusted to \$1 and Structure ID 1303350010002 was adjusted to \$66,637. The remaining structures were left at the cost of \$72,128.

## Flood Data Source

### FIS and FRIM Data

FIS and FIRM data was not entered into the BCA tool for each structure. This was deemed unnecessary as this is a preliminary BCA to show probable cost-effectiveness. The appropriate FIS and FIRM data was used for the BCA.

The Harris County Flood Insurance Study Volume 6 (Revised JANUARY 6, 2017) was used to estimate flood elevations. The study was obtained from the FEMA Flood Map Service Center.

The Flood Insurance Rate Map used was 48201C0405M, effective 10/16/2013.

## Riverine Elevation and Discharge Data

### First Floor Elevation

For structures without surveyed FFEs, the following steps were used to determine the elevation of each structure's lowest floor. This involved both GIS and imagery verification. Primary inputs for this process included building footprints, a Lidar derived bare earth digital elevation model (DEM), and Google Street View structure images.

First, a point along the structure edge was chosen for determination of lowest floor elevation. Elevation markers were placed on the street side of the structure for verification in Step 2. The ground elevation of elevation markers was determined by extracting values to points (with bilinear interpolation) from a Lidar derived bare earth DEM. Houston-Galveston Area Council 2008 Lidar (NAVD 88) was used for this analysis.

Following FEMA guidelines for measuring lowest floor elevation, each structure was assessed individually to determine the height (in feet) of the lowest floor in relation to the ground at the elevation marker location along the structure edge. Once the floor height above ground was determined through imagery verification, this difference was added to the ground elevation derived in Step 1 to determine lowest floor elevation.

### Streambed and Flood Elevation

The Harris County Flood Insurance Study Volume 6 (Revised JANUARY 6, 2017) was used to estimate flood elevations.

GIS was used to determine the stream distance from each structure to the relevant FIS stream confluence. Primary inputs for this process included building footprints and NFHL profile baselines. Near distances were calculated from structures to relevant stream centerline and resulting X,Y coordinates were converted to point features. These points represent the intersection of stream features and the

shortest distance line from the structure to stream. The shortest distance line is perpendicular to streamflow at the point of intersection. Through linear referencing, stream distances were calculated from each structure stream point to the relevant FIS confluence point.

## Structure Information

### Building Size

Microsoft Building Footprint Data was used to estimate First Finished Floor square footage. Because building footprint data was used to estimate structure size, all structures are modeled to be 1 story.

### Building Replacement Value

Marshall Valuation Service provided building replacement values for residential and commercial buildings. A value of \$135 was used for residential structures and \$75 for commercial properties. These values are attached to the end of this document.

### Structure Type

Building types were gleaned from the Harris County Appraisal District.

### Mental Stress and Anxiety

An occupancy of 2 persons per household was assumed for the BCA. The average household size for this zip code (77433) is 3.26. Therefore, this is a conservative estimate.

### Lost Productivity

It was assumed that each household had 1 worker.

To determine if this project was cost-effective, the Katy Prairie Conservancy contracted Earth Economics to perform the Benefit-Cost Analysis (BCA) for this project. This BCA uses best available data and science to measure the “cost-effectiveness” (the net benefits of the project will equal or exceed the cost of the project) of the project for HMGP grant eligibility. This memorandum describes the methods and findings of this BCA, and provides justifications for key assumptions, pursuant to FEMA requirements for Hazard Mitigation Assistance (HMA) grant applications.

## Benefit-Cost Ratio

Using the below inputs, **the final Aggregate Benefit-Cost Ratio (BCR) for this project is 1.28.**

Total Standard Mitigation Benefits (\$)	Total Social Benefits (\$)	Total Mitigation Project Benefits (\$)	Total Mitigation Project Cost (\$)	Benefit Cost Ratio - Standard	Benefit Cost Ratio - Standard + Social
\$8,750,426.00	\$403,095.00	\$9,153,521.00	\$7,134,570.00	1.23	1.28

## The Benefit Cost Analysis Inputs

The following sections will document the Data entries into the BCC, version 6.0 for the BCA. Batch processing was used.

### Project Configuration

This project uses the Floodplain and Stream Restoration module; detail for each component are as follows:

#### Floodplain and Stream Restoration

1. **Property Structure Type:** Residential
2. **Hazard Type:** Flood
3. **Mitigation Action Type:** Floodwater Diversion and Storage
4. **Damage and Frequency Relationship based on:** Modeled Damages, based on Harris County Flood Insurance Study

### Cost Estimation

#### Project Useful Life (PUL)

This analysis used FEMA’s standard PUL of 30 years for Floodwater Diversion and Storage

#### Initial Project Costs

The total cost for this project is \$6,675,005

See Cost Estimate for detailed cost breakdown.

#### Annual Maintenance Costs

The annual maintenance cost is estimated at 0.5% of capital costs, \$33,375/ year based in input for the engineering/design of the project.

## Hazard Probability Parameters

### Bulk Structure Analysis

Hydrologic research has not been conducted on Warren Lake area to allow for detailed modeling of downstream flood risk reduction. Flood risk reductions were conservatively estimated by calculating the avoided depth created by the 856 acre-feet of additional storage, spread across the entirety of the 500 Year floodplain from Warren Lake to the impacted parcels. This calculation yielded the following reduced flood elevations:

- 10-year flood elevations were reduced by 2.5 inches (0.208 feet)
- 50-year flood elevations were reduced by 2 inches (0.166 feet)
- 100-year flood elevations were reduced by 1 inch (0.083 feet)
- 500-year flood elevations were reduced by 0.5 inches (0.042 feet)

### Building Information

Building Type: One Story

Basement: No

NFIP Policy: No

### Standard Benefits – Building

Select Damage Curve: USACE Generic

Enter Building Size (sq. ft.): See Appendix A

Building Replacement Value (\$/sq. ft.): \$135

### Standard Benefits – Contents

Enter Contents Value (\$): 50% of building replacement value

### Standard Benefits – Contents

The average household size for this zip code (77433) is 3.26. 3.26 times 90 homes is **293**

## Data Sources

### FIS and FRIM Data

FIS and FIRM data was not entered into the BCA tool for each structure. This was deemed unnecessary as this is a preliminary BCA to show probable cost-effectiveness. The appropriate FIS and FIRM data was used for the BCA.

The Harris County Flood Insurance Study Volume 6 (Revised JANUARY 6, 2017) was used to estimate flood elevations. The study was obtained from the FEMA Flood Map Service Center.

The Flood Insurance Rate Map used was 48201C0405M, effective 10/16/2013.

### First Floor Elevation

For structures without surveyed FFEs, the following steps were used to determine the elevation of each structure's lowest floor. This involved both GIS and imagery verification. Primary inputs for this process

included building footprints, a Lidar derived bare earth digital elevation model (DEM), and Google Street View structure images.

First, a point along the structure edge was chosen for determination of lowest floor elevation. Elevation markers were placed on the street side of the structure for verification in Step 2. The ground elevation of elevation markers was determined by extracting values to points (with bilinear interpolation) from a Lidar derived bare earth DEM. Houston-Galveston Area Council 2008 Lidar (NAVD 88) was used for this analysis.

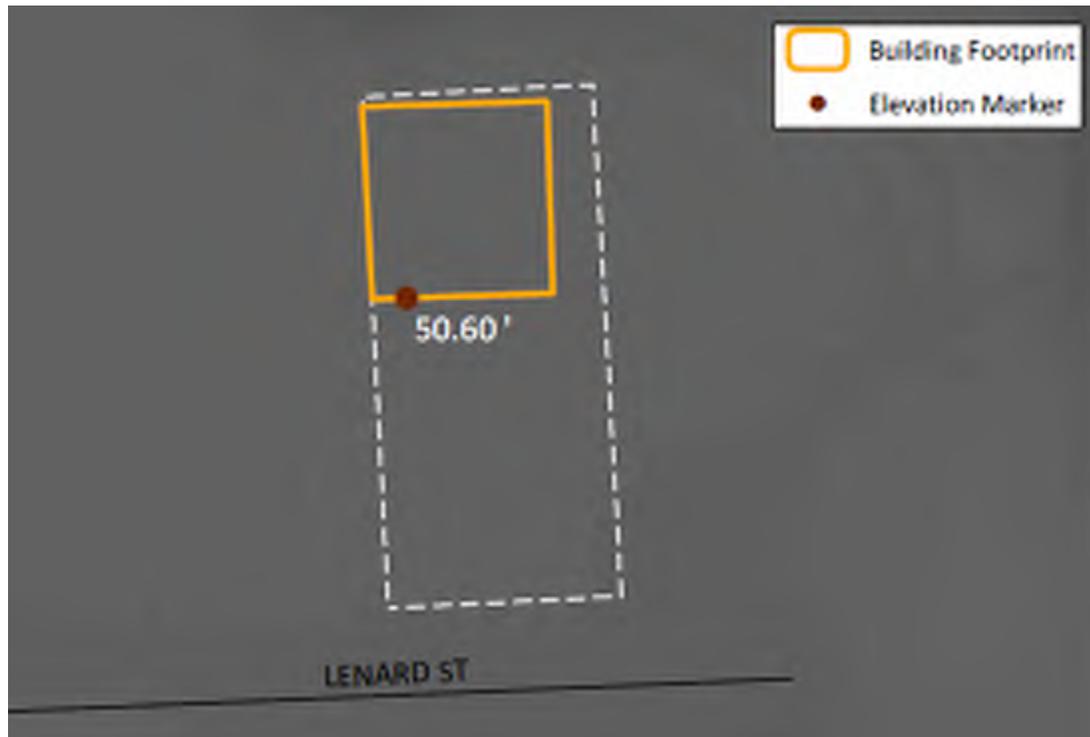


Figure 1. Illustrative example of first floor elevation calculation

Following FEMA guidelines for measuring lowest floor elevation, each structure was assessed individually to determine the height (in feet) of the lowest floor in relation to the ground at the elevation marker location along the structure edge. Once the floor height above ground was determined through imagery verification, this difference was added to the ground elevation derived in Step 1 to determine lowest floor elevation.

### Streambed and Flood Elevation

The Harris County Flood Insurance Study Volume 6 (Revised JANUARY 6, 2017) was used to estimate flood elevations.

GIS was used to determine the stream distance from each structure to the relevant FIS stream confluence. Primary inputs for this process included building footprints and NFHL profile baselines. Near distances were calculated from structures to relevant stream centerline and resulting X,Y coordinates were converted to point features. These points represent the intersection of stream features and the shortest distance line from the structure to stream. The shortest distance line is perpendicular to streamflow at the point of intersection. Through linear referencing, stream distances were calculated from each structure stream point to the relevant FIS confluence point.



Figure 2. Illustrative example of stream distance calculation

## Structure Information

### Building Size

Microsoft Building Footprint Data was used to estimate First Finished Floor square footage. Because building footprint data was used to estimate structure size, all structures are modeled to be 1 story.

### Building Replacement Value

Marshall Valuation Service provided building replacement values for residential and commercial buildings. A value of \$135 was used for residential structures and \$75 for commercial properties. These values are attached to the end of this document.

### Structure Type

Building types were gleaned from the Harris County Appraisal District.

## Benefit-Cost Ratio

Using the above inputs, the final Aggregate Benefit-Cost Ratio (BCR) for this project is 1.28

Total Standard Mitigation Benefits (\$)	Total Social Benefits (\$)	Total Mitigation Project Benefits (\$)	Total Mitigation Project Cost (\$)	Benefit Cost Ratio - Standard	Benefit Cost Ratio - Standard + Social
\$8,750,426.00	\$403,095.00	\$9,153,521.00	\$7,134,570.00	1.23	1.28

ATTACHMENT A  
Structure Inventory

# Warren Lake Dam Flood Risk Reduction

## Sturcture Inventory FIS Flood Elevations



HCAD #	Address	Zip Code	FF Sq. Ft.	FFE Estimate	Stream Bed	0.1	0.02	0.01	0.002
1361760010003	19014 E JOSEY OVERLOOK DR	77433	4,395	152.19	146.9	151.4	151.8	151.9	152.3
1357530050006	16522 MOUNT HOPE DR	77433	3,915	151.41	146.3	150.9	151.3	151.4	151.9
1336910010002	18622 PRINCE RANCH DR	77433	2,301	150.34	145.7	150.3	150.6	150.8	151.1
1336910010001	18626 PRINCE RANCH DR	77433	2,165	150.34	145.7	150.3	150.6	150.8	151.1
1336910010011	18615 GARLINGTON DR	77433	2,424	150.36	145.7	150.3	150.6	150.8	151.1
1336910010010	18611 GARLINGTON DR	77433	2,213	150.49	145.7	150.3	150.6	150.8	151.1
1336910010009	18607 GARLINGTON DR	77433	2,214	150.51	145.7	150.3	150.6	150.8	151.1
1336910010008	18603 GARLINGTON DR	77433	3,677	150.59	145.7	150.3	150.6	150.8	151.1
1336910010006	18606 PRINCE RANCH DR	77433	2,567	150.89	145.7	150.3	150.6	150.8	151.1
1336910010012	18619 GARLINGTON DR	77433	1,775	150.28	145.6	150.3	150.6	150.7	151.1
1336910010013	18623 GARLINGTON DR	77433	2,847	150.29	145.6	150.3	150.6	150.7	151.1
1336910010014	18627 GARLINGTON DR	77433	3,133	150.32	145.6	150.3	150.6	150.7	151.1
1336910020027	16702 BLACKLAND PRAIRIE DR	77433	2,899	150.49	145.6	150.3	150.6	150.7	151.1
1336910020003	16711 BLOOMING PLUM DR	77433	2,367	150.50	145.6	150.3	150.6	150.7	151.1
1336910020002	16707 BLOOMING PLUM DR	77433	2,157	150.67	145.6	150.3	150.6	150.7	151.1
1361760010014	18822 E JOSEY OVERLOOK DR	77433	3,882	151.21	145.4	150.6	150.9	151.1	151.5
1357540030002	18831 TRINITY STAR DR	77433	2,821	150.78	145.4	150.1	150.4	150.5	150.9
1357540030001	18827 TRINITY STAR DR	77433	3,237	150.95	145.4	150.1	150.4	150.5	150.9
1361760010015	18818 E JOSEY OVERLOOK DR	77433	4,093	151.49	145.4	150.6	150.9	151.1	151.5
1361760010011	18906 E JOSEY OVERLOOK DR	77433	4,313	151.14	145.3	150.7	151	151.2	151.6
1361760010013	18826 E JOSEY OVERLOOK DR	77433	5,290	151.22	145.3	150.7	151	151.2	151.6
1357530050013	16606 EMMAUS LN	77433	2,550	151.23	145.3	150.7	151	151.2	151.6
1357540020026	18902 TRINITY STAR DR	77433	3,361	150.96	145.3	150	150.4	150.5	150.9
1357540020028	18818 TRINITY STAR DR	77433	2,592	150.99	145.3	150	150.4	150.5	150.9
1357540020029	18814 TRINITY STAR DR	77433	2,610	151.03	145.3	150	150.4	150.5	150.9
1357540020027	18822 TRINITY STAR DR	77433	2,809	151.03	145.3	150	150.4	150.5	150.9
1336910020012	16734 BLACKLAND PRAIRIE DR	77433	3,435	150.50	145.0	150	150.3	150.4	150.7
1336920030004	16734 SYCAMORE BEND DR	77433	1,970	150.72	145.0	150	150.2	150.4	150.7
1336920030003	16730 SYCAMORE BEND DR	77433	1,833	150.82	145.0	150	150.3	150.4	150.7
1336920030006	16742 SYCAMORE BEND DR	77433	2,011	150.45	144.8	149.8	150.1	150.3	150.6
1336910020010	18615 NAVARRO BRANCH DR	77433	2,641	150.47	144.8	149.8	150.1	150.3	150.6
1336910020011	18619 NAVARRO BRANCH DR	77433	3,231	150.49	144.8	149.8	150.1	150.3	150.6
1336910020009	18611 NAVARRO BRANCH DR	77433	2,950	150.72	144.8	149.8	150.1	150.3	150.6

# Warren Lake Dam Flood Risk Reduction

## Sturcture Inventory FIS Flood Elevations



1336910020017	18610 EMHOUSE LN	77433	2,538	150.46	144.5	150	150.3	150.5	150.8
1336910020023	18615 EMHOUSE LN	77433	3,621	150.48	144.5	150	150.3	150.5	150.8
1336910020021	18607 EMHOUSE LN	77433	2,853	150.50	144.5	150	150.3	150.5	150.8
1336910020018	18606 EMHOUSE LN	77433	2,562	150.51	144.5	150	150.3	150.5	150.8
1336910020022	18611 EMHOUSE LN	77433	2,903	150.51	144.5	150	150.3	150.5	150.8
1336910020014	16726 BLACKLAND PRAIRIE DR	77433	2,572	150.51	144.5	150	150.3	150.5	150.8
1336910020026	16706 BLACKLAND PRAIRIE DR	77433	2,714	150.51	144.5	150	150.3	150.5	150.8
1336910020016	18614 EMHOUSE LN	77433	2,469	150.52	144.5	150	150.3	150.5	150.8
1336910020006	16727 BLOOMING PLUM DR	77433	2,770	150.84	144.5	150	150.3	150.5	150.8
1357540020033	18807 TRINITY STAR DR	77434	2,891	150.94	144.5	150	150.3	150.5	150.8
1336900020003	18722 TOWN BLUFF DR	77433	2,868	150.24	144.3	149.6	149.9	150	150.3
1336900020008	17110 LUMBERTON DR	77433	2,915	150.27	144.3	149.6	149.9	150	150.3
1336900020010	17102 LUMBERTON DR	77433	3,218	150.40	144.3	149.6	149.9	150	150.3
1336900020001	18730 TOWN BLUFF DR	77433	2,411	150.57	144.3	149.6	149.9	150	150.3
1336900020009	17106 LUMBERTON DR	77433	3,158	150.57	144.3	149.6	149.9	150	150.3
1336900020002	18726 TOWN BLUFF DR	77433	2,091	150.60	144.3	149.6	149.9	150	150.3
1336900010014	17027 LUMBERTON DR	77433	2,760	150.08	143.4	149.2	149.7	149.8	150.1
1336900010013	17023 LUMBERTON DR	77433	2,716	150.16	143.4	149.2	149.7	149.8	150.1
1336900010015	17111 LUMBERTON DR	77433	2,741	150.18	143.4	149.2	149.7	149.8	150.1
1336900010017	17119 LUMBERTON DR	77433	2,342	150.19	143.4	149.2	149.7	149.8	150.1
1324030020006	19415 SHADY EDGE DR	77433	4,080	151.65	133.3	150.5	151.3	151.6	152.6
1324030020002	19331 SHADY EDGE DR	77433	3,354	150.41	133.2	150.4	151.2	151.6	152.5
1324030020001	19327 SHADY EDGE DR	77433	4,565	150.46	133.2	150.4	151.2	151.6	152.5
1324030020003	19403 SHADY EDGE DR	77433	5,787	150.53	133.2	150.4	151.2	151.6	152.5
1324030020004	19407 SHADY EDGE DR	77433	4,060	150.55	133.2	150.4	151.2	151.6	152.5
1324030010024	19319 SHADY EDGE DR	77433	3,528	150.72	133.2	150.4	151.1	151.5	152.4
1324030020005	19411 SHADY EDGE DR	77433	4,325	150.84	133.2	150.4	151.2	151.6	152.5
1324030010026	19311 SHADY EDGE DR	77433	3,940	150.79	133.2	150.4	151.1	151.5	152.4
1324030010025	19315 SHADY EDGE DR	77433	6,197	151.12	133.2	150.4	151.1	151.5	152.4
1324030010028	19303 SHADY EDGE DR	77433	4,541	150.72	133.1	150.3	151.1	151.4	152.4
1324030010027	19305 SHADY EDGE DR	77433	3,987	150.82	133.1	150.3	151.1	151.4	152.4
1303360020003	12623 COVE LANDING DR	77433	4,207	150.18	133	150.1	150.9	151.3	152.2
1303360020001	12631 COVE LANDING DR	77433	3,761	150.37	133	150.1	150.9	151.3	152.2
1303360010015	12610 COVE LANDING DR	77433	3,811	150.63	133	150.1	150.9	151.3	152.2
1303360010014	12614 COVE LANDING DR	77433	3,901	150.68	133	150.1	150.9	151.3	152.2



06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Project Summary:**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: Katy Prairie Conservancy

Analyst: Johnny Mojica

Discount Rate: 0.070

Point of Contact:

Phone Number:

Address:

Email:

Comments:

**Structure Summary For:**

1267770020022, 18606 N THOMAS SHORT DR, CYPRESS, Texas, 77434, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$73,866

Costs: \$1

BCR: 73,866.00

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	73,866.00	\$73,866	\$1

1290250010002, 0 HOUSE-HAHL RD, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$44,647

Costs: \$1

BCR: 44,647.00

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	44,647.00	\$44,647	\$1

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1303340010004, 0 N BRIDGELAND LAKE PKY, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$456,681

Costs: \$1

BCR: 456,681.00

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	456,681.00	\$456,681	\$1

1303350010001, 12534 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$361,004

Costs: \$1

BCR: 361,004.00

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	361,004.00	\$361,004	\$1

1303350010002, 12530 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$251,992

Costs: \$66,637

BCR: 3.78

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.78	\$251,992	\$66,637

1303350010003, 12526 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$248,268

Costs: \$72,128

BCR: 3.44

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.44	\$248,268	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1303350010004, 12522 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$195,019

Costs: \$72,128

BCR: 2.70

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.70	\$195,019	\$72,128

1303350010005, 12518 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$208,661

Costs: \$72,128

BCR: 2.89

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.89	\$208,661	\$72,128

1303350010006, 12514 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$134,784

Costs: \$72,128

BCR: 1.87

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.87	\$134,784	\$72,128

1303350010007, 12510 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$123,995

Costs: \$72,128

BCR: 1.72

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.72	\$123,995	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1303350010029, 12526 BUNKER COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$110,139

Costs: \$72,128

BCR: 1.53

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.53	\$110,139	\$72,128

1303360010007, 12607 COVE SPRINGS DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$269,726

Costs: \$72,128

BCR: 3.74

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.74	\$269,726	\$72,128

1303360010008, 12611 COVE SPRINGS DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$238,628

Costs: \$72,128

BCR: 3.31

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.31	\$238,628	\$72,128

1303360010009, 12615 COVE SPRINGS DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$210,809

Costs: \$72,128

BCR: 2.92

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.92	\$210,809	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1303360010010, 19103 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$391,937

Costs: \$72,128

BCR: 5.43

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	5.43	\$391,937	\$72,128

1303360010011, 19107 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$117,932

Costs: \$72,128

BCR: 1.64

Mitigation	Hazard	BCR	Benefits	Costs
Drainage Improvement	Flood	1.64	\$117,932	\$72,128

1303360010012, 19111 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$316,244

Costs: \$72,128

BCR: 4.38

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.38	\$316,244	\$72,128

1303360010013, 19115 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$214,032

Costs: \$72,128

BCR: 2.97

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.97	\$214,032	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 6 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1303360010014, 12614 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$252,208

Costs: \$72,128

BCR: 3.50

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.50	\$252,208	\$72,128

1303360010015, 12610 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$257,375

Costs: \$72,128

BCR: 3.57

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.57	\$257,375	\$72,128

1303360010017, 12602 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$131,650

Costs: \$72,128

BCR: 1.83

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.83	\$131,650	\$72,128

1303360020001, 12631 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$396,313

Costs: \$72,128

BCR: 5.49

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	5.49	\$396,313	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1303360020002, 12627 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$242,833

Costs: \$72,128

BCR: 3.37

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.37	\$242,833	\$72,128

1303360020003, 12623 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$542,107

Costs: \$72,128

BCR: 7.52

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	7.52	\$542,107	\$72,128

1303360020004, 12619 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$221,004

Costs: \$72,128

BCR: 3.06

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.06	\$221,004	\$72,128

1303360020006, 12611 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$131,513

Costs: \$72,128

BCR: 1.82

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.82	\$131,513	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1324030010024, 19319 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$347,111

Costs: \$72,128

BCR: 4.81

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.81	\$347,111	\$72,128

1324030010025, 19315 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$334,553

Costs: \$72,128

BCR: 4.64

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.64	\$334,553	\$72,128

1324030010026, 19311 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$347,172

Costs: \$72,128

BCR: 4.81

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.81	\$347,172	\$72,128

1324030010027, 19305 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$275,785

Costs: \$72,128

BCR: 3.82

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.82	\$275,785	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1324030010028, 19303 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$380,110

Costs: \$72,128

BCR: 5.27

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	5.27	\$380,110	\$72,128

1324030020001, 19327 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$591,501

Costs: \$72,128

BCR: 8.20

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	8.20	\$591,501	\$72,128

1324030020002, 19331 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$458,753

Costs: \$72,128

BCR: 6.36

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.36	\$458,753	\$72,128

1324030020003, 19403 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$696,325

Costs: \$72,128

BCR: 9.65

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	9.65	\$696,325	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1324030020004, 19407 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$488,002

Costs: \$72,128

BCR: 6.77

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.77	\$488,002	\$72,128

1324030020005, 19411 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$357,083

Costs: \$72,128

BCR: 4.95

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.95	\$357,083	\$72,128

1324030020006, 19415 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$150,477

Costs: \$72,128

BCR: 2.09

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.09	\$150,477	\$72,128

1336900010013, 17023 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$166,586

Costs: \$72,128

BCR: 2.31

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.31	\$166,586	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336900010014, 17027 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$188,137

Costs: \$72,128

BCR: 2.61

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.61	\$188,137	\$72,128

1336900010015, 17111 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$161,407

Costs: \$72,128

BCR: 2.24

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.24	\$161,407	\$72,128

1336900010017, 17119 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$136,831

Costs: \$72,128

BCR: 1.90

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.90	\$136,831	\$72,128

1336900020001, 18730 TOWN BLUFF DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$151,422

Costs: \$72,128

BCR: 2.10

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.10	\$151,422	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 12 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336900020002, 18726 TOWN BLUFF DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$121,810

Costs: \$72,128

BCR: 1.69

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.69	\$121,810	\$72,128

1336900020003, 18722 TOWN BLUFF DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$337,729

Costs: \$72,128

BCR: 4.68

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.68	\$337,729	\$72,128

1336900020008, 17110 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$329,643

Costs: \$72,128

BCR: 4.57

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.57	\$329,643	\$72,128

1336900020009, 17106 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$192,299

Costs: \$72,128

BCR: 2.67

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.67	\$192,299	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 13 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336900020010, 17102 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$278,011

Costs: \$72,128

BCR: 3.85

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.85	\$278,011	\$72,128

1336910010001, 18626 PRINCE RANCH DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$535,370

Costs: \$72,128

BCR: 7.42

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	7.42	\$535,370	\$72,128

1336910010002, 18622 PRINCE RANCH DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$568,715

Costs: \$72,128

BCR: 7.88

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	7.88	\$568,715	\$72,128

1336910010006, 18606 PRINCE RANCH DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$311,411

Costs: \$72,128

BCR: 4.32

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.32	\$311,411	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 14 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336910010008, 18603 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$670,404

Costs: \$72,128

BCR: 9.29

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	9.29	\$670,404	\$72,128

1336910010009, 18607 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$453,374

Costs: \$72,128

BCR: 6.29

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.29	\$453,374	\$72,128

1336910010010, 18611 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$464,192

Costs: \$72,128

BCR: 6.44

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.44	\$464,192	\$72,128

1336910010011, 18615 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$583,368

Costs: \$72,128

BCR: 8.09

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	8.09	\$583,368	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 15 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336910010012, 18619 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$465,253

Costs: \$72,128

BCR: 6.45

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.45	\$465,253	\$72,128

1336910010013, 18623 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$731,701

Costs: \$72,128

BCR: 10.14

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	10.14	\$731,701	\$72,128

1336910010014, 18627 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$782,540

Costs: \$72,128

BCR: 10.85

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	10.85	\$782,540	\$72,128

1336910020002, 16707 BLOOMING PLUM DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$354,749

Costs: \$72,128

BCR: 4.92

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.92	\$354,749	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 16 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336910020003, 16711 BLOOMING PLUM DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$487,905

Costs: \$72,128

BCR: 6.76

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.76	\$487,905	\$72,128

1336910020006, 16727 BLOOMING PLUM DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$208,089

Costs: \$72,128

BCR: 2.89

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.89	\$208,089	\$72,128

1336910020009, 18611 NAVARRO BRANCH DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$175,949

Costs: \$72,128

BCR: 2.44

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.44	\$175,949	\$72,128

1336910020010, 18615 NAVARRO BRANCH DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$281,131

Costs: \$72,128

BCR: 3.90

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.90	\$281,131	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 17 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336910020011, 18619 NAVARRO BRANCH DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$187,060

Costs: \$72,128

BCR: 2.59

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.59	\$187,060	\$72,128

1336910020012, 16734 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$488,434

Costs: \$72,128

BCR: 6.77

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.77	\$488,434	\$72,128

1336910020014, 16726 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$338,974

Costs: \$72,128

BCR: 4.70

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.70	\$338,974	\$72,128

1336910020016, 18614 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$325,527

Costs: \$72,128

BCR: 4.51

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.51	\$325,527	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336910020017, 18610 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$358,117

Costs: \$72,128

BCR: 4.97

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.97	\$358,117	\$72,128

1336910020018, 18606 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$341,181

Costs: \$72,128

BCR: 4.73

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.73	\$341,181	\$72,128

1336910020021, 18607 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$379,353

Costs: \$72,128

BCR: 5.26

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	5.26	\$379,353	\$72,128

1336910020022, 18611 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$384,287

Costs: \$72,128

BCR: 5.33

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	5.33	\$384,287	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 19 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336910020023, 18615 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$494,710

Costs: \$72,128

BCR: 6.86

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.86	\$494,710	\$72,128

1336910020026, 16706 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$358,120

Costs: \$72,128

BCR: 4.97

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.97	\$358,120	\$72,128

1336910020027, 16702 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$602,436

Costs: \$72,128

BCR: 8.35

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	8.35	\$602,436	\$72,128

1336920030003, 16730 SYCAMORE BEND DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$158,479

Costs: \$72,128

BCR: 2.20

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.20	\$158,479	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 20 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1336920030004, 16734 SYCAMORE BEND DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$197,426

Costs: \$72,128

BCR: 2.74

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.74	\$197,426	\$72,128

1336920030006, 16742 SYCAMORE BEND DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$223,925

Costs: \$72,128

BCR: 3.10

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.10	\$223,925	\$72,128

1357530050006, 16522 MOUNT HOPE DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$475,268

Costs: \$72,128

BCR: 6.59

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	6.59	\$475,268	\$72,128

1357530050013, 16606 EMMAUS LN, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$307,748

Costs: \$72,128

BCR: 4.27

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.27	\$307,748	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 21 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1357540020026, 18902 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$188,935

Costs: \$72,128

BCR: 2.62

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.62	\$188,935	\$72,128

1357540020027, 18822 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$139,226

Costs: \$72,128

BCR: 1.93

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.93	\$139,226	\$72,128

1357540020028, 18818 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$138,952

Costs: \$72,128

BCR: 1.93

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.93	\$138,952	\$72,128

1357540020029, 18814 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$131,509

Costs: \$72,128

BCR: 1.82

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	1.82	\$131,509	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1357540020033, 18807 TRINITY STAR DR, CYPRESS, Texas, 77434, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$162,226

Costs: \$72,128

BCR: 2.25

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	2.25	\$162,226	\$72,128

1357540030001, 18827 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$236,484

Costs: \$72,128

BCR: 3.28

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.28	\$236,484	\$72,128

1357540030002, 18831 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$294,014

Costs: \$72,128

BCR: 4.08

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.08	\$294,014	\$72,128

1361760010003, 19014 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$354,856

Costs: \$72,128

BCR: 4.92

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	4.92	\$354,856	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 23 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

1361760010011, 18906 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$577,482

Costs: \$72,128

BCR: 8.01

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	8.01	\$577,482	\$72,128

1361760010013, 18826 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$633,420

Costs: \$72,128

BCR: 8.78

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	8.78	\$633,420	\$72,128

1361760010014, 18822 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$406,548

Costs: \$72,128

BCR: 5.64

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	5.64	\$406,548	\$72,128

1361760010015, 18818 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Structure Type: Building

Historic Building: No

Contact:

Benefits: \$240,023

Costs: \$72,128

BCR: 3.33

Mitigation	Hazard	BCR	Benefits	Costs
Floodwater Diversion and Storage	Flood	3.33	\$240,023	\$72,128

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1267770020022, 18606 N THOMAS SHORT DR, CYPRESS, Texas, 77434, Harris

Benefits: \$73,866

Costs: \$1

BCR: 73,866.00

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,132

BRV (\$/sf): \$150.00

Total BRV: \$469,800

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.37

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$469,800  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.87

Utilities that are not elevated: No

Height FFE Above Grade: 150.37

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 129.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	148.70	4,449.0	148.38	4,360.0
50	2.00%	149.60	7,337.0	149.36	7,190.3
100	1.00%	150.10	9,128.0	149.94	8,945.4
500	0.20%	151.10	15,128.0	151.02	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$11,745	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$62,953	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$109,463	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$150,806	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$188,390	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$221,276	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$469,800	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$469,800	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$469,800	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$469,800	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$469,800	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$469,800	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$469,800	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$469,800	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$469,800	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$469,800	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$469,800	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$469,800	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$11,275	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$38,054	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$62,483	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$84,094	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$103,356	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$120,739	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$135,302	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$147,987	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$158,792	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$167,719	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$174,766	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$180,403	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$184,162	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$186,511	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$187,920	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$187,920	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$187,920	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$187,920	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$4,365

Present Value: \$60,244

Annual: \$0

Present Value: \$0

Annual: \$4,365

Present Value: \$60,244

Mitigation Benefits: \$60,244

Benefits Minus Costs: \$60,243

Mitigation Costs: \$1

Benefit-Cost Ratio: 60,244.00

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$1

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$1

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance: 0

Present Worth of Annual Maintenance Costs: \$0

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1290250010002, 0 HOUSE-HAHL RD, CYPRESS, Texas, 77433, Harris

Benefits: \$44,647

Costs: \$1

BCR: 44,647.00

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 1,144

BRV (\$/sf): \$150.00

Total BRV: \$171,600

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 147.35

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$171,600  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -209.04

Utilities that are not elevated: No

Height FFE Above Grade: 147.35

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 127.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	145.90	4,449.0	145.58	4,360.0
50	2.00%	147.00	7,337.0	146.76	7,190.3
100	1.00%	147.40	9,128.0	147.24	8,945.4
500	0.20%	149.10	15,128.0	149.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$4,290	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$22,994	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$39,983	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$55,084	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$68,812	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$80,824	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$171,600	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$171,600	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$171,600	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$171,600	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$171,600	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$171,600	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$171,600	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$171,600	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$171,600	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$171,600	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$171,600	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$171,600	0.0%	0.0%	\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$4,118	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$13,900	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$22,823	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$30,716	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$37,752	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$44,101	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$49,421	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$54,054	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$58,001	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$61,261	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$63,835	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$65,894	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$67,267	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$68,125	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$68,640	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$68,640	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$68,640	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$68,640	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$2,248
Present Value:	\$31,025

Annual:	\$0
Present Value:	\$0

Annual:	\$2,248
Present Value:	\$31,025

Mitigation Benefits: \$31,025

Mitigation Costs: \$1

Benefits Minus Costs: \$31,024

Benefit-Cost Ratio: 31,025.00

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$1

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$1

Years of Maintenance: 0

Cost Basis Year:

Present Worth of Annual Maintenance Costs: \$0

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303340010004, 0 N BRIDGELAND LAKE PKY, CYPRESS, Texas, 77433, Harris

Benefits: \$456,681

Costs: \$1

BCR: 456,681.00

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 100,015

BRV (\$/sf): \$75.00

Total BRV: \$7,501,125

Residential: No

Building Type:

Obstruction: N/A

Foundation Type:

Basement:

Building Primary Use: Schools

Structure Type: Engineered

Historic Building: No

Structure Elevation: 150.08

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent:

Building Contents: \$450,068  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above  
Grade:

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$144,022

ICC: No

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

Total Reduced Street Maintenance Costs

\$0.00

### Volunteer Costs

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Number of Volunteers Required: 0      Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00      Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00      Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2      Number of Worker: 1

Treatment Costs per person: \$2,443.00      Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00      Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.1

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.50	4,449.0	149.18	4,360.0
50	2.00%	150.30	7,337.0	150.06	7,190.3
100	1.00%	150.70	9,128.0	150.54	8,945.4
500	0.20%	151.60	15,128.0	151.52	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using Schools (Default)**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
0.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
1.0	13.0%	0.0%	\$975,146	0.0%	0.0%	\$0
2.0	21.5%	0.0%	\$1,612,742	0.0%	0.0%	\$0
3.0	26.7%	0.0%	\$2,002,800	0.0%	0.0%	\$0
4.0	32.7%	0.0%	\$2,452,868	0.0%	0.0%	\$0
5.0	36.2%	0.0%	\$2,715,407	0.0%	0.0%	\$0
6.0	39.7%	0.0%	\$2,977,947	0.0%	0.0%	\$0
7.0	41.6%	0.0%	\$3,120,468	0.0%	0.0%	\$0
8.0	44.5%	0.0%	\$3,338,001	0.0%	0.0%	\$0
9.0	46.4%	0.0%	\$3,480,522	0.0%	0.0%	\$0
10.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0
11.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0
12.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0
13.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0
14.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0
15.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0
16.0	48.5%	0.0%	\$3,638,046	0.0%	0.0%	\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using Schools (Default)**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%		0.0%	0.0%	
-1.0	0.0%	0.0%		0.0%	0.0%	
0.0	0.0%	0.0%		0.0%	0.0%	
1.0	22.0%	0.0%	\$99,015	0.0%	0.0%	\$0
2.0	30.0%	0.0%	\$135,020	0.0%	0.0%	\$0
3.0	39.0%	0.0%	\$175,526	0.0%	0.0%	\$0
4.0	45.0%	0.0%	\$202,530	0.0%	0.0%	\$0
5.0	48.0%	0.0%	\$216,032	0.0%	0.0%	\$0
6.0	52.0%	0.0%	\$234,035	0.0%	0.0%	\$0
7.0	56.0%	0.0%	\$252,038	0.0%	0.0%	\$0
8.0	59.0%	0.0%	\$265,540	0.0%	0.0%	\$0
9.0	61.0%	0.0%	\$274,541	0.0%	0.0%	\$0
10.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0
11.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0
12.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0
13.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0
14.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0
15.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0
16.0	63.0%	0.0%	\$283,543	0.0%	0.0%	\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using Schools (Default)**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0			0.0		
-1.0	0.0			0.0		
0.0	0.0			0.0		
1.0	45.0		\$213,073	0.0		\$0
2.0	90.0		\$426,146	0.0		\$0
3.0	135.0		\$639,219	0.0		\$0
4.0	180.0		\$852,292	0.0		\$0
5.0	225.0		\$1,065,365	0.0		\$0
6.0	270.0		\$1,278,438	0.0		\$0
7.0	315.0		\$1,491,511	0.0		\$0
8.0	360.0		\$1,704,584	0.0		\$0
9.0	405.0		\$1,917,657	0.0		\$0
10.0	450.0		\$2,130,731	0.0		\$0
11.0	450.0		\$2,130,731	0.0		\$0
12.0	450.0		\$2,130,731	0.0		\$0
13.0	450.0		\$2,130,731	0.0		\$0
14.0	450.0		\$2,130,731	0.0		\$0
15.0	450.0		\$2,130,731	0.0		\$0
16.0	450.0		\$2,130,731	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using Schools (Default)**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0			0.0		
-1.0	0.0			0.0		
0.0	0.0			0.0		
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	450.0		\$0	0.0		\$0
12.0	450.0		\$0	0.0		\$0
13.0	450.0		\$0	0.0		\$0
14.0	450.0		\$0	0.0		\$0
15.0	450.0		\$0	0.0		\$0
16.0	450.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$32,104

Present Value: \$443,059

Annual: \$0

Present Value: \$0

Annual: \$32,104

Present Value: \$443,059

Mitigation Benefits: \$443,059

Benefits Minus Costs: \$443,058

Mitigation Costs: \$1

Benefit-Cost Ratio: 443,059.00

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$1

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$1

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance: 0

Present Worth of Annual Maintenance Costs: \$0

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010001, 12534 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$361,004

Costs: \$1

BCR: 361,004.00

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 5,197

BRV (\$/sf): \$150.00

Total BRV: \$779,550

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 149.50

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$779,550  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 149.50

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 130.9

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.00	4,449.0	148.68	4,360.0
50	2.00%	149.90	7,337.0	149.66	7,190.3
100	1.00%	150.30	9,128.0	150.14	8,945.4
500	0.20%	151.30	15,128.0	151.22	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$19,489	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$104,460	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$181,635	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$250,236	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$312,600	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$367,168	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$779,550	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$779,550	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$779,550	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$779,550	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$779,550	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$779,550	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$779,550	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$779,550	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$779,550	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$779,550	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$779,550	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$779,550	0.0%	0.0%	\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$18,709	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$63,144	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$103,680	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$139,539	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$171,501	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$200,344	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$224,510	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$245,558	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$263,488	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$278,299	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$289,993	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$299,347	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$305,584	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$309,481	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$311,820	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$311,820	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$311,820	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$311,820	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$25,171
Present Value:	\$347,382

Annual:	\$0
Present Value:	\$0

Annual:	\$25,171
Present Value:	\$347,382

Mitigation Benefits: \$347,382

Mitigation Costs: \$1

Benefits Minus Costs: \$347,381

Benefit-Cost Ratio: 347,382.00

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$1

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$1

Years of Maintenance: 0

Cost Basis Year:

Present Worth of Annual Maintenance Costs: \$0

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 59 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 60 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010002, 12530 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$251,992

Costs: \$66,637

BCR: 3.78

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,286

BRV (\$/sf): \$150.00

Total BRV: \$642,900

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 149.70

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$642,900  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 149.70

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 130.9

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.00	4,449.0	148.68	4,360.0
50	2.00%	149.90	7,337.0	149.66	7,190.3
100	1.00%	150.30	9,128.0	150.14	8,945.4
500	0.20%	151.30	15,128.0	151.22	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$16,073	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$86,149	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$149,796	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$206,371	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$257,803	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$302,806	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$642,900	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$642,900	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$642,900	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$642,900	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$642,900	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$642,900	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$642,900	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$642,900	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$642,900	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$642,900	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$642,900	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$642,900	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,430	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$52,075	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$85,506	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$115,079	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$141,438	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$165,225	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$185,155	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$202,514	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$217,300	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$229,515	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$239,159	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$246,874	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$252,017	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$255,231	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$257,160	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$257,160	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$257,160	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$257,160	0.0%	0.0%	\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$17,272
Present Value:	\$238,370

Annual:	\$0
Present Value:	\$0

Annual:	\$17,272
Present Value:	\$238,370

Mitigation Benefits: \$238,370

Mitigation Costs: \$66,637

Benefits Minus Costs: \$171,733

Benefit-Cost Ratio: 3.58

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$66,637

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$66,637

Years of Maintenance: 0

Cost Basis Year:

Present Worth of Annual Maintenance Costs: \$0

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010003, 12526 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$248,268

Costs: \$72,128

BCR: 3.44

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,035

BRV (\$/sf): \$150.00

Total BRV: \$605,250

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 149.72

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$605,250  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 149.72

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 131.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.10	4,449.0	148.78	4,360.0
50	2.00%	149.90	7,337.0	149.66	7,190.3
100	1.00%	150.30	9,128.0	150.14	8,945.4
500	0.20%	151.30	15,128.0	151.22	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,131	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$81,104	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$141,023	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$194,285	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$242,705	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$285,073	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$605,250	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$605,250	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$605,250	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$605,250	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$605,250	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$605,250	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$605,250	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$605,250	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$605,250	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$605,250	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$605,250	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$605,250	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,526	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$49,025	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$80,498	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$108,340	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$133,155	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$155,549	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$174,312	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$190,654	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$204,575	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$216,074	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$225,153	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$232,416	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$237,258	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$240,284	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$242,100	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$242,100	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$242,100	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$242,100	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$17,002

Present Value: \$234,646

Annual: \$0

Present Value: \$0

Annual: \$17,002

Present Value: \$234,646

Mitigation Benefits: \$234,646

Benefits Minus Costs: \$162,518

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 3.25

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
-------	-------------	-------------

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010004, 12522 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$195,019

Costs: \$72,128

BCR: 2.70

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,701

BRV (\$/sf): \$150.00

Total BRV: \$555,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 149.88

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$555,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 149.88

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 79 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 131.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.10	4,449.0	148.78	4,360.0
50	2.00%	149.90	7,337.0	149.66	7,190.3
100	1.00%	150.30	9,128.0	150.14	8,945.4
500	0.20%	151.30	15,128.0	151.22	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,879	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$74,390	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$129,350	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$178,203	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$222,615	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$261,476	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$555,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$555,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$555,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$555,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$555,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$555,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$555,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$555,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$555,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$555,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$555,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$555,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,324	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$44,967	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$73,835	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$99,372	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$122,133	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$142,674	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$159,883	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$174,872	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$187,641	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$198,189	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$206,516	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$213,178	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$217,619	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$220,395	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$222,060	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$222,060	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$222,060	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$222,060	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$13,144
Present Value:	\$181,397

Annual:	\$0
Present Value:	\$0

Annual:	\$13,144
Present Value:	\$181,397

Mitigation Benefits: \$181,397

Mitigation Costs: \$72,128

Benefits Minus Costs: \$109,269

Benefit-Cost Ratio: 2.51

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010005, 12518 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$208,661

Costs: \$72,128

BCR: 2.89

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,543

BRV (\$/sf): \$150.00

Total BRV: \$681,450

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.11

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$681,450  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.11

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 88 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 131.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	4,449.0	148.88	4,360.0
50	2.00%	150.00	7,337.0	149.76	7,190.3
100	1.00%	150.40	9,128.0	150.24	8,945.4
500	0.20%	151.40	15,128.0	151.32	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$17,036	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$91,314	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$158,778	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$218,745	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$273,261	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$320,963	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$681,450	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$681,450	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$681,450	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$681,450	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$681,450	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$681,450	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$681,450	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$681,450	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$681,450	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$681,450	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$681,450	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$681,450	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$16,355	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$55,197	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$90,633	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$121,980	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$149,919	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$175,133	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$196,258	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$214,657	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$230,330	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$243,278	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$253,499	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$261,677	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$267,128	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$270,536	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$272,580	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$272,580	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$272,580	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$272,580	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$14,132
Present Value:	\$195,039

Annual:	\$0
Present Value:	\$0

Annual:	\$14,132
Present Value:	\$195,039

Mitigation Benefits: \$195,039

Mitigation Costs: \$72,128

Benefits Minus Costs: \$122,911

Benefit-Cost Ratio: 2.70

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010006, 12514 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$134,784

Costs: \$72,128

BCR: 1.87

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,568

BRV (\$/sf): \$150.00

Total BRV: \$535,200

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.34

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$535,200  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.34

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 131.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	4,449.0	148.88	4,360.0
50	2.00%	150.00	7,337.0	149.76	7,190.3
100	1.00%	150.40	9,128.0	150.24	8,945.4
500	0.20%	151.40	15,128.0	151.32	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,380	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$71,717	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$124,702	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$171,799	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$214,615	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$252,079	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$535,200	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$535,200	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$535,200	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$535,200	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$535,200	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$535,200	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$535,200	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$535,200	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$535,200	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$535,200	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$535,200	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$535,200	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,845	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$43,351	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$71,182	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$95,801	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$117,744	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$137,546	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$154,138	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$168,588	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$180,898	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$191,066	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$199,094	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$205,517	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$209,798	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$212,474	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$214,080	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$214,080	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$214,080	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$214,080	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 100 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 101 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 102 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 103 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$8,779

Present Value: \$121,162

Annual: \$0

Present Value: \$0

Annual: \$8,779

Present Value: \$121,162

Mitigation Benefits: \$121,162

Benefits Minus Costs: \$49,034

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 1.68

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 104 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 105 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010007, 12510 BROOK COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$123,995

Costs: \$72,128

BCR: 1.72

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,533

BRV (\$/sf): \$150.00

Total BRV: \$679,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.59

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$679,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.59

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 106 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 131.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	4,449.0	148.88	4,360.0
50	2.00%	150.00	7,337.0	149.76	7,190.3
100	1.00%	150.40	9,128.0	150.24	8,945.4
500	0.20%	151.40	15,128.0	151.32	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 107 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$16,999	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$91,113	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$158,428	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$218,264	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$272,660	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$320,256	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$679,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$679,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$679,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$679,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$679,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$679,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$679,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$679,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$679,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$679,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$679,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$679,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 108 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$16,319	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$55,076	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$90,433	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$121,711	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$149,589	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$174,747	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$195,826	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$214,184	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$229,823	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$242,742	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$252,941	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$261,101	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$266,540	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$269,940	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$271,980	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$271,980	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$271,980	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$271,980	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 109 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 110 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 111 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 112 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$7,998
Present Value:	\$110,373

Annual:	\$0
Present Value:	\$0

Annual:	\$7,998
Present Value:	\$110,373

Mitigation Benefits: \$110,373

Mitigation Costs: \$72,128

Benefits Minus Costs: \$38,245

Benefit-Cost Ratio: 1.53

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 113 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
-------	-------------	-------------

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 114 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303350010029, 12526 BUNKER COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$110,139

Costs: \$72,128

BCR: 1.53

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,063

BRV (\$/sf): \$150.00

Total BRV: \$609,450

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.44

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$609,450  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 150.44

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 115 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 130.9

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.00	4,449.0	148.68	4,360.0
50	2.00%	149.90	7,337.0	149.66	7,190.3
100	1.00%	150.30	9,128.0	150.14	8,945.4
500	0.20%	151.30	15,128.0	151.22	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 116 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,236	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$81,666	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$142,002	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$195,633	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$244,389	0.0%	0.0%	\$0
4.0	47.1%	0.0%		0.0%	0.0%	
5.0	53.2%	0.0%		0.0%	0.0%	
6.0	58.6%	0.0%		0.0%	0.0%	
7.0	63.2%	0.0%		0.0%	0.0%	
8.0	67.2%	0.0%		0.0%	0.0%	
9.0	70.5%	0.0%		0.0%	0.0%	
10.0	73.2%	0.0%		0.0%	0.0%	
11.0	75.4%	0.0%		0.0%	0.0%	
12.0	77.2%	0.0%		0.0%	0.0%	
13.0	78.5%	0.0%	\$609,450	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$609,450	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$609,450	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$609,450	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 117 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,627	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$49,365	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$81,057	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$109,092	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$134,079	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$156,629	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$175,522	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$191,977	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$205,994	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$217,574	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$226,715	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$234,029	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$238,904	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$241,952	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$243,780	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$243,780	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$243,780	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$243,780	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 121 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$6,994
Present Value:	\$96,517

Annual:	\$0
Present Value:	\$0

Annual:	\$6,994
Present Value:	\$96,517

Mitigation Benefits: \$96,517

Mitigation Costs: \$72,128

Benefits Minus Costs: \$24,389

Benefit-Cost Ratio: 1.34

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 122 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 123 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010007, 12607 COVE SPRINGS DR, CYPRESS, Texas, 77433, Harris

Benefits: \$269,726

Costs: \$72,128

BCR: 3.74

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,573

BRV (\$/sf): \$150.00

Total BRV: \$535,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.49

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$535,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.49

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 125 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,399	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$71,817	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$124,876	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$172,040	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$214,916	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$252,432	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$535,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$535,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$535,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$535,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$535,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$535,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$535,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$535,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$535,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$535,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$535,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$535,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 126 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,863	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$43,412	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$71,281	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$95,935	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$117,909	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$137,739	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$154,354	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$168,824	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$181,151	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$191,334	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$199,373	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$205,805	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$210,092	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$212,772	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$214,380	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$214,380	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$214,380	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$214,380	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 127 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 128 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 129 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$18,557
Present Value:	\$256,104

Annual:	\$0
Present Value:	\$0

Annual:	\$18,557
Present Value:	\$256,104

Mitigation Benefits: \$256,104

Mitigation Costs: \$72,128

Benefits Minus Costs: \$183,976

Benefit-Cost Ratio: 3.55

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 132 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010008, 12611 COVE SPRINGS DR, CYPRESS, Texas, 77433, Harris

Benefits: \$238,628

Costs: \$72,128

BCR: 3.31

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,214

BRV (\$/sf): \$150.00

Total BRV: \$632,100

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.70

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$632,100  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.70

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 133 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 134 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,803	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$84,701	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$147,279	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$202,904	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$253,472	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$297,719	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$632,100	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$632,100	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$632,100	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$632,100	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$632,100	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$632,100	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$632,100	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$632,100	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$632,100	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$632,100	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$632,100	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$632,100	0.0%	0.0%	\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,170	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$51,200	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$84,069	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$113,146	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$139,062	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$162,450	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$182,045	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$199,112	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$213,650	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$225,660	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$235,141	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$242,726	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$247,783	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$250,944	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$252,840	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$252,840	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$252,840	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$252,840	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 139 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$16,304
Present Value:	\$225,006

Annual:	\$0
Present Value:	\$0

Annual:	\$16,304
Present Value:	\$225,006

Mitigation Benefits: \$225,006

Mitigation Costs: \$72,128

Benefits Minus Costs: \$152,878

Benefit-Cost Ratio: 3.12

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010009, 12615 COVE SPRINGS DR, CYPRESS, Texas, 77433, Harris

Benefits: \$210,809

Costs: \$72,128

BCR: 2.92

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,542

BRV (\$/sf): \$150.00

Total BRV: \$531,300

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.66

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$531,300  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.66

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

Total Benefits: **\$28,832,985**Total Costs: **\$6,197,495**BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,283	2.5%	0.0%	\$13,283
0.0	13.4%	0.0%	\$71,194	13.4%	0.0%	\$71,194
1.0	23.3%	0.0%	\$123,793	23.3%	0.0%	\$123,793
2.0	32.1%	0.0%	\$170,547	32.1%	0.0%	\$170,547
3.0	40.1%	0.0%	\$213,051	40.1%	0.0%	\$213,051
4.0	47.1%	0.0%	\$250,242	47.1%	0.0%	\$250,242
5.0	53.2%	0.0%	\$531,300	53.2%	0.0%	\$531,300
6.0	58.6%	0.0%	\$531,300	58.6%	0.0%	\$531,300
7.0	63.2%	0.0%	\$531,300	63.2%	0.0%	\$531,300
8.0	67.2%	0.0%	\$531,300	67.2%	0.0%	\$531,300
9.0	70.5%	0.0%	\$531,300	70.5%	0.0%	\$531,300
10.0	73.2%	0.0%	\$531,300	73.2%	0.0%	\$531,300
11.0	75.4%	0.0%	\$531,300	75.4%	0.0%	\$531,300
12.0	77.2%	0.0%	\$531,300	77.2%	0.0%	\$531,300
13.0	78.5%	0.0%	\$531,300	78.5%	0.0%	\$531,300
14.0	79.5%	0.0%	\$531,300	79.5%	0.0%	\$531,300
15.0	80.2%	0.0%	\$531,300	80.2%	0.0%	\$531,300
16.0	80.7%	0.0%	\$531,300	80.7%	0.0%	\$531,300

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,751	2.4%	0.0%	\$12,751
0.0	8.1%	0.0%	\$43,035	8.1%	0.0%	\$43,035
1.0	13.3%	0.0%	\$70,663	13.3%	0.0%	\$70,663
2.0	17.9%	0.0%	\$95,103	17.9%	0.0%	\$95,103
3.0	22.0%	0.0%	\$116,886	22.0%	0.0%	\$116,886
4.0	25.7%	0.0%	\$136,544	25.7%	0.0%	\$136,544
5.0	28.8%	0.0%	\$153,014	28.8%	0.0%	\$153,014
6.0	31.5%	0.0%	\$167,360	31.5%	0.0%	\$167,360
7.0	33.8%	0.0%	\$179,579	33.8%	0.0%	\$179,579
8.0	35.7%	0.0%	\$189,674	35.7%	0.0%	\$189,674
9.0	37.2%	0.0%	\$197,644	37.2%	0.0%	\$197,644
10.0	38.4%	0.0%	\$204,019	38.4%	0.0%	\$204,019
11.0	39.2%	0.0%	\$208,270	39.2%	0.0%	\$208,270
12.0	39.7%	0.0%	\$210,926	39.7%	0.0%	\$210,926
13.0	40.0%	0.0%	\$212,520	40.0%	0.0%	\$212,520
14.0	40.0%	0.0%	\$212,520	40.0%	0.0%	\$212,520
15.0	40.0%	0.0%	\$212,520	40.0%	0.0%	\$212,520
16.0	40.0%	0.0%	\$212,520	40.0%	0.0%	\$212,520

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$14,288
Present Value:	\$197,187

Annual:	\$0
Present Value:	\$0

Annual:	\$14,288
Present Value:	\$197,187

Mitigation Benefits: \$197,187

Mitigation Costs: \$72,128

Benefits Minus Costs: \$125,059

Benefit-Cost Ratio: 2.73

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010010, 19103 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$391,937

Costs: \$72,128

BCR: 5.43

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,976

BRV (\$/sf): \$150.00

Total BRV: \$596,400

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.31

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$596,400  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.31

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,910	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$79,918	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$138,961	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$191,444	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$239,156	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$280,904	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$596,400	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$596,400	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$596,400	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$596,400	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$596,400	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$596,400	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$596,400	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$596,400	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$596,400	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$596,400	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$596,400	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$596,400	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,314	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$48,308	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$79,321	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$106,756	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$131,208	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$153,275	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$171,763	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$187,866	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$201,583	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$212,915	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$221,861	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$229,018	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$233,789	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$236,771	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$238,560	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$238,560	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$238,560	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$238,560	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$27,413
Present Value:	\$378,315

Annual:	\$0
Present Value:	\$0

Annual:	\$27,413
Present Value:	\$378,315

Mitigation Benefits: \$378,315

Mitigation Costs: \$72,128

Benefits Minus Costs: \$306,187

Benefit-Cost Ratio: 5.25

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010011, 19107 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$117,932

Costs: \$72,128

BCR: 1.64

Hazard: **Flood**

Mitigation Option: Drainage Improvement

Latitude:

Longitude:

Size of Building: 3,799

BRV (\$/sf): \$150.00

Total BRV: \$569,850

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.42

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$569,850  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade:

One Time Displacement Costs: \$0

Grade:

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,246	2.5%	0.0%	\$14,246
0.0	13.4%	0.0%	\$76,360	13.4%	0.0%	\$76,360
1.0	23.3%	0.0%	\$132,775	23.3%	0.0%	\$132,775
2.0	32.1%	0.0%	\$182,922	32.1%	0.0%	\$182,922
3.0	40.1%	0.0%	\$228,510	40.1%	0.0%	\$228,510
4.0	47.1%	0.0%	\$268,399	47.1%	0.0%	\$268,399
5.0	53.2%	0.0%	\$569,850	53.2%	0.0%	\$569,850
6.0	58.6%	0.0%	\$569,850	58.6%	0.0%	\$569,850
7.0	63.2%	0.0%	\$569,850	63.2%	0.0%	\$569,850
8.0	67.2%	0.0%	\$569,850	67.2%	0.0%	\$569,850
9.0	70.5%	0.0%	\$569,850	70.5%	0.0%	\$569,850
10.0	73.2%	0.0%	\$569,850	73.2%	0.0%	\$569,850
11.0	75.4%	0.0%	\$569,850	75.4%	0.0%	\$569,850
12.0	77.2%	0.0%	\$569,850	77.2%	0.0%	\$569,850
13.0	78.5%	0.0%	\$569,850	78.5%	0.0%	\$569,850
14.0	79.5%	0.0%	\$569,850	79.5%	0.0%	\$569,850
15.0	80.2%	0.0%	\$569,850	80.2%	0.0%	\$569,850
16.0	80.7%	0.0%	\$569,850	80.7%	0.0%	\$569,850

Total Benefits: **\$28,832,985**Total Costs: **\$6,197,495**BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,676	2.4%	0.0%	\$13,676
0.0	8.1%	0.0%	\$46,158	8.1%	0.0%	\$46,158
1.0	13.3%	0.0%	\$75,790	13.3%	0.0%	\$75,790
2.0	17.9%	0.0%	\$102,003	17.9%	0.0%	\$102,003
3.0	22.0%	0.0%	\$125,367	22.0%	0.0%	\$125,367
4.0	25.7%	0.0%	\$146,451	25.7%	0.0%	\$146,451
5.0	28.8%	0.0%	\$164,117	28.8%	0.0%	\$164,117
6.0	31.5%	0.0%	\$179,503	31.5%	0.0%	\$179,503
7.0	33.8%	0.0%	\$192,609	33.8%	0.0%	\$192,609
8.0	35.7%	0.0%	\$203,436	35.7%	0.0%	\$203,436
9.0	37.2%	0.0%	\$211,984	37.2%	0.0%	\$211,984
10.0	38.4%	0.0%	\$218,822	38.4%	0.0%	\$218,822
11.0	39.2%	0.0%	\$223,381	39.2%	0.0%	\$223,381
12.0	39.7%	0.0%	\$226,230	39.7%	0.0%	\$226,230
13.0	40.0%	0.0%	\$227,940	40.0%	0.0%	\$227,940
14.0	40.0%	0.0%	\$227,940	40.0%	0.0%	\$227,940
15.0	40.0%	0.0%	\$227,940	40.0%	0.0%	\$227,940
16.0	40.0%	0.0%	\$227,940	40.0%	0.0%	\$227,940

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 163 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 164 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 165 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 166 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$21,970

Present Value: \$303,203

Annual: \$14,412

Present Value: \$198,893

Annual: \$7,558

Present Value: \$104,310

Mitigation Benefits: \$104,310

Mitigation Costs: \$72,128

Benefits Minus Costs: \$32,182

Benefit-Cost Ratio: 1.45

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 167 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 168 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010012, 19111 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$316,244

Costs: \$72,128

BCR: 4.38

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,222

BRV (\$/sf): \$150.00

Total BRV: \$633,300

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.49

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$633,300  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.49

One Time Displacement Costs: \$0

Grade:

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 169 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 170 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,833	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$84,862	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$147,559	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$203,289	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$253,953	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$298,284	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$633,300	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$633,300	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$633,300	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$633,300	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$633,300	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$633,300	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$633,300	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$633,300	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$633,300	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$633,300	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$633,300	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$633,300	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 171 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,199	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$51,297	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$84,229	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$113,361	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$139,326	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$162,758	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$182,390	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$199,490	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$214,055	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$226,088	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$235,588	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$243,187	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$248,254	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$251,420	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$253,320	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$253,320	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$253,320	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$253,320	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 172 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 173 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 174 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 175 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$21,928
Present Value:	\$302,622

Annual:	\$0
Present Value:	\$0

Annual:	\$21,928
Present Value:	\$302,622

Mitigation Benefits: \$302,622

Mitigation Costs: \$72,128

Benefits Minus Costs: \$230,494

Benefit-Cost Ratio: 4.20

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 176 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 177 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010013, 19115 BREEZEWAY COVE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$214,032

Costs: \$72,128

BCR: 2.97

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,420

BRV (\$/sf): \$150.00

Total BRV: \$513,000

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.69

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$513,000  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.43

Utilities that are not elevated: No

Height FFE Above Grade: 150.69

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 178 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.9

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.20	9,128.0	151.04	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 179 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,825	2.5%	0.0%	\$12,825
0.0	13.4%	0.0%	\$68,742	13.4%	0.0%	\$68,742
1.0	23.3%	0.0%	\$119,529	23.3%	0.0%	\$119,529
2.0	32.1%	0.0%	\$164,673	32.1%	0.0%	\$164,673
3.0	40.1%	0.0%	\$205,713	40.1%	0.0%	\$205,713
4.0	47.1%	0.0%	\$241,623	47.1%	0.0%	\$241,623
5.0	53.2%	0.0%	\$513,000	53.2%	0.0%	\$513,000
6.0	58.6%	0.0%	\$513,000	58.6%	0.0%	\$513,000
7.0	63.2%	0.0%	\$513,000	63.2%	0.0%	\$513,000
8.0	67.2%	0.0%	\$513,000	67.2%	0.0%	\$513,000
9.0	70.5%	0.0%	\$513,000	70.5%	0.0%	\$513,000
10.0	73.2%	0.0%	\$513,000	73.2%	0.0%	\$513,000
11.0	75.4%	0.0%	\$513,000	75.4%	0.0%	\$513,000
12.0	77.2%	0.0%	\$513,000	77.2%	0.0%	\$513,000
13.0	78.5%	0.0%	\$513,000	78.5%	0.0%	\$513,000
14.0	79.5%	0.0%	\$513,000	79.5%	0.0%	\$513,000
15.0	80.2%	0.0%	\$513,000	80.2%	0.0%	\$513,000
16.0	80.7%	0.0%	\$513,000	80.7%	0.0%	\$513,000

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,312	2.4%	0.0%	\$12,312
0.0	8.1%	0.0%	\$41,553	8.1%	0.0%	\$41,553
1.0	13.3%	0.0%	\$68,229	13.3%	0.0%	\$68,229
2.0	17.9%	0.0%	\$91,827	17.9%	0.0%	\$91,827
3.0	22.0%	0.0%	\$112,860	22.0%	0.0%	\$112,860
4.0	25.7%	0.0%	\$131,841	25.7%	0.0%	\$131,841
5.0	28.8%	0.0%	\$147,744	28.8%	0.0%	\$147,744
6.0	31.5%	0.0%	\$161,595	31.5%	0.0%	\$161,595
7.0	33.8%	0.0%	\$173,394	33.8%	0.0%	\$173,394
8.0	35.7%	0.0%	\$183,141	35.7%	0.0%	\$183,141
9.0	37.2%	0.0%	\$190,836	37.2%	0.0%	\$190,836
10.0	38.4%	0.0%	\$196,992	38.4%	0.0%	\$196,992
11.0	39.2%	0.0%	\$201,096	39.2%	0.0%	\$201,096
12.0	39.7%	0.0%	\$203,661	39.7%	0.0%	\$203,661
13.0	40.0%	0.0%	\$205,200	40.0%	0.0%	\$205,200
14.0	40.0%	0.0%	\$205,200	40.0%	0.0%	\$205,200
15.0	40.0%	0.0%	\$205,200	40.0%	0.0%	\$205,200
16.0	40.0%	0.0%	\$205,200	40.0%	0.0%	\$205,200

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$14,522

Present Value: \$200,410

Annual: \$0

Present Value: \$0

Annual: \$14,522

Present Value: \$200,410

Mitigation Benefits: \$200,410

Benefits Minus Costs: \$128,282

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 2.78

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 185 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010014, 12614 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$252,208

Costs: \$72,128

BCR: 3.50

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,901

BRV (\$/sf): \$150.00

Total BRV: \$585,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.68

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$585,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 150.68

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 188 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,629	2.5%	0.0%	\$14,629
0.0	13.4%	0.0%	\$78,410	13.4%	0.0%	\$78,410
1.0	23.3%	0.0%	\$136,340	23.3%	0.0%	\$136,340
2.0	32.1%	0.0%	\$187,833	32.1%	0.0%	\$187,833
3.0	40.1%	0.0%	\$234,645	40.1%	0.0%	\$234,645
4.0	47.1%	0.0%	\$275,606	47.1%	0.0%	\$275,606
5.0	53.2%	0.0%	\$585,150	53.2%	0.0%	\$585,150
6.0	58.6%	0.0%	\$585,150	58.6%	0.0%	\$585,150
7.0	63.2%	0.0%	\$585,150	63.2%	0.0%	\$585,150
8.0	67.2%	0.0%	\$585,150	67.2%	0.0%	\$585,150
9.0	70.5%	0.0%	\$585,150	70.5%	0.0%	\$585,150
10.0	73.2%	0.0%	\$585,150	73.2%	0.0%	\$585,150
11.0	75.4%	0.0%	\$585,150	75.4%	0.0%	\$585,150
12.0	77.2%	0.0%	\$585,150	77.2%	0.0%	\$585,150
13.0	78.5%	0.0%	\$585,150	78.5%	0.0%	\$585,150
14.0	79.5%	0.0%	\$585,150	79.5%	0.0%	\$585,150
15.0	80.2%	0.0%	\$585,150	80.2%	0.0%	\$585,150
16.0	80.7%	0.0%	\$585,150	80.7%	0.0%	\$585,150

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,044	2.4%	0.0%	\$14,044
0.0	8.1%	0.0%	\$47,397	8.1%	0.0%	\$47,397
1.0	13.3%	0.0%	\$77,825	13.3%	0.0%	\$77,825
2.0	17.9%	0.0%	\$104,742	17.9%	0.0%	\$104,742
3.0	22.0%	0.0%	\$128,733	22.0%	0.0%	\$128,733
4.0	25.7%	0.0%	\$150,384	25.7%	0.0%	\$150,384
5.0	28.8%	0.0%	\$168,523	28.8%	0.0%	\$168,523
6.0	31.5%	0.0%	\$184,322	31.5%	0.0%	\$184,322
7.0	33.8%	0.0%	\$197,781	33.8%	0.0%	\$197,781
8.0	35.7%	0.0%	\$208,899	35.7%	0.0%	\$208,899
9.0	37.2%	0.0%	\$217,676	37.2%	0.0%	\$217,676
10.0	38.4%	0.0%	\$224,698	38.4%	0.0%	\$224,698
11.0	39.2%	0.0%	\$229,379	39.2%	0.0%	\$229,379
12.0	39.7%	0.0%	\$232,305	39.7%	0.0%	\$232,305
13.0	40.0%	0.0%	\$234,060	40.0%	0.0%	\$234,060
14.0	40.0%	0.0%	\$234,060	40.0%	0.0%	\$234,060
15.0	40.0%	0.0%	\$234,060	40.0%	0.0%	\$234,060
16.0	40.0%	0.0%	\$234,060	40.0%	0.0%	\$234,060

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$17,288
Present Value:	\$238,586

Annual:	\$0
Present Value:	\$0

Annual:	\$17,288
Present Value:	\$238,586

Mitigation Benefits: \$238,586

Mitigation Costs: \$72,128

Benefits Minus Costs: \$166,458

Benefit-Cost Ratio: 3.31

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010015, 12610 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$257,375

Costs: \$72,128

BCR: 3.57

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,811

BRV (\$/sf): \$150.00

Total BRV: \$571,650

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.63

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$571,650  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 150.63

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 196 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,291	2.5%	0.0%	\$14,291
0.0	13.4%	0.0%	\$76,601	13.4%	0.0%	\$76,601
1.0	23.3%	0.0%	\$133,194	23.3%	0.0%	\$133,194
2.0	32.1%	0.0%	\$183,500	32.1%	0.0%	\$183,500
3.0	40.1%	0.0%	\$229,232	40.1%	0.0%	\$229,232
4.0	47.1%	0.0%	\$269,247	47.1%	0.0%	\$269,247
5.0	53.2%	0.0%	\$571,650	53.2%	0.0%	\$571,650
6.0	58.6%	0.0%	\$571,650	58.6%	0.0%	\$571,650
7.0	63.2%	0.0%	\$571,650	63.2%	0.0%	\$571,650
8.0	67.2%	0.0%	\$571,650	67.2%	0.0%	\$571,650
9.0	70.5%	0.0%	\$571,650	70.5%	0.0%	\$571,650
10.0	73.2%	0.0%	\$571,650	73.2%	0.0%	\$571,650
11.0	75.4%	0.0%	\$571,650	75.4%	0.0%	\$571,650
12.0	77.2%	0.0%	\$571,650	77.2%	0.0%	\$571,650
13.0	78.5%	0.0%	\$571,650	78.5%	0.0%	\$571,650
14.0	79.5%	0.0%	\$571,650	79.5%	0.0%	\$571,650
15.0	80.2%	0.0%	\$571,650	80.2%	0.0%	\$571,650
16.0	80.7%	0.0%	\$571,650	80.7%	0.0%	\$571,650

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,720	2.4%	0.0%	\$13,720
0.0	8.1%	0.0%	\$46,304	8.1%	0.0%	\$46,304
1.0	13.3%	0.0%	\$76,029	13.3%	0.0%	\$76,029
2.0	17.9%	0.0%	\$102,325	17.9%	0.0%	\$102,325
3.0	22.0%	0.0%	\$125,763	22.0%	0.0%	\$125,763
4.0	25.7%	0.0%	\$146,914	25.7%	0.0%	\$146,914
5.0	28.8%	0.0%	\$164,635	28.8%	0.0%	\$164,635
6.0	31.5%	0.0%	\$180,070	31.5%	0.0%	\$180,070
7.0	33.8%	0.0%	\$193,218	33.8%	0.0%	\$193,218
8.0	35.7%	0.0%	\$204,079	35.7%	0.0%	\$204,079
9.0	37.2%	0.0%	\$212,654	37.2%	0.0%	\$212,654
10.0	38.4%	0.0%	\$219,514	38.4%	0.0%	\$219,514
11.0	39.2%	0.0%	\$224,087	39.2%	0.0%	\$224,087
12.0	39.7%	0.0%	\$226,945	39.7%	0.0%	\$226,945
13.0	40.0%	0.0%	\$228,660	40.0%	0.0%	\$228,660
14.0	40.0%	0.0%	\$228,660	40.0%	0.0%	\$228,660
15.0	40.0%	0.0%	\$228,660	40.0%	0.0%	\$228,660
16.0	40.0%	0.0%	\$228,660	40.0%	0.0%	\$228,660

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$17,662
Present Value:	\$243,753

Annual:	\$0
Present Value:	\$0

Annual:	\$17,662
Present Value:	\$243,753

Mitigation Benefits: \$243,753

Mitigation Costs: \$72,128

Benefits Minus Costs: \$171,625

Benefit-Cost Ratio: 3.38

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360010017, 12602 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$131,650

Costs: \$72,128

BCR: 1.83

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,742

BRV (\$/sf): \$150.00

Total BRV: \$711,300

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.37

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$711,300  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 151.37

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 205 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 132.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	4,449.0	149.68	4,360.0
50	2.00%	150.80	7,337.0	150.56	7,190.3
100	1.00%	151.10	9,128.0	150.94	8,945.4
500	0.20%	152.10	15,128.0	152.02	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 206 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$17,783	2.5%	0.0%	\$17,783
0.0	13.4%	0.0%	\$95,314	13.4%	0.0%	\$95,314
1.0	23.3%	0.0%	\$165,733	23.3%	0.0%	\$165,733
2.0	32.1%	0.0%	\$228,327	32.1%	0.0%	\$228,327
3.0	40.1%	0.0%	\$285,231	40.1%	0.0%	\$285,231
4.0	47.1%	0.0%	\$335,022	47.1%	0.0%	\$335,022
5.0	53.2%	0.0%	\$711,300	53.2%	0.0%	\$711,300
6.0	58.6%	0.0%	\$711,300	58.6%	0.0%	\$711,300
7.0	63.2%	0.0%	\$711,300	63.2%	0.0%	\$711,300
8.0	67.2%	0.0%	\$711,300	67.2%	0.0%	\$711,300
9.0	70.5%	0.0%	\$711,300	70.5%	0.0%	\$711,300
10.0	73.2%	0.0%	\$711,300	73.2%	0.0%	\$711,300
11.0	75.4%	0.0%	\$711,300	75.4%	0.0%	\$711,300
12.0	77.2%	0.0%	\$711,300	77.2%	0.0%	\$711,300
13.0	78.5%	0.0%	\$711,300	78.5%	0.0%	\$711,300
14.0	79.5%	0.0%	\$711,300	79.5%	0.0%	\$711,300
15.0	80.2%	0.0%	\$711,300	80.2%	0.0%	\$711,300
16.0	80.7%	0.0%	\$711,300	80.7%	0.0%	\$711,300

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$17,071	2.4%	0.0%	\$17,071
0.0	8.1%	0.0%	\$57,615	8.1%	0.0%	\$57,615
1.0	13.3%	0.0%	\$94,603	13.3%	0.0%	\$94,603
2.0	17.9%	0.0%	\$127,323	17.9%	0.0%	\$127,323
3.0	22.0%	0.0%	\$156,486	22.0%	0.0%	\$156,486
4.0	25.7%	0.0%	\$182,804	25.7%	0.0%	\$182,804
5.0	28.8%	0.0%	\$204,854	28.8%	0.0%	\$204,854
6.0	31.5%	0.0%	\$224,060	31.5%	0.0%	\$224,060
7.0	33.8%	0.0%	\$240,419	33.8%	0.0%	\$240,419
8.0	35.7%	0.0%	\$253,934	35.7%	0.0%	\$253,934
9.0	37.2%	0.0%	\$264,604	37.2%	0.0%	\$264,604
10.0	38.4%	0.0%	\$273,139	38.4%	0.0%	\$273,139
11.0	39.2%	0.0%	\$278,830	39.2%	0.0%	\$278,830
12.0	39.7%	0.0%	\$282,386	39.7%	0.0%	\$282,386
13.0	40.0%	0.0%	\$284,520	40.0%	0.0%	\$284,520
14.0	40.0%	0.0%	\$284,520	40.0%	0.0%	\$284,520
15.0	40.0%	0.0%	\$284,520	40.0%	0.0%	\$284,520
16.0	40.0%	0.0%	\$284,520	40.0%	0.0%	\$284,520

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 209 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	45.0		\$0
2.0	90.0		\$0	90.0		\$0
3.0	135.0		\$0	135.0		\$0
4.0	180.0		\$0	180.0		\$0
5.0	225.0		\$0	225.0		\$0
6.0	270.0		\$0	270.0		\$0
7.0	315.0		\$0	315.0		\$0
8.0	360.0		\$0	360.0		\$0
9.0	405.0		\$0	405.0		\$0
10.0	450.0		\$0	450.0		\$0
11.0	495.0		\$0	495.0		\$0
12.0	540.0		\$0	540.0		\$0
13.0	585.0		\$0	585.0		\$0
14.0	630.0		\$0	630.0		\$0
15.0	675.0		\$0	675.0		\$0
16.0	720.0		\$0	720.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 210 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 211 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$8,552
Present Value:	\$118,028

Annual:	\$0
Present Value:	\$0

Annual:	\$8,552
Present Value:	\$118,028

Mitigation Benefits: \$118,028

Mitigation Costs: \$72,128

Benefits Minus Costs: \$45,900

Benefit-Cost Ratio: 1.64

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 212 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 213 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360020001, 12631 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$396,313

Costs: \$72,128

BCR: 5.49

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,761

BRV (\$/sf): \$150.00

Total BRV: \$564,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.37

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$564,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 150.37

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 214 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2

Number of Worker: 1

Treatment Costs per person: \$2,443.00

Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00

Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 215 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,104	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$75,596	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$131,447	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$181,092	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$226,224	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$265,715	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$564,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$564,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$564,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$564,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$564,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$564,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$564,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$564,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$564,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$564,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$564,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$564,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,540	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$45,696	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$75,032	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$100,983	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$124,113	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$144,987	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$162,475	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$177,707	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$190,683	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$201,402	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$209,864	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$216,634	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$221,147	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$223,968	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$225,660	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$225,660	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$225,660	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$225,660	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 217 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 218 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 219 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 220 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$27,730
Present Value:	\$382,691

Annual:	\$0
Present Value:	\$0

Annual:	\$27,730
Present Value:	\$382,691

Mitigation Benefits: \$382,691

Mitigation Costs: \$72,128

Benefits Minus Costs: \$310,563

Benefit-Cost Ratio: 5.31

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 222 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360020002, 12627 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$242,833

Costs: \$72,128

BCR: 3.37

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,854

BRV (\$/sf): \$150.00

Total BRV: \$578,100

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.71

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$578,100  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 150.71

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 223 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,453	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$77,465	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$134,697	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$185,570	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$231,818	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$272,285	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$578,100	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$578,100	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$578,100	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$578,100	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$578,100	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$578,100	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$578,100	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$578,100	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$578,100	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$578,100	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$578,100	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$578,100	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,874	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$46,826	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$76,887	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$103,480	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$127,182	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$148,572	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$166,493	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$182,102	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$195,398	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$206,382	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$215,053	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$221,990	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$226,615	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$229,506	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$231,240	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$231,240	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$231,240	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$231,240	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 226 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 227 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 228 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 229 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$16,609
Present Value:	\$229,211

Annual:	\$0
Present Value:	\$0

Annual:	\$16,609
Present Value:	\$229,211

Mitigation Benefits: \$229,211

Mitigation Costs: \$72,128

Benefits Minus Costs: \$157,083

Benefit-Cost Ratio: 3.18

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 230 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 231 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360020003, 12623 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$542,107

Costs: \$72,128

BCR: 7.52

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,207

BRV (\$/sf): \$150.00

Total BRV: \$631,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.18

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$631,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 150.18

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 232 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,776	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$84,561	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$147,035	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$202,567	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$253,051	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$297,225	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$631,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$631,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$631,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$631,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$631,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$631,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$631,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$631,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$631,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$631,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$631,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$631,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,145	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$51,115	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$83,930	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$112,958	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$138,831	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$162,180	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$181,742	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$198,781	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$213,295	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$225,285	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$234,751	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$242,323	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$247,372	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$250,527	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$252,420	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$252,420	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$252,420	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$252,420	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 235 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 236 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 237 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 238 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$38,294
Present Value:	\$528,485

Annual:	\$0
Present Value:	\$0

Annual:	\$38,294
Present Value:	\$528,485

Mitigation Benefits: \$528,485

Mitigation Costs: \$72,128

Benefits Minus Costs: \$456,357

Benefit-Cost Ratio: 7.33

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 240 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360020004, 12619 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$221,004

Costs: \$72,128

BCR: 3.06

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,490

BRV (\$/sf): \$150.00

Total BRV: \$673,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.95

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$673,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 150.95

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 241 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$16,838	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$90,249	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$156,926	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$216,194	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$270,074	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$317,219	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$673,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$673,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$673,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$673,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$673,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$673,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$673,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$673,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$673,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$673,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$673,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$673,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$16,164	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$54,554	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$89,576	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$120,557	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$148,170	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$173,090	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$193,968	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$212,153	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$227,643	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$240,440	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$250,542	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$258,624	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$264,012	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$267,380	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$269,400	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$269,400	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$269,400	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$269,400	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 245 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 246 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 247 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$15,027
Present Value:	\$207,382

Annual:	\$0
Present Value:	\$0

Annual:	\$15,027
Present Value:	\$207,382

Mitigation Benefits: \$207,382

Mitigation Costs: \$72,128

Benefits Minus Costs: \$135,254

Benefit-Cost Ratio: 2.88

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 248 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1303360020006, 12611 COVE LANDING DR, CYPRESS, Texas, 77433, Harris

Benefits: \$131,513

Costs: \$72,128

BCR: 1.82

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,407

BRV (\$/sf): \$150.00

Total BRV: \$511,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.24

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$511,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.57

Utilities that are not elevated: No

Height FFE Above Grade: 151.24

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	4,449.0	149.78	4,360.0
50	2.00%	150.90	7,337.0	150.66	7,190.3
100	1.00%	151.30	9,128.0	151.14	8,945.4
500	0.20%	152.20	15,128.0	152.12	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 251 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,776	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$68,481	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$119,075	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$164,047	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$204,931	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$240,705	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$511,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$511,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$511,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$511,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$511,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$511,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$511,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$511,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$511,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$511,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$511,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$511,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 252 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,265	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$41,395	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$67,970	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$91,478	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$112,431	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$131,340	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$147,182	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$160,981	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$172,735	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$182,445	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$190,111	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$196,243	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$200,332	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$202,887	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$204,420	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$204,420	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$204,420	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$204,420	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 253 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 254 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 255 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 256 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$8,542
Present Value:	\$117,891

Annual:	\$0
Present Value:	\$0

Annual:	\$8,542
Present Value:	\$117,891

Mitigation Benefits: \$117,891

Mitigation Costs: \$72,128

Benefits Minus Costs: \$45,763

Benefit-Cost Ratio: 1.63

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 257 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 258 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030010024, 19319 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$347,111

Costs: \$72,128

BCR: 4.81

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,528

BRV (\$/sf): \$150.00

Total BRV: \$529,200

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.72

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$529,200  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.85

Utilities that are not elevated: No

Height FFE Above Grade: 150.72

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 259 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.10	7,337.0	150.86	7,190.3
100	1.00%	151.50	9,128.0	151.34	8,945.4
500	0.20%	152.40	15,128.0	152.32	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 260 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,230	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$70,913	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$123,304	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$169,873	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$212,209	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$249,253	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$529,200	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$529,200	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$529,200	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$529,200	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$529,200	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$529,200	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$529,200	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$529,200	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$529,200	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$529,200	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$529,200	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$529,200	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,701	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$42,865	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$70,384	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$94,727	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$116,424	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$136,004	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$152,410	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$166,698	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$178,870	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$188,924	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$196,862	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$203,213	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$207,446	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$210,092	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$211,680	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$211,680	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$211,680	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$211,680	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 264 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 265 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$24,165
Present Value:	\$333,489

Annual:	\$0
Present Value:	\$0

Annual:	\$24,165
Present Value:	\$333,489

Mitigation Benefits: \$333,489

Mitigation Costs: \$72,128

Benefits Minus Costs: \$261,361

Benefit-Cost Ratio: 4.62

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 266 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 267 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030010025, 19315 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$334,553

Costs: \$72,128

BCR: 4.64

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 6,197

BRV (\$/sf): \$150.00

Total BRV: \$929,550

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.12

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$929,550  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.85

Utilities that are not elevated: No

Height FFE Above Grade: 151.12

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 268 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.10	7,337.0	150.86	7,190.3
100	1.00%	151.50	9,128.0	151.34	8,945.4
500	0.20%	152.40	15,128.0	152.32	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 269 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$23,239	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$124,560	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$216,585	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$298,386	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$372,750	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$437,818	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$929,550	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$929,550	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$929,550	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$929,550	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$929,550	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$929,550	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$929,550	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$929,550	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$929,550	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$929,550	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$929,550	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$929,550	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 270 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$22,309	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$75,294	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$123,630	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$166,389	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$204,501	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$238,894	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$267,710	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$292,808	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$314,188	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$331,849	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$345,793	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$356,947	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$364,384	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$369,031	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$371,820	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$371,820	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$371,820	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$371,820	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 272 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 273 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 274 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$23,255

Present Value: \$320,931

Annual: \$0

Present Value: \$0

Annual: \$23,255

Present Value: \$320,931

Mitigation Benefits: \$320,931

Benefits Minus Costs: \$248,803

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 4.45

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 275 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 276 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030010026, 19311 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$347,172

Costs: \$72,128

BCR: 4.81

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,940

BRV (\$/sf): \$150.00

Total BRV: \$591,000

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.79

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$591,000  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.85

Utilities that are not elevated: No

Height FFE Above Grade: 150.79

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 277 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.10	7,337.0	150.86	7,190.3
100	1.00%	151.50	9,128.0	151.34	8,945.4
500	0.20%	152.40	15,128.0	152.32	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 278 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,775	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$79,194	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$137,703	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$189,711	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$236,991	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$278,361	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$591,000	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$591,000	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$591,000	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$591,000	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$591,000	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$591,000	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$591,000	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$591,000	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$591,000	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$591,000	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$591,000	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$591,000	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 279 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,184	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$47,871	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$78,603	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$105,789	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$130,020	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$151,887	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$170,208	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$186,165	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$199,758	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$210,987	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$219,852	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$226,944	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$231,672	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$234,627	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$236,400	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$236,400	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$236,400	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$236,400	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 280 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 281 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 282 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 283 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$24,169
Present Value:	\$333,550

Annual:	\$0
Present Value:	\$0

Annual:	\$24,169
Present Value:	\$333,550

Mitigation Benefits: \$333,550

Mitigation Costs: \$72,128

Benefits Minus Costs: \$261,422

Benefit-Cost Ratio: 4.62

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 284 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 285 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030010027, 19305 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$275,785

Costs: \$72,128

BCR: 3.82

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,987

BRV (\$/sf): \$150.00

Total BRV: \$598,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.82

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$598,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.71

Utilities that are not elevated: No

Height FFE Above Grade: 150.82

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 286 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.1

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	4,449.0	149.98	4,360.0
50	2.00%	151.10	7,337.0	150.86	7,190.3
100	1.00%	151.40	9,128.0	151.24	8,945.4
500	0.20%	152.40	15,128.0	152.32	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 287 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,951	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$80,139	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$139,346	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$191,974	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$239,818	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$281,682	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$598,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$598,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$598,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$598,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$598,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$598,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$598,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$598,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$598,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$598,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$598,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$598,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 288 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,353	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$48,442	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$79,541	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$107,051	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$131,571	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$153,699	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$172,238	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$188,386	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$202,141	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$213,504	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$222,475	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$229,651	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$234,436	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$237,426	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$239,220	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$239,220	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$239,220	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$239,220	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 290 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 292 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$18,996
Present Value:	\$262,163

Annual:	\$0
Present Value:	\$0

Annual:	\$18,996
Present Value:	\$262,163

Mitigation Benefits: \$262,163

Mitigation Costs: \$72,128

Benefits Minus Costs: \$190,035

Benefit-Cost Ratio: 3.63

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 293 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 294 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030010028, 19303 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$380,110

Costs: \$72,128

BCR: 5.27

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,541

BRV (\$/sf): \$150.00

Total BRV: \$681,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.72

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$681,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.71

Utilities that are not elevated: No

Height FFE Above Grade: 150.72

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 295 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.1

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	4,449.0	149.98	4,360.0
50	2.00%	151.10	7,337.0	150.86	7,190.3
100	1.00%	151.40	9,128.0	151.24	8,945.4
500	0.20%	152.40	15,128.0	152.32	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 296 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$17,029	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$91,274	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$158,708	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$218,649	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$273,141	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$320,822	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$681,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$681,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$681,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$681,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$681,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$681,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$681,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$681,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$681,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$681,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$681,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$681,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 297 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$16,348	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$55,173	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$90,593	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$121,926	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$149,853	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$175,056	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$196,171	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$214,562	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$230,229	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$243,171	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$253,388	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$261,562	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$267,011	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$270,417	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$272,460	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$272,460	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$272,460	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$272,460	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 298 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 299 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 300 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 301 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$26,556
Present Value:	\$366,488

Annual:	\$0
Present Value:	\$0

Annual:	\$26,556
Present Value:	\$366,488

Mitigation Benefits: \$366,488

Mitigation Costs: \$72,128

Benefits Minus Costs: \$294,360

Benefit-Cost Ratio: 5.08

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 302 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 303 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030020001, 19327 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$591,501

Costs: \$72,128

BCR: 8.20

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,565

BRV (\$/sf): \$150.00

Total BRV: \$684,750

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.46

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$684,750  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.00

Utilities that are not elevated: No

Height FFE Above Grade: 150.46

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 304 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.20	7,337.0	150.96	7,190.3
100	1.00%	151.60	9,128.0	151.44	8,945.4
500	0.20%	152.50	15,128.0	152.42	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$17,119	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$91,757	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$159,547	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$219,805	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$274,585	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$322,517	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$684,750	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$684,750	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$684,750	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$684,750	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$684,750	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$684,750	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$684,750	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$684,750	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$684,750	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$684,750	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$684,750	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$684,750	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$16,434	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$55,465	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$91,072	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$122,570	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$150,645	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$175,981	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$197,208	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$215,696	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$231,446	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$244,456	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$254,727	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$262,944	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$268,422	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$271,846	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$273,900	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$273,900	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$273,900	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$273,900	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 308 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 309 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 310 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$41,873
Present Value:	\$577,879

Annual:	\$0
Present Value:	\$0

Annual:	\$41,873
Present Value:	\$577,879

Mitigation Benefits: \$577,879

Mitigation Costs: \$72,128

Benefits Minus Costs: \$505,751

Benefit-Cost Ratio: 8.01

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 312 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030020002, 19331 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$458,753

Costs: \$72,128

BCR: 6.36

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,354

BRV (\$/sf): \$150.00

Total BRV: \$503,100

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.41

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$503,100  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.00

Utilities that are not elevated: No

Height FFE Above Grade: 150.41

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 313 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.20	7,337.0	150.96	7,190.3
100	1.00%	151.60	9,128.0	151.44	8,945.4
500	0.20%	152.50	15,128.0	152.42	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 314 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,578	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$67,415	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$117,222	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$161,495	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$201,743	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$236,960	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$503,100	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$503,100	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$503,100	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$503,100	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$503,100	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$503,100	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$503,100	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$503,100	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$503,100	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$503,100	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$503,100	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$503,100	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,074	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$40,751	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$66,912	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$90,055	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$110,682	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$129,297	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$144,893	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$158,477	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$170,048	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$179,607	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$187,153	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$193,190	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$197,215	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$199,731	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$201,240	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$201,240	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$201,240	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$201,240	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 317 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 318 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 319 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$32,254
Present Value:	\$445,131

Annual:	\$0
Present Value:	\$0

Annual:	\$32,254
Present Value:	\$445,131

Mitigation Benefits: \$445,131

Mitigation Costs: \$72,128

Benefits Minus Costs: \$373,003

Benefit-Cost Ratio: 6.17

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 320 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 321 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030020003, 19403 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$696,325

Costs: \$72,128

BCR: 9.65

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 5,787

BRV (\$/sf): \$150.00

Total BRV: \$868,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.53

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$868,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.00

Utilities that are not elevated: No

Height FFE Above Grade: 150.53

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 322 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.20	7,337.0	150.96	7,190.3
100	1.00%	151.60	9,128.0	151.44	8,945.4
500	0.20%	152.50	15,128.0	152.42	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 323 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$21,701	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$116,319	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$202,256	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$278,644	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$348,088	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$408,852	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$868,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$868,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$868,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$868,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$868,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$868,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$868,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$868,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$868,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$868,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$868,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$868,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 324 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$20,833	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$70,312	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$115,451	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$155,381	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$190,971	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$223,089	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$249,998	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$273,436	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$293,401	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$309,894	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$322,915	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$333,331	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$340,276	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$344,616	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$347,220	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$347,220	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$347,220	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$347,220	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 325 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 326 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 327 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 328 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$49,469
Present Value:	\$682,703

Annual:	\$0
Present Value:	\$0

Annual:	\$49,469
Present Value:	\$682,703

Mitigation Benefits: \$682,703

Mitigation Costs: \$72,128

Benefits Minus Costs: \$610,575

Benefit-Cost Ratio: 9.47

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 329 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 330 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030020004, 19407 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$488,002

Costs: \$72,128

BCR: 6.77

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,060

BRV (\$/sf): \$150.00

Total BRV: \$609,000

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.55

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$609,000  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.00

Utilities that are not elevated: No

Height FFE Above Grade: 150.55

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 331 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.20	7,337.0	150.96	7,190.3
100	1.00%	151.60	9,128.0	151.44	8,945.4
500	0.20%	152.50	15,128.0	152.42	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 332 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,225	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$81,606	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$141,897	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$195,489	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$244,209	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$286,839	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$609,000	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$609,000	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$609,000	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$609,000	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$609,000	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$609,000	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$609,000	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$609,000	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$609,000	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$609,000	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$609,000	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$609,000	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 333 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,616	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$49,329	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$80,997	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$109,011	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$133,980	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$156,513	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$175,392	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$191,835	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$205,842	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$217,413	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$226,548	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$233,856	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$238,728	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$241,773	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$243,600	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$243,600	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$243,600	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$243,600	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 334 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 335 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 336 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Environmental Benefits**

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

**Other Benefits**

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 337 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$34,373

Present Value: \$474,380

Annual: \$0

Present Value: \$0

Annual: \$34,373

Present Value: \$474,380

Mitigation Benefits: \$474,380

Benefits Minus Costs: \$402,252

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 6.58

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 338 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 339 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030020005, 19411 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$357,083

Costs: \$72,128

BCR: 4.95

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,325

BRV (\$/sf): \$150.00

Total BRV: \$648,750

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.84

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$648,750  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.00

Utilities that are not elevated: No

Height FFE Above Grade: 150.84

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 340 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.2

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.40	4,449.0	150.08	4,360.0
50	2.00%	151.20	7,337.0	150.96	7,190.3
100	1.00%	151.60	9,128.0	151.44	8,945.4
500	0.20%	152.50	15,128.0	152.42	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 341 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$16,219	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$86,933	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$151,159	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$208,249	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$260,149	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$305,561	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$648,750	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$648,750	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$648,750	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$648,750	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$648,750	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$648,750	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$648,750	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$648,750	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$648,750	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$648,750	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$648,750	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$648,750	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 342 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,570	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$52,549	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$86,284	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$116,126	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$142,725	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$166,729	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$186,840	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$204,356	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$219,278	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$231,604	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$241,335	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$249,120	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$254,310	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$257,554	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$259,500	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$259,500	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$259,500	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$259,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 343 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 344 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 345 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 346 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$24,887

Present Value: \$343,461

Annual: \$0

Present Value: \$0

Annual: \$24,887

Present Value: \$343,461

Mitigation Benefits: \$343,461

Benefits Minus Costs: \$271,333

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 4.76

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 347 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 348 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1324030020006, 19415 SHADY EDGE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$150,477

Costs: \$72,128

BCR: 2.09

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,080

BRV (\$/sf): \$150.00

Total BRV: \$612,000

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.65

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$612,000  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.00

Utilities that are not elevated: No

Height FFE Above Grade: 151.65

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 349 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 133.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.50	4,449.0	150.18	4,360.0
50	2.00%	151.30	7,337.0	151.06	7,190.3
100	1.00%	151.60	9,128.0	151.44	8,945.4
500	0.20%	152.60	15,128.0	152.52	14,825.4

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 350 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,300	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$82,008	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$142,596	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$196,452	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$245,412	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$288,252	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$612,000	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$612,000	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$612,000	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$612,000	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$612,000	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$612,000	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$612,000	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$612,000	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$612,000	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$612,000	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$612,000	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$612,000	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,688	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$49,572	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$81,396	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$109,548	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$134,640	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$157,284	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$176,256	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$192,780	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$206,856	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$218,484	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$227,664	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$235,008	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$239,904	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$242,964	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$244,800	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$244,800	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$244,800	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$244,800	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 353 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 354 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 355 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$9,917
Present Value:	\$136,855

Annual:	\$0
Present Value:	\$0

Annual:	\$9,917
Present Value:	\$136,855

Mitigation Benefits: \$136,855

Mitigation Costs: \$72,128

Benefits Minus Costs: \$64,727

Benefit-Cost Ratio: 1.90

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 357 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900010013, 17023 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$166,586

Costs: \$72,128

BCR: 2.31

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,716

BRV (\$/sf): \$150.00

Total BRV: \$407,400

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.16

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$407,400  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.16

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 358 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 143.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	485.0	148.88	475.3
50	2.00%	149.70	1,025.0	149.46	1,004.5
100	1.00%	149.80	1,381.0	149.64	1,353.4
500	0.20%	150.10	2,590.0	150.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 359 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,185	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$54,592	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$94,924	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$130,775	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$163,367	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$191,885	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$407,400	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$407,400	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$407,400	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$407,400	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$407,400	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$407,400	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$407,400	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$407,400	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$407,400	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$407,400	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$407,400	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$407,400	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 360 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,778	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$32,999	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$54,184	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$72,925	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$89,628	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$104,702	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$117,331	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$128,331	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$137,701	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$145,442	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$151,553	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$156,442	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$159,701	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$161,738	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$162,960	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$162,960	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$162,960	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$162,960	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 361 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 363 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 364 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$11,084
Present Value:	\$152,964

Annual:	\$0
Present Value:	\$0

Annual:	\$11,084
Present Value:	\$152,964

Mitigation Benefits: \$152,964

Mitigation Costs: \$72,128

Benefits Minus Costs: \$80,836

Benefit-Cost Ratio: 2.12

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 365 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
-------	-------------	-------------

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 366 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900010014, 17027 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$188,137

Costs: \$72,128

BCR: 2.61

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,760

BRV (\$/sf): \$150.00

Total BRV: \$414,000

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.08

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$414,000  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.08

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 367 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 143.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	485.0	148.88	475.3
50	2.00%	149.70	1,025.0	149.46	1,004.5
100	1.00%	149.80	1,381.0	149.64	1,353.4
500	0.20%	150.10	2,590.0	150.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 368 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,350	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$55,476	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$96,462	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$132,894	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$166,014	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$194,994	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$414,000	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$414,000	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$414,000	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$414,000	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$414,000	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$414,000	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$414,000	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$414,000	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$414,000	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$414,000	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$414,000	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$414,000	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,936	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$33,534	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$55,062	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$74,106	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$91,080	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$106,398	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$119,232	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$130,410	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$139,932	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$147,798	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$154,008	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$158,976	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$162,288	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$164,358	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$165,600	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$165,600	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$165,600	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$165,600	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 370 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 371 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 372 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 373 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$12,645
Present Value:	\$174,515

Annual:	\$0
Present Value:	\$0

Annual:	\$12,645
Present Value:	\$174,515

Mitigation Benefits: \$174,515

Mitigation Costs: \$72,128

Benefits Minus Costs: \$102,387

Benefit-Cost Ratio: 2.42

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 374 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 375 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900010015, 17111 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$161,407

Costs: \$72,128

BCR: 2.24

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,741

BRV (\$/sf): \$150.00

Total BRV: \$411,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.18

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$411,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.18

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 376 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 143.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	485.0	148.88	475.3
50	2.00%	149.70	1,025.0	149.46	1,004.5
100	1.00%	149.80	1,381.0	149.64	1,353.4
500	0.20%	150.10	2,590.0	150.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 377 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,279	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$55,094	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$95,798	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$131,979	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$164,871	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$193,652	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$411,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$411,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$411,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$411,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$411,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$411,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$411,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$411,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$411,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$411,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$411,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$411,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 378 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,868	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$33,303	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$54,683	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$73,596	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$90,453	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$105,666	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$118,411	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$129,512	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$138,969	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$146,781	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$152,948	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$157,882	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$161,171	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$163,227	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$164,460	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$164,460	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$164,460	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$164,460	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 379 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 380 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 381 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 382 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$10,708

Present Value: \$147,785

Annual: \$0

Present Value: \$0

Annual: \$10,708

Present Value: \$147,785

Mitigation Benefits: \$147,785

Benefits Minus Costs: \$75,657

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 2.05

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 383 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 384 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900010017, 17119 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$136,831

Costs: \$72,128

BCR: 1.90

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,342

BRV (\$/sf): \$150.00

Total BRV: \$351,300

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.19

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$351,300  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.19

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 385 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 143.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.20	485.0	148.88	475.3
50	2.00%	149.70	1,025.0	149.46	1,004.5
100	1.00%	149.80	1,381.0	149.64	1,353.4
500	0.20%	150.10	2,590.0	150.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 386 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,783	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$47,074	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$81,853	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$112,767	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$140,871	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$165,462	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$351,300	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$351,300	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$351,300	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$351,300	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$351,300	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$351,300	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$351,300	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$351,300	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$351,300	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$351,300	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$351,300	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$351,300	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 387 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$8,431	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$28,455	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$46,723	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$62,883	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$77,286	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$90,284	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$101,174	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$110,660	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$118,739	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$125,414	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$130,684	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$134,899	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$137,710	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$139,466	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$140,520	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$140,520	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$140,520	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$140,520	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 388 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 389 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 390 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

## Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

## Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 391 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$8,928
Present Value:	\$123,209

Annual:	\$0
Present Value:	\$0

Annual:	\$8,928
Present Value:	\$123,209

Mitigation Benefits: \$123,209

Mitigation Costs: \$72,128

Benefits Minus Costs: \$51,081

Benefit-Cost Ratio: 1.71

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 392 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 393 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900020001, 18730 TOWN BLUFF DR, CYPRESS, Texas, 77433, Harris

Benefits: \$151,422

Costs: \$72,128

BCR: 2.10

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,411

BRV (\$/sf): \$150.00

Total BRV: \$361,650

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.57

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$361,650  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.73

Utilities that are not elevated: No

Height FFE Above Grade: 150.57

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 394 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.60	485.0	149.28	475.3
50	2.00%	149.90	1,025.0	149.66	1,004.5
100	1.00%	150.00	1,381.0	149.84	1,353.4
500	0.20%	150.30	2,590.0	150.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 395 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,041	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$48,461	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$84,264	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$116,090	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$145,022	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$170,337	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$361,650	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$361,650	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$361,650	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$361,650	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$361,650	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$361,650	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$361,650	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$361,650	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$361,650	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$361,650	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$361,650	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$361,650	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 396 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$8,680	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$29,294	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$48,099	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$64,735	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$79,563	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$92,944	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$104,155	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$113,920	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$122,238	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$129,109	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$134,534	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$138,874	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$141,767	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$143,575	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$144,660	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$144,660	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$144,660	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$144,660	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 397 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 398 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 399 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 400 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$9,985
Present Value:	\$137,800

Annual:	\$0
Present Value:	\$0

Annual:	\$9,985
Present Value:	\$137,800

Mitigation Benefits: \$137,800

Mitigation Costs: \$72,128

Benefits Minus Costs: \$65,672

Benefit-Cost Ratio: 1.91

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 401 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 402 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900020002, 18726 TOWN BLUFF DR, CYPRESS, Texas, 77433, Harris

Benefits: \$121,810

Costs: \$72,128

BCR: 1.69

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,091

BRV (\$/sf): \$150.00

Total BRV: \$313,650

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.60

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$313,650  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.73

Utilities that are not elevated: No

Height FFE Above Grade: 150.60

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 403 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.60	485.0	149.28	475.3
50	2.00%	149.90	1,025.0	149.66	1,004.5
100	1.00%	150.00	1,381.0	149.84	1,353.4
500	0.20%	150.30	2,590.0	150.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 404 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$7,841	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$42,029	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$73,080	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$100,682	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$125,774	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$147,729	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$313,650	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$313,650	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$313,650	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$313,650	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$313,650	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$313,650	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$313,650	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$313,650	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$313,650	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$313,650	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$313,650	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$313,650	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 405 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,528	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$25,406	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$41,715	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$56,143	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$69,003	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$80,608	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$90,331	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$98,800	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$106,014	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$111,973	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$116,678	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$120,442	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$122,951	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$124,519	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$125,460	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$125,460	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$125,460	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$125,460	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 406 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 407 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 408 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 409 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$7,839
Present Value:	\$108,188

Annual:	\$0
Present Value:	\$0

Annual:	\$7,839
Present Value:	\$108,188

Mitigation Benefits: \$108,188

Mitigation Costs: \$72,128

Benefits Minus Costs: \$36,060

Benefit-Cost Ratio: 1.50

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 410 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 411 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900020003, 18722 TOWN BLUFF DR, CYPRESS, Texas, 77433, Harris

Benefits: \$337,729

Costs: \$72,128

BCR: 4.68

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,868

BRV (\$/sf): \$150.00

Total BRV: \$430,200

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.24

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$430,200  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.73

Utilities that are not elevated: No

Height FFE Above Grade: 150.24

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 412 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.60	485.0	149.28	475.3
50	2.00%	149.90	1,025.0	149.66	1,004.5
100	1.00%	150.00	1,381.0	149.84	1,353.4
500	0.20%	150.30	2,590.0	150.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,755	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$57,647	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$100,237	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$138,094	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$172,510	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$202,624	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$430,200	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$430,200	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$430,200	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$430,200	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$430,200	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$430,200	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$430,200	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$430,200	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$430,200	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$430,200	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$430,200	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$430,200	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,325	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$34,846	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$57,217	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$77,006	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$94,644	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$110,561	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$123,898	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$135,513	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$145,408	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$153,581	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$160,034	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$165,197	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$168,638	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$170,789	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$172,080	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$172,080	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$172,080	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$172,080	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 416 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 417 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 418 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$23,485

Present Value: \$324,107

Annual: \$0

Present Value: \$0

Annual: \$23,485

Present Value: \$324,107

Mitigation Benefits: \$324,107

Benefits Minus Costs: \$251,979

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 4.49

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 419 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 420 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900020008, 17110 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$329,643

Costs: \$72,128

BCR: 4.57

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,915

BRV (\$/sf): \$150.00

Total BRV: \$437,250

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.27

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$437,250  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.73

Utilities that are not elevated: No

Height FFE Above Grade: 150.27

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 421 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.60	485.0	149.28	475.3
50	2.00%	149.90	1,025.0	149.66	1,004.5
100	1.00%	150.00	1,381.0	149.84	1,353.4
500	0.20%	150.30	2,590.0	150.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 422 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,931	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$58,592	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$101,879	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$140,357	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$175,337	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$205,945	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$437,250	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$437,250	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$437,250	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$437,250	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$437,250	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$437,250	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$437,250	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$437,250	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$437,250	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$437,250	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$437,250	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$437,250	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,494	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$35,417	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$58,154	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$78,268	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$96,195	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$112,373	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$125,928	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$137,734	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$147,791	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$156,098	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$162,657	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$167,904	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$171,402	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$173,588	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$174,900	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$174,900	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$174,900	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$174,900	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 426 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 427 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$22,899
Present Value:	\$316,021

Annual:	\$0
Present Value:	\$0

Annual:	\$22,899
Present Value:	\$316,021

Mitigation Benefits: \$316,021

Mitigation Costs: \$72,128

Benefits Minus Costs: \$243,893

Benefit-Cost Ratio: 4.38

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 428 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 429 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900020009, 17106 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$192,299

Costs: \$72,128

BCR: 2.67

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,158

BRV (\$/sf): \$150.00

Total BRV: \$473,700

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.57

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$473,700  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.73

Utilities that are not elevated: No

Height FFE Above Grade: 150.57

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 430 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.60	485.0	149.28	475.3
50	2.00%	149.90	1,025.0	149.66	1,004.5
100	1.00%	150.00	1,381.0	149.84	1,353.4
500	0.20%	150.30	2,590.0	150.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 431 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$11,843	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$63,476	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$110,372	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$152,058	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$189,954	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$223,113	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$473,700	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$473,700	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$473,700	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$473,700	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$473,700	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$473,700	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$473,700	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$473,700	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$473,700	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$473,700	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$473,700	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$473,700	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 432 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$11,369	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$38,370	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$63,002	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$84,792	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$104,214	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$121,741	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$136,426	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$149,216	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$160,111	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$169,111	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$176,216	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$181,901	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$185,690	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$188,059	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$189,480	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$189,480	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$189,480	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$189,480	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 433 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 434 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 435 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 436 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$12,947
Present Value:	\$178,677

Annual:	\$0
Present Value:	\$0

Annual:	\$12,947
Present Value:	\$178,677

Mitigation Benefits: \$178,677

Mitigation Costs: \$72,128

Benefits Minus Costs: \$106,549

Benefit-Cost Ratio: 2.48

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 437 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 438 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336900020010, 17102 LUMBERTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$278,011

Costs: \$72,128

BCR: 3.85

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,218

BRV (\$/sf): \$150.00

Total BRV: \$482,700

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.40

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$482,700  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -212.73

Utilities that are not elevated: No

Height FFE Above Grade: 150.40

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 439 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2

Number of Worker: 1

Treatment Costs per person: \$2,443.00

Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00

Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.60	485.0	149.28	475.3
50	2.00%	149.90	1,025.0	149.66	1,004.5
100	1.00%	150.00	1,381.0	149.84	1,353.4
500	0.20%	150.30	2,590.0	150.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 440 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,068	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$64,682	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$112,469	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$154,947	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$193,563	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$227,352	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$482,700	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$482,700	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$482,700	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$482,700	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$482,700	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$482,700	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$482,700	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$482,700	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$482,700	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$482,700	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$482,700	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$482,700	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 441 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$11,585	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$39,099	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$64,199	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$86,403	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$106,194	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$124,054	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$139,018	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$152,051	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$163,153	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$172,324	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$179,564	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$185,357	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$189,218	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$191,632	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$193,080	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$193,080	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$193,080	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$193,080	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 442 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 443 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 444 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

## Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

## Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 445 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$19,158
Present Value:	\$264,389

Annual:	\$0
Present Value:	\$0

Annual:	\$19,158
Present Value:	\$264,389

Mitigation Benefits: \$264,389

Mitigation Costs: \$72,128

Benefits Minus Costs: \$192,261

Benefit-Cost Ratio: 3.67

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 446 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 447 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010001, 18626 PRINCE RANCH DR, CYPRESS, Texas, 77433, Harris

Benefits: \$535,370

Costs: \$72,128

BCR: 7.42

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,165

BRV (\$/sf): \$150.00

Total BRV: \$324,750

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.34

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$324,750  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.34

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 448 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 449 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,119	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$43,517	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$75,667	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$104,245	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$130,225	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$152,957	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$324,750	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$324,750	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$324,750	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$324,750	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$324,750	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$324,750	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$324,750	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$324,750	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$324,750	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$324,750	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$324,750	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$324,750	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 450 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,794	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$26,305	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$43,192	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$58,130	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$71,445	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$83,461	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$93,528	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$102,296	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$109,766	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$115,936	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$120,807	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$124,704	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$127,302	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$128,926	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$129,900	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$129,900	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$129,900	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$129,900	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 451 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 452 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 453 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 454 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$37,806
Present Value:	\$521,748

Annual:	\$0
Present Value:	\$0

Annual:	\$37,806
Present Value:	\$521,748

Mitigation Benefits: \$521,748

Mitigation Costs: \$72,128

Benefits Minus Costs: \$449,620

Benefit-Cost Ratio: 7.23

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 455 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 456 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010002, 18622 PRINCE RANCH DR, CYPRESS, Texas, 77433, Harris

Benefits: \$568,715

Costs: \$72,128

BCR: 7.88

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,301

BRV (\$/sf): \$150.00

Total BRV: \$345,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.34

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$345,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.34

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 457 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 458 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,629	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$46,250	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$80,420	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$110,793	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$138,405	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$162,566	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$345,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$345,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$345,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$345,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$345,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$345,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$345,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$345,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$345,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$345,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$345,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$345,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 459 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$8,284	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$27,957	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$45,905	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$61,782	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$75,933	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$88,704	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$99,403	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$108,722	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$116,661	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$123,219	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$128,396	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$132,538	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$135,299	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$137,025	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$138,060	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$138,060	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$138,060	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$138,060	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 461 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 462 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 463 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$40,222
Present Value:	\$555,093

Annual:	\$0
Present Value:	\$0

Annual:	\$40,222
Present Value:	\$555,093

Mitigation Benefits: \$555,093

Mitigation Costs: \$72,128

Benefits Minus Costs: \$482,965

Benefit-Cost Ratio: 7.70

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 464 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 465 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010006, 18606 PRINCE RANCH DR, CYPRESS, Texas, 77433, Harris

Benefits: \$311,411

Costs: \$72,128

BCR: 4.32

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,567

BRV (\$/sf): \$150.00

Total BRV: \$385,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.89

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$385,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.89

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 466 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 467 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,626	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$51,597	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$89,717	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$123,601	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$154,405	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$181,359	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$385,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$385,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$385,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$385,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$385,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$385,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$385,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$385,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$385,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$385,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$385,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$385,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 468 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,241	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$31,189	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$51,212	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$68,924	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$84,711	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$98,958	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$110,894	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$121,291	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$130,147	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$137,463	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$143,239	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$147,859	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$150,940	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$152,865	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$154,020	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$154,020	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$154,020	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$154,020	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 469 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 470 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 472 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$21,578
Present Value:	\$297,789

Annual:	\$0
Present Value:	\$0

Annual:	\$21,578
Present Value:	\$297,789

Mitigation Benefits: \$297,789

Mitigation Costs: \$72,128

Benefits Minus Costs: \$225,661

Benefit-Cost Ratio: 4.13

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 473 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 474 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010008, 18603 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$670,404

Costs: \$72,128

BCR: 9.29

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,677

BRV (\$/sf): \$150.00

Total BRV: \$551,550

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.59

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$551,550  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.59

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 475 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,789	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$73,908	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$128,511	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$177,048	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$221,172	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$259,780	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$551,550	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$551,550	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$551,550	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$551,550	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$551,550	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$551,550	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$551,550	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$551,550	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$551,550	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$551,550	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$551,550	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$551,550	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,237	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$44,676	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$73,356	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$98,727	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$121,341	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$141,748	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$158,846	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$173,738	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$186,424	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$196,903	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$205,177	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$211,795	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$216,208	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$218,965	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$220,620	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$220,620	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$220,620	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$220,620	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 480 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$47,590
Present Value:	\$656,782

Annual:	\$0
Present Value:	\$0

Annual:	\$47,590
Present Value:	\$656,782

Mitigation Benefits: \$656,782

Mitigation Costs: \$72,128

Benefits Minus Costs: \$584,654

Benefit-Cost Ratio: 9.11

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 482 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010009, 18607 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$453,374

Costs: \$72,128

BCR: 6.29

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,214

BRV (\$/sf): \$150.00

Total BRV: \$332,100

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.51

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$332,100  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.51

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,303	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$44,501	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$77,379	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$106,604	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$133,172	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$156,419	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$332,100	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$332,100	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$332,100	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$332,100	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$332,100	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$332,100	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$332,100	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$332,100	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$332,100	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$332,100	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$332,100	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$332,100	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,970	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$26,900	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$44,169	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$59,446	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$73,062	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$85,350	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$95,645	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$104,612	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$112,250	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$118,560	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$123,541	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$127,526	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$130,183	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$131,844	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$132,840	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$132,840	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$132,840	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$132,840	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 489 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 490 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$31,864

Present Value: \$439,752

Annual: \$0

Present Value: \$0

Annual: \$31,864

Present Value: \$439,752

Mitigation Benefits: \$439,752

Mitigation Costs: \$72,128

Benefits Minus Costs: \$367,624

Benefit-Cost Ratio: 6.10

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 491 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
-------	-------------	-------------

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 492 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010010, 18611 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$464,192

Costs: \$72,128

BCR: 6.44

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,213

BRV (\$/sf): \$150.00

Total BRV: \$331,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.49

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$331,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.49

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 493 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 494 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,299	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$44,481	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$77,344	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$106,556	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$133,112	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$156,348	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$331,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$331,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$331,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$331,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$331,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$331,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$331,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$331,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$331,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$331,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$331,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$331,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 495 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,967	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$26,888	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$44,149	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$59,419	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$73,029	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$85,311	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$95,602	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$104,564	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$112,199	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$118,506	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$123,485	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$127,469	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$130,124	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$131,784	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$132,780	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$132,780	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$132,780	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$132,780	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 496 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 497 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 498 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 499 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$32,648
Present Value:	\$450,570

Annual:	\$0
Present Value:	\$0

Annual:	\$32,648
Present Value:	\$450,570

Mitigation Benefits: \$450,570

Mitigation Costs: \$72,128

Benefits Minus Costs: \$378,442

Benefit-Cost Ratio: 6.25

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 500 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 501 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010011, 18615 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$583,368

Costs: \$72,128

BCR: 8.09

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,424

BRV (\$/sf): \$150.00

Total BRV: \$363,600

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.36

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$363,600  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.86

Utilities that are not elevated: No

Height FFE Above Grade: 150.36

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 502 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.7

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.80	1,381.0	150.64	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 503 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,090	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$48,722	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$84,719	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$116,716	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$145,804	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$171,256	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$363,600	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$363,600	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$363,600	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$363,600	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$363,600	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$363,600	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$363,600	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$363,600	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$363,600	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$363,600	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$363,600	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$363,600	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 504 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$8,726	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$29,452	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$48,359	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$65,084	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$79,992	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$93,445	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$104,717	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$114,534	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$122,897	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$129,805	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$135,259	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$139,622	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$142,531	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$144,349	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$145,440	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$145,440	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$145,440	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$145,440	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 505 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 506 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 507 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 508 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$41,284
Present Value:	\$569,746

Annual:	\$0
Present Value:	\$0

Annual:	\$41,284
Present Value:	\$569,746

Mitigation Benefits: \$569,746

Mitigation Costs: \$72,128

Benefits Minus Costs: \$497,618

Benefit-Cost Ratio: 7.90

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 509 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 510 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010012, 18619 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$465,253

Costs: \$72,128

BCR: 6.45

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 1,775

BRV (\$/sf): \$150.00

Total BRV: \$266,250

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.28

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$266,250  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above Grade: 150.28

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 511 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.6

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	150.10	475.3
50	2.00%	150.60	1,025.0	150.44	1,004.5
100	1.00%	150.70	1,381.0	150.62	1,353.4
500	0.20%	151.10	2,590.0	151.06	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 512 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$6,656	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$35,678	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$62,036	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$85,466	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$106,766	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$125,404	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$266,250	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$266,250	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$266,250	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$266,250	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$266,250	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$266,250	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$266,250	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$266,250	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$266,250	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$266,250	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$266,250	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$266,250	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$6,390	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$21,566	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$35,411	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$47,659	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$58,575	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$68,426	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$76,680	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$83,869	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$89,993	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$95,051	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$99,045	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$102,240	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$104,370	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$105,701	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$106,500	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$106,500	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$106,500	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$106,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 514 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 515 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 516 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 517 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$32,725
Present Value:	\$451,631

Annual:	\$0
Present Value:	\$0

Annual:	\$32,725
Present Value:	\$451,631

Mitigation Benefits: \$451,631

Mitigation Costs: \$72,128

Benefits Minus Costs: \$379,503

Benefit-Cost Ratio: 6.26

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 518 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 519 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010013, 18623 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$731,701

Costs: \$72,128

BCR: 10.14

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,847

BRV (\$/sf): \$150.00

Total BRV: \$427,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.29

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$427,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above Grade: 150.29

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 520 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.6

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.70	1,381.0	150.54	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 521 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,676	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$57,225	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$99,503	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$137,083	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$171,247	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$201,141	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$427,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$427,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$427,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$427,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$427,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$427,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$427,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$427,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$427,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$427,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$427,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$427,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 522 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,249	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$34,591	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$56,798	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$76,442	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$93,951	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$109,752	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$122,990	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$134,521	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$144,343	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$152,457	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$158,863	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$163,987	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$167,404	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$169,539	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$170,820	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$170,820	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$170,820	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$170,820	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 524 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 525 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 526 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$52,032
Present Value:	\$718,079

Annual:	\$0
Present Value:	\$0

Annual:	\$52,032
Present Value:	\$718,079

Mitigation Benefits: \$718,079

Mitigation Costs: \$72,128

Benefits Minus Costs: \$645,951

Benefit-Cost Ratio: 9.96

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 527 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
-------	-------------	-------------

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 528 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910010014, 18627 GARLINGTON DR, CYPRESS, Texas, 77433, Harris

Benefits: \$782,540

Costs: \$72,128

BCR: 10.85

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,133

BRV (\$/sf): \$150.00

Total BRV: \$469,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.32

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$469,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above Grade: 150.32

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 529 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.6

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.70	1,381.0	150.54	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 530 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$11,749	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$62,973	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$109,498	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$150,854	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$188,450	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$221,346	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$469,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$469,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$469,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$469,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$469,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$469,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$469,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$469,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$469,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$469,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$469,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$469,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 531 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$11,279	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$38,066	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$62,503	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$84,121	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$103,389	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$120,777	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$135,346	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$148,034	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$158,843	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$167,772	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$174,821	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$180,461	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$184,220	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$186,570	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$187,980	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$187,980	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$187,980	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$187,980	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 532 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 533 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 534 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 535 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$55,716
Present Value:	\$768,918

Annual:	\$0
Present Value:	\$0

Annual:	\$55,716
Present Value:	\$768,918

Mitigation Benefits: \$768,918

Mitigation Costs: \$72,128

Benefits Minus Costs: \$696,790

Benefit-Cost Ratio: 10.66

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 536 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 537 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020002, 16707 BLOOMING PLUM DR, CYPRESS, Texas, 77433, Harris

Benefits: \$354,749

Costs: \$72,128

BCR: 4.92

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,157

BRV (\$/sf): \$150.00

Total BRV: \$323,550

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.67

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$323,550  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above Grade: 150.67

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 538 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2

Number of Worker: 1

Treatment Costs per person: \$2,443.00

Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00

Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.6

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.70	1,381.0	150.54	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 539 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,089	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$43,356	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$75,387	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$103,860	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$129,744	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$152,392	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$323,550	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$323,550	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$323,550	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$323,550	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$323,550	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$323,550	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$323,550	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$323,550	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$323,550	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$323,550	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$323,550	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$323,550	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,765	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$26,208	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$43,032	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$57,915	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$71,181	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$83,152	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$93,182	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$101,918	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$109,360	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$115,507	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$120,361	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$124,243	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$126,832	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$128,449	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$129,420	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$129,420	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$129,420	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$129,420	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 543 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Environmental Benefits**

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

**Other Benefits**

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 544 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$24,718
Present Value:	\$341,127

Annual:	\$0
Present Value:	\$0

Annual:	\$24,718
Present Value:	\$341,127

Mitigation Benefits: \$341,127

Mitigation Costs: \$72,128

Benefits Minus Costs: \$268,999

Benefit-Cost Ratio: 4.73

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 545 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 546 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020003, 16711 BLOOMING PLUM DR, CYPRESS, Texas, 77433, Harris

Benefits: \$487,905

Costs: \$72,128

BCR: 6.76

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,367

BRV (\$/sf): \$150.00

Total BRV: \$355,050

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.50

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$355,050  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above Grade: 150.50

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 547 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.6

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.70	1,381.0	150.54	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 548 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$8,876	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$47,577	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$82,727	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$113,971	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$142,375	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$167,229	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$355,050	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$355,050	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$355,050	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$355,050	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$355,050	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$355,050	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$355,050	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$355,050	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$355,050	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$355,050	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$355,050	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$355,050	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 549 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$8,521	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$28,759	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$47,222	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$63,554	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$78,111	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$91,248	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$102,254	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$111,841	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$120,007	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$126,753	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$132,079	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$136,339	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$139,180	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$140,955	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$142,020	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$142,020	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$142,020	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$142,020	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 550 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 551 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 552 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 553 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$34,366
Present Value:	\$474,283

Annual:	\$0
Present Value:	\$0

Annual:	\$34,366
Present Value:	\$474,283

Mitigation Benefits: \$474,283

Mitigation Costs: \$72,128

Benefits Minus Costs: \$402,155

Benefit-Cost Ratio: 6.58

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 554 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 555 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020006, 16727 BLOOMING PLUM DR, CYPRESS, Texas, 77433, Harris

Benefits: \$208,089

Costs: \$72,128

BCR: 2.89

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,770

BRV (\$/sf): \$150.00

Total BRV: \$415,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.84

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$415,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.84

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 556 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 557 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,388	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$55,677	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$96,812	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$133,376	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$166,616	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$195,701	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$415,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$415,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$415,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$415,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$415,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$415,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$415,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$415,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$415,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$415,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$415,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$415,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,972	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$33,656	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$55,262	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$74,375	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$91,410	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$106,784	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$119,664	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$130,883	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$140,439	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$148,334	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$154,566	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$159,552	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$162,876	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$164,954	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$166,200	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$166,200	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$166,200	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$166,200	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 559 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 560 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 561 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 562 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$14,091
Present Value:	\$194,467

Annual:	\$0
Present Value:	\$0

Annual:	\$14,091
Present Value:	\$194,467

Mitigation Benefits: \$194,467

Mitigation Costs: \$72,128

Benefits Minus Costs: \$122,339

Benefit-Cost Ratio: 2.70

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 563 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 564 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020009, 18611 NAVARRO BRANCH DR, CYPRESS, Texas, 77433, Harris

Benefits: \$175,949

Costs: \$72,128

BCR: 2.44

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,950

BRV (\$/sf): \$150.00

Total BRV: \$442,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.72

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$442,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 150.72

One Time Displacement Costs: \$0

Grade:

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 565 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.80	485.0	149.48	475.3
50	2.00%	150.10	1,025.0	149.86	1,004.5
100	1.00%	150.30	1,381.0	150.14	1,353.4
500	0.20%	150.60	2,590.0	150.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 566 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$11,063	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$59,295	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$103,103	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$142,043	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$177,443	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$208,418	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$442,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$442,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$442,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$442,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$442,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$442,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$442,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$442,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$442,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$442,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$442,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$442,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 567 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,620	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$35,843	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$58,853	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$79,208	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$97,350	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$113,723	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$127,440	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$139,388	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$149,565	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$157,973	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$164,610	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$169,920	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$173,460	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$175,673	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$177,000	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$177,000	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$177,000	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$177,000	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 569 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 570 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 571 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$11,762
Present Value:	\$162,327

Annual:	\$0
Present Value:	\$0

Annual:	\$11,762
Present Value:	\$162,327

Mitigation Benefits: \$162,327

Mitigation Costs: \$72,128

Benefits Minus Costs: \$90,199

Benefit-Cost Ratio: 2.25

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 573 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020010, 18615 NAVARRO BRANCH DR, CYPRESS, Texas, 77433, Harris

Benefits: \$281,131

Costs: \$72,128

BCR: 3.90

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,641

BRV (\$/sf): \$150.00

Total BRV: \$396,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.47

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$396,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 150.47

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 574 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.80	485.0	149.48	475.3
50	2.00%	150.10	1,025.0	149.86	1,004.5
100	1.00%	150.30	1,381.0	150.14	1,353.4
500	0.20%	150.60	2,590.0	150.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 575 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,904	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$53,084	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$92,303	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$127,164	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$158,856	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$186,587	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$396,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$396,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$396,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$396,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$396,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$396,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$396,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$396,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$396,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$396,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$396,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$396,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 576 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,508	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$32,088	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$52,688	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$70,911	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$87,153	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$101,811	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$114,091	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$124,787	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$133,899	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$141,426	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$147,368	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$152,122	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$155,291	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$157,272	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$158,460	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$158,460	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$158,460	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$158,460	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 577 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 578 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 579 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 580 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$19,384

Present Value: \$267,509

Annual: \$0

Present Value: \$0

Annual: \$19,384

Present Value: \$267,509

Mitigation Benefits: \$267,509

Benefits Minus Costs: \$195,381

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 3.71

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 581 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 582 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020011, 18619 NAVARRO BRANCH DR, CYPRESS, Texas, 77433, Harris

Benefits: \$187,060

Costs: \$72,128

BCR: 2.59

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,231

BRV (\$/sf): \$150.00

Total BRV: \$484,650

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.49

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$484,650  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 150.49

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.80	485.0	149.48	475.3
50	2.00%	150.10	1,025.0	149.86	1,004.5
100	1.00%	150.30	1,381.0	150.14	1,353.4
500	0.20%	150.60	2,590.0	150.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,116	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$64,943	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$112,923	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$155,573	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$194,345	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$228,270	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$484,650	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$484,650	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$484,650	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$484,650	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$484,650	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$484,650	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$484,650	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$484,650	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$484,650	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$484,650	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$484,650	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$484,650	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$11,632	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$39,257	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$64,458	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$86,752	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$106,623	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$124,555	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$139,579	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$152,665	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$163,812	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$173,020	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$180,290	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$186,106	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$189,983	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$192,406	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$193,860	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$193,860	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$193,860	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$193,860	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 587 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 588 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$12,567
Present Value:	\$173,438

Annual:	\$0
Present Value:	\$0

Annual:	\$12,567
Present Value:	\$173,438

Mitigation Benefits: \$173,438

Mitigation Costs: \$72,128

Benefits Minus Costs: \$101,310

Benefit-Cost Ratio: 2.40

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 590 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020012, 16734 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$488,434

Costs: \$72,128

BCR: 6.77

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,435

BRV (\$/sf): \$150.00

Total BRV: \$515,250

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.50

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$515,250  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.50

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.40	1,381.0	150.24	1,353.4
500	0.20%	150.70	2,590.0	150.62	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 593 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,881	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$69,044	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$120,053	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$165,395	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$206,615	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$242,683	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$515,250	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$515,250	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$515,250	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$515,250	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$515,250	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$515,250	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$515,250	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$515,250	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$515,250	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$515,250	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$515,250	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$515,250	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,366	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$41,735	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$68,528	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$92,230	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$113,355	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$132,419	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$148,392	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$162,304	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$174,155	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$183,944	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$191,673	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$197,856	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$201,978	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$204,554	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$206,100	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$206,100	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$206,100	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$206,100	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 597 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 598 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$34,405
Present Value:	\$474,812

Annual:	\$0
Present Value:	\$0

Annual:	\$34,405
Present Value:	\$474,812

Mitigation Benefits: \$474,812

Mitigation Costs: \$72,128

Benefits Minus Costs: \$402,684

Benefit-Cost Ratio: 6.58

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 599 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 600 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020014, 16726 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$338,974

Costs: \$72,128

BCR: 4.70

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,572

BRV (\$/sf): \$150.00

Total BRV: \$385,800

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.51

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$385,800  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.51

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 601 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 602 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,645	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$51,697	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$89,891	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$123,842	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$154,706	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$181,712	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$385,800	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$385,800	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$385,800	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$385,800	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$385,800	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$385,800	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$385,800	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$385,800	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$385,800	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$385,800	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$385,800	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$385,800	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,259	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$31,250	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$51,311	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$69,058	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$84,876	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$99,151	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$111,110	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$121,527	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$130,400	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$137,731	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$143,518	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$148,147	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$151,234	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$153,163	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$154,320	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$154,320	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$154,320	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$154,320	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 604 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 605 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 606 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 607 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$23,575
Present Value:	\$325,352

Annual:	\$0
Present Value:	\$0

Annual:	\$23,575
Present Value:	\$325,352

Mitigation Benefits: \$325,352

Mitigation Costs: \$72,128

Benefits Minus Costs: \$253,224

Benefit-Cost Ratio: 4.51

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 608 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 609 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020016, 18614 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Benefits: \$325,527

Costs: \$72,128

BCR: 4.51

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,469

BRV (\$/sf): \$150.00

Total BRV: \$370,350

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.52

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$370,350  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.52

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 610 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2

Number of Worker: 1

Treatment Costs per person: \$2,443.00

Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00

Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 611 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,259	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$49,627	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$86,292	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$118,882	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$148,510	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$174,435	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$370,350	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$370,350	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$370,350	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$370,350	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$370,350	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$370,350	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$370,350	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$370,350	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$370,350	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$370,350	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$370,350	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$370,350	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 612 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$8,888	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$29,998	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$49,257	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$66,293	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$81,477	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$95,180	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$106,661	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$116,660	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$125,178	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$132,215	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$137,770	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$142,214	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$145,177	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$147,029	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$148,140	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$148,140	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$148,140	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$148,140	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 613 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 614 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 615 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 616 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$22,601

Present Value: \$311,905

Annual: \$0

Present Value: \$0

Annual: \$22,601

Present Value: \$311,905

Mitigation Benefits: \$311,905

Benefits Minus Costs: \$239,777

Mitigation Costs: \$72,128

Benefit-Cost Ratio: 4.32

### Cost Estimate

Project Useful Life (years): 50

Mitigation Project Cost: \$72,128

Annual Project Maintenance Cost: \$0

Final Mitigation Project Cost: \$72,128

Cost Basis Year:

Construction Start Year:

Construction End Year:

Construction Type:

Detailed Scope of Work: Yes

Detailed Estimate for Entire Project: Yes

Years of Maintenance:

Present Worth of Annual Maintenance Costs:

Estimate Reflects Current Prices: No

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 617 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 618 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020017, 18610 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Benefits: \$358,117

Costs: \$72,128

BCR: 4.97

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,538

BRV (\$/sf): \$150.00

Total BRV: \$380,700

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.46

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$380,700  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.46

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 619 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 620 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,518	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$51,014	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$88,703	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$122,205	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$152,661	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$179,310	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$380,700	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$380,700	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$380,700	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$380,700	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$380,700	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$380,700	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$380,700	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$380,700	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$380,700	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$380,700	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$380,700	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$380,700	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,137	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$30,837	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$50,633	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$68,145	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$83,754	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$97,840	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$109,642	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$119,921	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$128,677	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$135,910	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$141,620	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$146,189	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$149,234	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$151,138	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$152,280	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$152,280	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$152,280	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$152,280	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 622 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 623 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 624 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 625 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$24,962
Present Value:	\$344,495

Annual:	\$0
Present Value:	\$0

Annual:	\$24,962
Present Value:	\$344,495

Mitigation Benefits: \$344,495

Mitigation Costs: \$72,128

Benefits Minus Costs: \$272,367

Benefit-Cost Ratio: 4.78

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 626 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 627 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020018, 18606 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Benefits: \$341,181

Costs: \$72,128

BCR: 4.73

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,562

BRV (\$/sf): \$150.00

Total BRV: \$384,300

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.51

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$384,300  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.51

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 628 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 629 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,608	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$51,496	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$89,542	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$123,360	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$154,104	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$181,005	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$384,300	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$384,300	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$384,300	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$384,300	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$384,300	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$384,300	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$384,300	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$384,300	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$384,300	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$384,300	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$384,300	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$384,300	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 630 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,223	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$31,128	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$51,112	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$68,790	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$84,546	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$98,765	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$110,678	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$121,055	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$129,893	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$137,195	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$142,960	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$147,571	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$150,646	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$152,567	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$153,720	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$153,720	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$153,720	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$153,720	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 632 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 633 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 634 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$23,735
Present Value:	\$327,559

Annual:	\$0
Present Value:	\$0

Annual:	\$23,735
Present Value:	\$327,559

Mitigation Benefits: \$327,559

Mitigation Costs: \$72,128

Benefits Minus Costs: \$255,431

Benefit-Cost Ratio: 4.54

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 636 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020021, 18607 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Benefits: \$379,353

Costs: \$72,128

BCR: 5.26

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,853

BRV (\$/sf): \$150.00

Total BRV: \$427,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.50

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$427,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.50

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,699	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$57,345	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$99,712	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$137,372	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$171,608	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$201,564	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$427,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$427,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$427,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$427,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$427,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$427,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$427,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$427,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$427,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$427,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$427,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$427,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,271	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$34,664	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$56,917	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$76,603	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$94,149	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$109,983	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$123,250	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$134,804	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$144,647	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$152,778	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$159,197	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$164,333	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$167,756	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$169,896	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$171,180	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$171,180	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$171,180	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$171,180	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 640 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 641 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 643 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$26,501
Present Value:	\$365,731

Annual:	\$0
Present Value:	\$0

Annual:	\$26,501
Present Value:	\$365,731

Mitigation Benefits: \$365,731

Mitigation Costs: \$72,128

Benefits Minus Costs: \$293,603

Benefit-Cost Ratio: 5.07

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 644 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 645 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020022, 18611 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Benefits: \$384,287

Costs: \$72,128

BCR: 5.33

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,903

BRV (\$/sf): \$150.00

Total BRV: \$435,450

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.51

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$435,450  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.51

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 646 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,886	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$58,350	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$101,460	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$139,779	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$174,615	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$205,097	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$435,450	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$435,450	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$435,450	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$435,450	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$435,450	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$435,450	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$435,450	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$435,450	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$435,450	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$435,450	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$435,450	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$435,450	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,451	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$35,271	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$57,915	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$77,946	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$95,799	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$111,911	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$125,410	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$137,167	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$147,182	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$155,456	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$161,987	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$167,213	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$170,696	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$172,874	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$174,180	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$174,180	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$174,180	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$174,180	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 649 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$26,858
Present Value:	\$370,665

Annual:	\$0
Present Value:	\$0

Annual:	\$26,858
Present Value:	\$370,665

Mitigation Benefits: \$370,665

Mitigation Costs: \$72,128

Benefits Minus Costs: \$298,537

Benefit-Cost Ratio: 5.14

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 653 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020023, 18615 EMHOUSE LN, CYPRESS, Texas, 77433, Harris

Benefits: \$494,710

Costs: \$72,128

BCR: 6.86

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,621

BRV (\$/sf): \$150.00

Total BRV: \$543,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.48

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$543,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.48

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 655 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 656 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$13,579	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$72,782	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$126,554	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$174,351	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$217,803	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$255,824	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$543,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$543,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$543,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$543,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$543,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$543,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$543,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$543,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$543,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$543,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$543,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$543,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,036	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$43,995	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$72,239	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$97,224	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$119,493	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$139,590	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$156,427	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$171,092	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$183,585	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$193,905	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$202,052	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$208,570	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$212,915	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$215,631	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$217,260	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$217,260	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$217,260	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$217,260	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 661 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$34,860
Present Value:	\$481,088

Annual:	\$0
Present Value:	\$0

Annual:	\$34,860
Present Value:	\$481,088

Mitigation Benefits: \$481,088

Mitigation Costs: \$72,128

Benefits Minus Costs: \$408,960

Benefit-Cost Ratio: 6.67

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 662 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 663 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020026, 16706 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$358,120

Costs: \$72,128

BCR: 4.97

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,714

BRV (\$/sf): \$150.00

Total BRV: \$407,100

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.51

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$407,100  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.51

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 664 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 665 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,178	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$54,551	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$94,854	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$130,679	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$163,247	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$191,744	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$407,100	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$407,100	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$407,100	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$407,100	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$407,100	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$407,100	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$407,100	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$407,100	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$407,100	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$407,100	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$407,100	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$407,100	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,770	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$32,975	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$54,144	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$72,871	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$89,562	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$104,625	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$117,245	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$128,237	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$137,600	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$145,335	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$151,441	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$156,326	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$159,583	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$161,619	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$162,840	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$162,840	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$162,840	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$162,840	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 667 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 670 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$24,962
Present Value:	\$344,498

Annual:	\$0
Present Value:	\$0

Annual:	\$24,962
Present Value:	\$344,498

Mitigation Benefits: \$344,498

Mitigation Costs: \$72,128

Benefits Minus Costs: \$272,370

Benefit-Cost Ratio: 4.78

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 672 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336910020027, 16702 BLACKLAND PRAIRIE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$602,436

Costs: \$72,128

BCR: 8.35

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,899

BRV (\$/sf): \$150.00

Total BRV: \$434,850

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.49

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$434,850  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.72

Utilities that are not elevated: No

Height FFE Above Grade: 150.49

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.6

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.30	485.0	149.98	475.3
50	2.00%	150.60	1,025.0	150.36	1,004.5
100	1.00%	150.70	1,381.0	150.54	1,353.4
500	0.20%	151.10	2,590.0	151.02	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,871	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$58,270	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$101,320	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$139,587	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$174,375	0.0%	0.0%	\$0
4.0	47.1%	0.0%		0.0%	0.0%	
5.0	53.2%	0.0%		0.0%	0.0%	
6.0	58.6%	0.0%		0.0%	0.0%	
7.0	63.2%	0.0%		0.0%	0.0%	
8.0	67.2%	0.0%		0.0%	0.0%	
9.0	70.5%	0.0%		0.0%	0.0%	
10.0	73.2%	0.0%		0.0%	0.0%	
11.0	75.4%	0.0%		0.0%	0.0%	
12.0	77.2%	0.0%		0.0%	0.0%	
13.0	78.5%	0.0%	\$434,850	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$434,850	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$434,850	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$434,850	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,436	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$35,223	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$57,835	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$77,838	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$95,667	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$111,756	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$125,237	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$136,978	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$146,979	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$155,241	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$161,764	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$166,982	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$170,461	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$172,635	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$173,940	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$173,940	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$173,940	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$173,940	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 676 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 677 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 678 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 679 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$42,665
Present Value:	\$588,814

Annual:	\$0
Present Value:	\$0

Annual:	\$42,665
Present Value:	\$588,814

Mitigation Benefits: \$588,814

Mitigation Costs: \$72,128

Benefits Minus Costs: \$516,686

Benefit-Cost Ratio: 8.16

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 680 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 681 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336920030003, 16730 SYCAMORE BEND DR, CYPRESS, Texas, 77433, Harris

Benefits: \$158,479

Costs: \$72,128

BCR: 2.20

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 1,833

BRV (\$/sf): \$150.00

Total BRV: \$274,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.82

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$274,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.82

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 682 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.40	1,381.0	150.24	1,353.4
500	0.20%	150.70	2,590.0	150.62	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$6,874	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$36,843	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$64,063	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$88,259	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$110,255	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$129,501	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$274,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$274,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$274,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$274,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$274,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$274,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$274,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$274,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$274,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$274,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$274,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$274,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 684 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$6,599	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$22,271	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$36,568	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$49,216	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$60,489	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$70,662	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$79,186	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$86,609	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$92,933	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$98,157	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$102,281	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$105,581	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$107,780	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$109,155	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$109,980	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$109,980	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$109,980	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$109,980	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 685 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 686 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 687 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 688 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual: \$10,496

Present Value: \$144,857

Annual: \$0

Present Value: \$0

Annual: \$10,496

Present Value: \$144,857

Mitigation Benefits: \$144,857

Mitigation Costs: \$72,128

Benefits Minus Costs: \$72,729

Benefit-Cost Ratio: 2.01

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 689 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 690 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336920030004, 16734 SYCAMORE BEND DR, CYPRESS, Texas, 77433, Harris

Benefits: \$197,426

Costs: \$72,128

BCR: 2.74

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 1,970

BRV (\$/sf): \$150.00

Total BRV: \$295,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.72

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$295,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.29

Utilities that are not elevated: No

Height FFE Above Grade: 150.72

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 691 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.0

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.20	1,025.0	149.96	1,004.5
100	1.00%	150.40	1,381.0	150.24	1,353.4
500	0.20%	150.70	2,590.0	150.62	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$7,388	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$39,597	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$68,852	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$94,856	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$118,496	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$139,181	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$295,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$295,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$295,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$295,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$295,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$295,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$295,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$295,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$295,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$295,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$295,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$295,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,092	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$23,936	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$39,302	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$52,895	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$65,010	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$75,944	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$85,104	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$93,083	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$99,879	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$105,494	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$109,926	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$113,472	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$115,836	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$117,314	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$118,200	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$118,200	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$118,200	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$118,200	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 695 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 696 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$13,318
Present Value:	\$183,804

Annual:	\$0
Present Value:	\$0

Annual:	\$13,318
Present Value:	\$183,804

Mitigation Benefits: \$183,804

Mitigation Costs: \$72,128

Benefits Minus Costs: \$111,676

Benefit-Cost Ratio: 2.55

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1336920030006, 16742 SYCAMORE BEND DR, CYPRESS, Texas, 77433, Harris

Benefits: \$223,925

Costs: \$72,128

BCR: 3.10

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,011

BRV (\$/sf): \$150.00

Total BRV: \$301,650

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.45

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$301,650  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.15

Utilities that are not elevated: No

Height FFE Above Grade: 150.45

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 700 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.8

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	149.80	485.0	149.48	475.3
50	2.00%	150.10	1,025.0	149.86	1,004.5
100	1.00%	150.30	1,381.0	150.14	1,353.4
500	0.20%	150.60	2,590.0	150.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 701 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$7,541	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$40,421	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$70,284	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$96,830	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$120,962	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$142,077	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$301,650	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$301,650	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$301,650	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$301,650	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$301,650	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$301,650	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$301,650	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$301,650	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$301,650	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$301,650	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$301,650	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$301,650	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 702 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$7,240	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$24,434	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$40,119	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$53,995	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$66,363	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$77,524	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$86,875	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$95,020	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$101,958	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$107,689	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$112,214	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$115,834	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$118,247	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$119,755	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$120,660	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$120,660	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$120,660	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$120,660	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 704 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 705 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$15,239
Present Value:	\$210,303

Annual:	\$0
Present Value:	\$0

Annual:	\$15,239
Present Value:	\$210,303

Mitigation Benefits: \$210,303

Mitigation Costs: \$72,128

Benefits Minus Costs: \$138,175

Benefit-Cost Ratio: 2.92

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 707 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 708 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357530050006, 16522 MOUNT HOPE DR, CYPRESS, Texas, 77433, Harris

Benefits: \$475,268

Costs: \$72,128

BCR: 6.59

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,915

BRV (\$/sf): \$150.00

Total BRV: \$587,250

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.41

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$587,250  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.71

Utilities that are not elevated: No

Height FFE Above Grade: 151.41

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 709 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 146.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.90	485.0	150.58	475.3
50	2.00%	151.30	1,025.0	151.06	1,004.5
100	1.00%	151.40	1,381.0	151.24	1,353.4
500	0.20%	151.90	2,590.0	151.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 710 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,681	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$78,692	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$136,829	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$188,507	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$235,487	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$276,595	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$587,250	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$587,250	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$587,250	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$587,250	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$587,250	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$587,250	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$587,250	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$587,250	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$587,250	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$587,250	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$587,250	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$587,250	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 711 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,094	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$47,567	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$78,104	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$105,118	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$129,195	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$150,923	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$169,128	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$184,984	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$198,491	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$209,648	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$218,457	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$225,504	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$230,202	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$233,138	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$234,900	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$234,900	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$234,900	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$234,900	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 712 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 714 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 715 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$33,451
Present Value:	\$461,646

Annual:	\$0
Present Value:	\$0

Annual:	\$33,451
Present Value:	\$461,646

Mitigation Benefits: \$461,646

Mitigation Costs: \$72,128

Benefits Minus Costs: \$389,518

Benefit-Cost Ratio: 6.40

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 716 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 717 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357530050013, 16606 EMMAUS LN, CYPRESS, Texas, 77433, Harris

Benefits: \$307,748

Costs: \$72,128

BCR: 4.27

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,550

BRV (\$/sf): \$150.00

Total BRV: \$382,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.23

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$382,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.43

Utilities that are not elevated: No

Height FFE Above Grade: 151.23

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 718 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.70	485.0	150.38	475.3
50	2.00%	151.00	1,025.0	150.76	1,004.5
100	1.00%	151.20	1,381.0	151.04	1,353.4
500	0.20%	151.60	2,590.0	151.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 719 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,563	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$51,255	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$89,123	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$122,783	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$153,383	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$180,158	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$382,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$382,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$382,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$382,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$382,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$382,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$382,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$382,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$382,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$382,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$382,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$382,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 720 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,180	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$30,983	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$50,873	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$68,468	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$84,150	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$98,303	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$110,160	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$120,488	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$129,285	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$136,553	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$142,290	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$146,880	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$149,940	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$151,853	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$153,000	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$153,000	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$153,000	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$153,000	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 721 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 722 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 723 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 724 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$21,312
Present Value:	\$294,126

Annual:	\$0
Present Value:	\$0

Annual:	\$21,312
Present Value:	\$294,126

Mitigation Benefits: \$294,126

Mitigation Costs: \$72,128

Benefits Minus Costs: \$221,998

Benefit-Cost Ratio: 4.08

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 725 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 726 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540020026, 18902 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Benefits: \$188,935

Costs: \$72,128

BCR: 2.62

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,361

BRV (\$/sf): \$150.00

Total BRV: \$504,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.96

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$504,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.96

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 727 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.40	1,025.0	150.16	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.90	2,590.0	150.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 728 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,604	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$67,556	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$117,467	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$161,832	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$202,164	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$237,455	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$504,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$504,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$504,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$504,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$504,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$504,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$504,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$504,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$504,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$504,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$504,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$504,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 729 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$12,100	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$40,836	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$67,052	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$90,243	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$110,913	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$129,567	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$145,195	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$158,807	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$170,403	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$179,982	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$187,544	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$193,594	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$197,627	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$200,148	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$201,660	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$201,660	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$201,660	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$201,660	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 730 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 731 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 732 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 733 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$12,703
Present Value:	\$175,313

Annual:	\$0
Present Value:	\$0

Annual:	\$12,703
Present Value:	\$175,313

Mitigation Benefits: \$175,313

Mitigation Costs: \$72,128

Benefits Minus Costs: \$103,185

Benefit-Cost Ratio: 2.43

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 734 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 735 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540020027, 18822 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Benefits: \$139,226

Costs: \$72,128

BCR: 1.93

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,809

BRV (\$/sf): \$150.00

Total BRV: \$421,350

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.03

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$421,350  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 151.03

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 736 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.40	1,025.0	150.16	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.90	2,590.0	150.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 737 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,534	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$56,461	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$98,175	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$135,253	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$168,961	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$198,456	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$421,350	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$421,350	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$421,350	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$421,350	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$421,350	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$421,350	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$421,350	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$421,350	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$421,350	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$421,350	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$421,350	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$421,350	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 738 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,112	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$34,129	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$56,040	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$75,422	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$92,697	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$108,287	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$121,349	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$132,725	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$142,416	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$150,422	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$156,742	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$161,798	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$165,169	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$167,276	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$168,540	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$168,540	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$168,540	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$168,540	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 739 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 740 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 742 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$9,101
Present Value:	\$125,604

Annual:	\$0
Present Value:	\$0

Annual:	\$9,101
Present Value:	\$125,604

Mitigation Benefits: \$125,604

Mitigation Costs: \$72,128

Benefits Minus Costs: \$53,476

Benefit-Cost Ratio: 1.74

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 744 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540020028, 18818 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Benefits: \$138,952

Costs: \$72,128

BCR: 1.93

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,592

BRV (\$/sf): \$150.00

Total BRV: \$388,800

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.99

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$388,800  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.99

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 745 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.40	1,025.0	150.16	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.90	2,590.0	150.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,720	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$52,099	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$90,590	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$124,805	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$155,909	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$183,125	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$388,800	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$388,800	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$388,800	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$388,800	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$388,800	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$388,800	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$388,800	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$388,800	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$388,800	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$388,800	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$388,800	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$388,800	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 747 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,331	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$31,493	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$51,710	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$69,595	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$85,536	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$99,922	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$111,974	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$122,472	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$131,414	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$138,802	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$144,634	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$149,299	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$152,410	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$154,354	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$155,520	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$155,520	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$155,520	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$155,520	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 748 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 749 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 750 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 751 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$9,081
Present Value:	\$125,330

Annual:	\$0
Present Value:	\$0

Annual:	\$9,081
Present Value:	\$125,330

Mitigation Benefits: \$125,330

Mitigation Costs: \$72,128

Benefits Minus Costs: \$53,202

Benefit-Cost Ratio: 1.74

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 753 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540020029, 18814 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Benefits: \$131,509

Costs: \$72,128

BCR: 1.82

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,610

BRV (\$/sf): \$150.00

Total BRV: \$391,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.03

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$391,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 151.03

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 754 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2

Number of Worker: 1

Treatment Costs per person: \$2,443.00

Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00

Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.40	1,025.0	150.16	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.90	2,590.0	150.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$9,788	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$52,461	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$91,220	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$125,672	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$156,992	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$184,397	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$391,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$391,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$391,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$391,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$391,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$391,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$391,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$391,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$391,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$391,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$391,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$391,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$9,396	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$31,712	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$52,070	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$70,079	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$86,130	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$100,616	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$112,752	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$123,323	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$132,327	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$139,766	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$145,638	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$150,336	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$153,468	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$155,426	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$156,600	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$156,600	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$156,600	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$156,600	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 760 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$8,542
Present Value:	\$117,887

Annual:	\$0
Present Value:	\$0

Annual:	\$8,542
Present Value:	\$117,887

Mitigation Benefits: \$117,887

Mitigation Costs: \$72,128

Benefits Minus Costs: \$45,759

Benefit-Cost Ratio: 1.63

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540020033, 18807 TRINITY STAR DR, CYPRESS, Texas, 77434, Harris

Benefits: \$162,226

Costs: \$72,128

BCR: 2.25

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,891

BRV (\$/sf): \$150.00

Total BRV: \$433,650

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.94

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$433,650  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.94

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 763 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required:	0	Number of Hours Volunteered/Person:	0
Cost of Volunteers Time (\$/Hour/Person):	\$0.00	Number of Days Lodging/Volunteer:	0
Per-Person Cost of Lodging for a Volunteer:	\$0.00	Cost of Volunteers:	\$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person:	2	Number of Worker:	1
Treatment Costs per person:	\$2,443.00	Productivity Loss per person:	\$8,736.00
Total Mental Stress and Anxiety Cost:	\$4,886.00	Total Lost Productivity Cost:	\$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 144.5

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.00	485.0	149.68	475.3
50	2.00%	150.30	1,025.0	150.06	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.80	2,590.0	150.72	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 764 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,841	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$58,109	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$101,040	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$139,202	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$173,894	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$204,249	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$433,650	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$433,650	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$433,650	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$433,650	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$433,650	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$433,650	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$433,650	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$433,650	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$433,650	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$433,650	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$433,650	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$433,650	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,408	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$35,126	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$57,675	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$77,623	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$95,403	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$111,448	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$124,891	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$136,600	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$146,574	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$154,813	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$161,318	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$166,522	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$169,991	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$172,159	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$173,460	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$173,460	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$173,460	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$173,460	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 767 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 768 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 769 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$10,768
Present Value:	\$148,604

Annual:	\$0
Present Value:	\$0

Annual:	\$10,768
Present Value:	\$148,604

Mitigation Benefits: \$148,604

Mitigation Costs: \$72,128

Benefits Minus Costs: \$76,476

Benefit-Cost Ratio: 2.06

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 770 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 771 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540030001, 18827 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Benefits: \$236,484

Costs: \$72,128

BCR: 3.28

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,237

BRV (\$/sf): \$150.00

Total BRV: \$485,550

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.95

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$485,550  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.95

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 772 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	485.0	149.78	475.3
50	2.00%	150.40	1,025.0	150.16	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.90	2,590.0	150.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 773 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$12,139	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$65,064	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$113,133	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$155,862	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$194,706	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$228,694	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$485,550	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$485,550	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$485,550	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$485,550	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$485,550	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$485,550	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$485,550	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$485,550	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$485,550	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$485,550	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$485,550	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$485,550	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$11,653	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$39,330	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$64,578	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$86,913	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$106,821	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$124,786	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$139,838	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$152,948	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$164,116	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$173,341	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$180,625	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$186,451	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$190,336	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$192,763	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$194,220	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$194,220	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$194,220	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$194,220	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 775 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 776 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 777 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

#### Land Use

Total Project Area (Acres): 0.00000000

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	0%	\$0

### Other Benefits

#### Other Benefits Before Mitigation

No Data

#### Other Benefits After Mitigation

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 778 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**BCR Calculation Results**

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$16,149
Present Value:	\$222,862

Annual:	\$0
Present Value:	\$0

Annual:	\$16,149
Present Value:	\$222,862

Mitigation Benefits: \$222,862

Mitigation Costs: \$72,128

Benefits Minus Costs: \$150,734

Benefit-Cost Ratio: 3.09

**Cost Estimate**

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 779 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 780 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1357540030002, 18831 TRINITY STAR DR, CYPRESS, Texas, 77433, Harris

Benefits: \$294,014

Costs: \$72,128

BCR: 4.08

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 2,821

BRV (\$/sf): \$150.00

Total BRV: \$423,150

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 150.78

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$423,150  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -213.44

Utilities that are not elevated: No

Height FFE Above Grade: 150.78

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

Length of road (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 781 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.10	485.0	149.78	475.3
50	2.00%	150.40	1,025.0	150.16	1,004.5
100	1.00%	150.50	1,381.0	150.34	1,353.4
500	0.20%	150.90	2,590.0	150.82	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 782 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$10,579	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$56,702	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$98,594	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$135,831	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$169,683	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$199,304	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$423,150	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$423,150	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$423,150	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$423,150	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$423,150	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$423,150	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$423,150	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$423,150	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$423,150	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$423,150	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$423,150	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$423,150	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 783 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$10,156	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$34,275	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$56,279	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$75,744	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$93,093	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$108,750	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$121,867	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$133,292	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$143,025	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$151,065	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$157,412	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$162,490	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$165,875	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$167,991	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$169,260	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$169,260	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$169,260	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$169,260	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 784 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 785 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 787 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$20,317
Present Value:	\$280,392

Annual:	\$0
Present Value:	\$0

Annual:	\$20,317
Present Value:	\$280,392

Mitigation Benefits: \$280,392

Mitigation Costs: \$72,128

Benefits Minus Costs: \$208,264

Benefit-Cost Ratio: 3.89

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 789 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1361760010003, 19014 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Benefits: \$354,856

Costs: \$72,128

BCR: 4.92

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,395

BRV (\$/sf): \$150.00

Total BRV: \$659,250

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 152.19

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$659,250  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -215.42

Utilities that are not elevated: No

Height FFE Above Grade: 152.19

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 790 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 146.9

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	151.40	485.0	151.08	475.3
50	2.00%	151.80	1,025.0	151.56	1,004.5
100	1.00%	151.90	1,381.0	151.74	1,353.4
500	0.20%	152.30	2,590.0	152.22	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$16,481	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$88,340	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$153,605	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$211,619	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$264,359	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$310,507	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$659,250	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$659,250	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$659,250	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$659,250	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$659,250	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$659,250	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$659,250	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$659,250	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$659,250	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$659,250	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$659,250	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$659,250	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,822	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$53,399	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$87,680	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$118,006	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$145,035	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$169,427	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$189,864	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$207,664	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$222,827	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$235,352	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$245,241	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$253,152	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$258,426	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$261,722	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$263,700	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$263,700	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$263,700	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$263,700	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 793 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 795 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 796 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$24,726
Present Value:	\$341,234

Annual:	\$0
Present Value:	\$0

Annual:	\$24,726
Present Value:	\$341,234

Mitigation Benefits: \$341,234

Mitigation Costs: \$72,128

Benefits Minus Costs: \$269,106

Benefit-Cost Ratio: 4.73

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 798 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1361760010011, 18906 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Benefits: \$577,482

Costs: \$72,128

BCR: 8.01

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,313

BRV (\$/sf): \$150.00

Total BRV: \$646,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.14

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$646,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.43

Utilities that are not elevated: No

Height FFE Above Grade: 151.14

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 799 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.70	485.0	150.38	475.3
50	2.00%	151.00	1,025.0	150.76	1,004.5
100	1.00%	151.20	1,381.0	151.04	1,353.4
500	0.20%	151.60	2,590.0	151.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 800 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$16,174	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$86,691	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$150,739	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$207,671	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$259,427	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$304,713	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$646,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$646,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$646,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$646,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$646,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$646,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$646,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$646,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$646,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$646,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$646,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$646,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 801 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$15,527	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$52,403	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$86,044	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$115,804	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$142,329	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$166,266	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$186,322	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$203,789	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$218,669	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$230,961	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$240,665	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$248,429	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$253,604	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$256,839	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$258,780	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$258,780	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$258,780	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$258,780	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 802 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 803 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 804 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 805 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$40,857
Present Value:	\$563,860

Annual:	\$0
Present Value:	\$0

Annual:	\$40,857
Present Value:	\$563,860

Mitigation Benefits: \$563,860

Mitigation Costs: \$72,128

Benefits Minus Costs: \$491,732

Benefit-Cost Ratio: 7.82

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 807 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1361760010013, 18826 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Benefits: \$633,420

Costs: \$72,128

BCR: 8.78

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 5,290

BRV (\$/sf): \$150.00

Total BRV: \$793,500

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.22

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$793,500  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.43

Utilities that are not elevated: No

Height FFE Above Grade: 151.22

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 808 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.3

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.70	485.0	150.38	475.3
50	2.00%	151.00	1,025.0	150.76	1,004.5
100	1.00%	151.20	1,381.0	151.04	1,353.4
500	0.20%	151.60	2,590.0	151.52	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 809 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$19,838	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$106,329	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$184,886	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$254,714	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$318,194	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$373,739	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$793,500	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$793,500	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$793,500	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$793,500	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$793,500	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$793,500	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$793,500	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$793,500	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$793,500	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$793,500	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$793,500	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$793,500	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 810 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$19,044	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$64,274	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$105,536	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$142,037	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$174,570	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$203,930	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$228,528	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$249,953	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$268,203	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$283,280	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$295,182	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$304,704	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$311,052	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$315,020	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$317,400	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$317,400	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$317,400	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$317,400	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 811 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 813 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 814 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$44,911
Present Value:	\$619,798

Annual:	\$0
Present Value:	\$0

Annual:	\$44,911
Present Value:	\$619,798

Mitigation Benefits: \$619,798

Mitigation Costs: \$72,128

Benefits Minus Costs: \$547,670

Benefit-Cost Ratio: 8.59

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 815 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 816 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1361760010014, 18822 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Benefits: \$406,548

Costs: \$72,128

BCR: 5.64

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 3,882

BRV (\$/sf): \$150.00

Total BRV: \$582,300

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.21

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$582,300  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 151.21

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

### Street Maintenance Details

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 817 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.60	485.0	150.28	475.3
50	2.00%	150.90	1,025.0	150.66	1,004.5
100	1.00%	151.10	1,381.0	150.94	1,353.4
500	0.20%	151.50	2,590.0	151.42	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

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Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$14,558	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$78,028	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$135,676	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$186,918	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$233,502	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$274,263	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$582,300	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$582,300	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$582,300	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$582,300	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$582,300	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$582,300	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$582,300	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$582,300	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$582,300	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$582,300	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$582,300	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$582,300	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 819 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$13,975	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$47,166	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$77,446	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$104,232	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$128,106	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$149,651	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$167,702	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$183,425	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$196,817	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$207,881	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$216,616	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$223,603	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$228,262	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$231,173	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$232,920	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$232,920	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$232,920	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$232,920	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 820 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 821 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 822 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 823 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$28,471
Present Value:	\$392,926

Annual:	\$0
Present Value:	\$0

Annual:	\$28,471
Present Value:	\$392,926

Mitigation Benefits: \$392,926

Mitigation Costs: \$72,128

Benefits Minus Costs: \$320,798

Benefit-Cost Ratio: 5.45

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 824 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Justification/Attachments**

Field	Description	Attachments
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06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 825 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Structure and Mitigation Details For:** 1361760010015, 18818 E JOSEY OVERLOOK DR, CYPRESS, Texas, 77433, Harris

Benefits: \$240,023

Costs: \$72,128

BCR: 3.33

Hazard: **Flood**

Mitigation Option: Floodwater Diversion and Storage

Latitude:

Longitude:

Size of Building: 4,093

BRV (\$/sf): \$150.00

Total BRV: \$613,950

Residential: Yes

Building Type: One-Story

Obstruction: N/A

Foundation Type: Slab

Basement: No

Building Primary Use:

Structure Type:

Historic Building: No

Structure Elevation: 151.49

First Floor Being Raised:

Demolition Threshold: 50.00%

Source of Flood Data: FIS

Project in SFHA: Yes

Community ID Number: 0

Effective FIS Date: 11/05/2018

FIRM Panel Number: 0

FIRM Effective Date: 11/05/2018

Project Useful Life: 50

H&H Study Title:

H&H Effective Date:

Flood Zone:

Loss of Rent: \$0

Building Contents: \$613,950  
(Default)

Value of Crawlspace Contents: \$0

Ground Surface Elevation:

Flood Zone Determination:

Breaking Wave Height: -214.29

Utilities that are not elevated: No

Height FFE Above Grade: 151.49

One Time Displacement Costs: \$0

NFIP: No

Displacement Costs: \$0 (Default)

ICC: No

Current federal lodging per diem: \$91

Population affected : 0

Current federal meals per diem: \$51

Cost per person to eat meals at home: \$7

**Street Maintenance Details**

Street maintenance budget (\$)

Miles of street (miles)

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 826 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

Length of road (miles)

Total Reduced Street Maintenance Costs \$0.00

**Volunteer Costs**

Number of Volunteers Required: 0 Number of Hours Volunteered/Person: 0

Cost of Volunteers Time (\$/Hour/Person): \$0.00 Number of Days Lodging/Volunteer: 0

Per-Person Cost of Lodging for a Volunteer: \$0.00 Cost of Volunteers: \$0.00

**Social Benefits**

**Mental Stress and Anxiety**

**Lost Productivity**

Number of Person: 2 Number of Worker: 1

Treatment Costs per person: \$2,443.00 Productivity Loss per person: \$8,736.00

Total Mental Stress and Anxiety Cost: \$4,886.00 Total Lost Productivity Cost: \$8,736.00

**Riverine Elevation and Discharge Data**

Streambed Elevation (ft): 145.4

Flood Profile Number:

Flood Source Name:

Elevation At Which Barrier Will Be Overtopped:

FEMA Elevation Certificate Diagram Description:

Other Elevation Source:

Recurrence Interval (yr)	Percent Annual Chance (%)	Elevation Before Mitigation (ft)	Discharge Before Mitigation (cfs)	Elevation After Mitigation (ft)	Discharge After Mitigation (cfs)
10	10.00%	150.60	485.0	150.28	475.3
50	2.00%	150.90	1,025.0	150.66	1,004.5
100	1.00%	151.10	1,381.0	150.94	1,353.4
500	0.20%	151.50	2,590.0	151.42	2,538.2

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 827 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Building Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.5%	0.0%	\$15,349	0.0%	0.0%	\$0
0.0	13.4%	0.0%	\$82,269	0.0%	0.0%	\$0
1.0	23.3%	0.0%	\$143,050	0.0%	0.0%	\$0
2.0	32.1%	0.0%	\$197,078	0.0%	0.0%	\$0
3.0	40.1%	0.0%	\$246,194	0.0%	0.0%	\$0
4.0	47.1%	0.0%	\$289,170	0.0%	0.0%	\$0
5.0	53.2%	0.0%	\$613,950	0.0%	0.0%	\$0
6.0	58.6%	0.0%	\$613,950	0.0%	0.0%	\$0
7.0	63.2%	0.0%	\$613,950	0.0%	0.0%	\$0
8.0	67.2%	0.0%	\$613,950	0.0%	0.0%	\$0
9.0	70.5%	0.0%	\$613,950	0.0%	0.0%	\$0
10.0	73.2%	0.0%	\$613,950	0.0%	0.0%	\$0
11.0	75.4%	0.0%	\$613,950	0.0%	0.0%	\$0
12.0	77.2%	0.0%	\$613,950	0.0%	0.0%	\$0
13.0	78.5%	0.0%	\$613,950	0.0%	0.0%	\$0
14.0	79.5%	0.0%	\$613,950	0.0%	0.0%	\$0
15.0	80.2%	0.0%	\$613,950	0.0%	0.0%	\$0
16.0	80.7%	0.0%	\$613,950	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 828 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Contents Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (pct)	Before Mitigation User Entered (pct)	Before Mitigation (\$)	After Mitigation (pct)	After Mitigation User Entered (pct)	After Mitigation (\$)
-2.0	0.0%	0.0%	\$0	0.0%	0.0%	\$0
-1.0	2.4%	0.0%	\$14,735	0.0%	0.0%	\$0
0.0	8.1%	0.0%	\$49,730	0.0%	0.0%	\$0
1.0	13.3%	0.0%	\$81,655	0.0%	0.0%	\$0
2.0	17.9%	0.0%	\$109,897	0.0%	0.0%	\$0
3.0	22.0%	0.0%	\$135,069	0.0%	0.0%	\$0
4.0	25.7%	0.0%	\$157,785	0.0%	0.0%	\$0
5.0	28.8%	0.0%	\$176,818	0.0%	0.0%	\$0
6.0	31.5%	0.0%	\$193,394	0.0%	0.0%	\$0
7.0	33.8%	0.0%	\$207,515	0.0%	0.0%	\$0
8.0	35.7%	0.0%	\$219,180	0.0%	0.0%	\$0
9.0	37.2%	0.0%	\$228,389	0.0%	0.0%	\$0
10.0	38.4%	0.0%	\$235,757	0.0%	0.0%	\$0
11.0	39.2%	0.0%	\$240,668	0.0%	0.0%	\$0
12.0	39.7%	0.0%	\$243,738	0.0%	0.0%	\$0
13.0	40.0%	0.0%	\$245,580	0.0%	0.0%	\$0
14.0	40.0%	0.0%	\$245,580	0.0%	0.0%	\$0
15.0	40.0%	0.0%	\$245,580	0.0%	0.0%	\$0
16.0	40.0%	0.0%	\$245,580	0.0%	0.0%	\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 829 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Displacement Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 830 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

**Depth-Damage Functions Using USACE Generic**

Loss of Function Flood Depth (ft)	Before Mitigation Values:			After Mitigation Values:		
	Before Mitigation (Days)	Before Mitigation User Entered (Days)	Before Mitigation (\$)	After Mitigation (Days)	After Mitigation User Entered (Days)	After Mitigation (\$)
-2.0	0.0		\$0	0.0		\$0
-1.0	0.0		\$0	0.0		\$0
0.0	0.0		\$0	0.0		\$0
1.0	45.0		\$0	0.0		\$0
2.0	90.0		\$0	0.0		\$0
3.0	135.0		\$0	0.0		\$0
4.0	180.0		\$0	0.0		\$0
5.0	225.0		\$0	0.0		\$0
6.0	270.0		\$0	0.0		\$0
7.0	315.0		\$0	0.0		\$0
8.0	360.0		\$0	0.0		\$0
9.0	405.0		\$0	0.0		\$0
10.0	450.0		\$0	0.0		\$0
11.0	495.0		\$0	0.0		\$0
12.0	540.0		\$0	0.0		\$0
13.0	585.0		\$0	0.0		\$0
14.0	630.0		\$0	0.0		\$0
15.0	675.0		\$0	0.0		\$0
16.0	720.0		\$0	0.0		\$0

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 831 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Environmental Benefits

Land Use

Total Project Area (Acres):

Parcel Type	% of Parcel Type Being Used	\$/Acre/Year
	%	

### Other Benefits

**Other Benefits Before Mitigation**

No Data

**Other Benefits After Mitigation**

No Data

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 832 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### BCR Calculation Results

Expected Annual Damages Before Mitigation

Expected Annual Damages After Mitigation

Expected Avoided Damages After Mitigation (Benefits)

Annual:	\$16,405
Present Value:	\$226,401

Annual:	\$0
Present Value:	\$0

Annual:	\$16,405
Present Value:	\$226,401

Mitigation Benefits: \$226,401

Mitigation Costs: \$72,128

Benefits Minus Costs: \$154,273

Benefit-Cost Ratio: 3.14

### Cost Estimate

Project Useful Life (years): 50

Construction Type:

Mitigation Project Cost: \$72,128

Detailed Scope of Work: Yes

Annual Project Maintenance Cost: \$0

Detailed Estimate for Entire Project: Yes

Final Mitigation Project Cost: \$72,128

Years of Maintenance:

Cost Basis Year:

Present Worth of Annual Maintenance Costs:

Construction Start Year:

Estimate Reflects Current Prices: No

Construction End Year:

Project Escalation:

06 Nov 2018

Project: **Warren Lake Dam Retrofit**

Pg 833 of 833

Total Benefits: **\$28,832,985**

Total Costs: **\$6,197,495**

BCR: **4.45**

Project Number:

Disaster #: 4332

Program: HMGP

Agency: **Katy Prairie Conservancy**

State:

Point of Contact:

Analyst: Johnny Mojica

### Justification/Attachments

Field	Description	Attachments
-------	-------------	-------------

---

**Appendix 5-4AS:  
Veterans Memorial BCA Memorandum**

---



PLANNING  
ENGINEERING  
PROGRAM MANAGEMENT

memo

**TEXAS**

AUSTIN  
COLLEGE STATION  
CORPUS CHRISTI  
DALLAS  
FORT WORTH  
FRISCO  
HOUSTON  
LAREDO  
MONTGOMERY COUNTY  
SAN ANTONIO  
SAN MARCOS  
WACO

**CALIFORNIA**

LOS ANGELES  
ORANGE  
SAN JOSE

**FLORIDA**

MIAMI

**ILLINOIS**

CHICAGO

**MICHIGAN**

FLINT  
LANSING

**OKLAHOMA**

NORMAN

To: Gary Bezemek, P.E.  
From: Tak Makino, CFM  
Date: March 1, 2023  
Subject: Veterans Memorial Detention Basin A  
State Flood Plan BCA

---

## Project Description

This BCA is for the project described as “Veterans Memorial Detention Basin A” in the Halls Bayou Watershed Flood Risk Reduction Phasing Study (Phasing Study) prepared for Harris County Flood Control District by LAN. The Phasing Study completed in 2021 updated the 2013 Halls Ahead Study Vision Plan and developed a phasing strategy for identified bond projects. The concept for the Veterans Memorial Basin was refined and studied in a 2021 grant study performed by LAN in coordination with Harris County Flood Control District. This BCA is based on the models and cost estimates from the grant study.

The Veterans Memorial Detention Basin A provides approximately 460 acre-feet of storage. The proposed detention basin would require 85 acres of ROW acquisition, with no required structural acquisition. The 100- and 500-year events show maximum depth reductions of up to 0.2 feet and 0.1 feet within Halls Bayou, respectively, compared to the Baseline Conditions model. There are no adverse impacts when compared to the Baseline Conditions water surface elevations.

The Texas Water Development Board (TWDB) requires each Flood Mitigation Project (FMP) included in a regional flood plan to have a benefit/cost analysis (BCA) performed. This memorandum documents to benefit cost analysis performed by LAN within the regional flood planning process.

## Benefit Cost Analysis

TWDB developed the Benefit-Cost Analysis (BCA) Input Tool to facilitate the calculation of flood mitigation benefits due to FMP. This tool receives input of existing and proposed conditions to determine expected benefits related to the construction of the FMP in question. The benefits considered in the analysis include the reduction in damages to residential structures, commercial structures, and social benefits. The BCA Input Tool was modified to handle the nearly 20,000 structures included in the analysis. The BCA Input Tool was used in conjunction with the Federal Emergency Management Agency (FEMA) BCA Toolkit v6.0.0. Social benefits used in the analysis were developed within the FMEA Benefit-Cost Calculator.

Lockwood, Andrews  
& Newnam, Inc.

A LEO A DALY COMPANY

2925 Briarpark Drive  
Suite 400  
Houston, TX 77042  
713.266.6900

lan-inc.com

## Structure Inventory

Two (2) datasets were used to obtain the information for Finished Floor Elevation (FFE), building footprint and building category.

- **Structure Inventory Dataset:** This information was obtained from Harris County Flood Control District (HCFCD). The FFE was obtained from this dataset.
- **Texas Buildings with SVI and Estimated Population (November 2021)** – This information was provided by TWDB for Regional Flood Planning. Building sizes and types were obtained from this dataset.

## Project Schedule

The project is currently being planned and will proceed to design phase. While currently this project has no start and end dates, this analysis assumes construction start and end dates of 2026-2027.

## BCA Assumptions

For purposes of the BCA, project benefits are elimination of flooding damages to residential, commercial, and industrial structures. Based on the provided building types, structures were reclassified as either residential, commercial, industrial, or agricultural. Public buildings were reclassified as commercial structures. Buildings marked as “Vacant or Unknown” in the TWDB dataset were reclassified as agricultural buildings. Benefits were quantified by inputting structure FFE’s and flood depths to the BCA\_Pilot\_v5 spreadsheet, provided by FNI.

## Flood Damages

The flood depths for each structure within the study area was determined for the 10 percent, 2 percent, 1 percent, and 0.2 percent annual chance events. The flood hazard data was obtained from the grant study, all hydrological and hydraulic analyses were completed by LAN. The structural flood damages are included in **Table 1**.

TABLE 1: PROJECT IMPACTS BY RECURRENCE INTERVAL

Flood Damages	10 - year storm		50 - year storm		100 - year storm		500 - year storm	
	Baseline	Project	Baseline	Project	Baseline	Project	Baseline	Project
Residential	\$103,461,774	\$77,076,954	\$218,659,948	\$202,588,345	\$294,426,650	\$272,932,116	\$488,751,938	\$481,909,375
Commercial	\$71,295,066	\$56,982,429	\$113,766,268	\$108,583,729	\$146,298,537	\$132,522,069	\$239,582,042	\$236,958,142
Total	\$174,756,840	\$134,059,382	\$332,426,216	\$311,172,074	\$440,725,187	\$405,454,185	\$728,333,980	\$718,867,517

## Benefits

The damage estimates from the BCA\_PILOT\_v5 model were inputted to the FEMA BCA Calculator. The total benefit, discounted at 7 percent over the assumed 30-year project duration, is **\$16,139,211** including **\$1,996,369** in residual value from right-of-way acquisition and **\$7,838,006** in environmental benefits from converting land to green space within the basin. These benefits include only include the mitigated damages to residential and commercial structures identified and no other additional mitigation.

**Discounted Total Benefits: \$16,139,211**

## Project Costs

According to the grant study, the overall cost to design and construct the project based on 2021 construction and Right-of-Way (ROW) costs. The features were assumed to have a useful life of 30 years. The total cost is **\$35,250,000** including **\$13,740,000** in construction costs, **\$1,590,000** in utility relocation, and **\$19,920,000** in ROW costs. The project construction cost used in the BCA includes Engineering and Design (12%), Mobilization and Demobilization (5%), Construction Management (10%), and Contingency (30%). The annual maintenance cost is estimated at 4% of the construction cost: **\$549,600**. Harris County Flood Control District will be responsible for long-term maintenance of Halls Bayou.

The adjusted project costs were input to the TWDB BCA Input Workbook v1.2 to calculate the project cost discounted by 7 percent over the construction period.

**Discounted Total Costs: \$33,036,230**

## Benefit Cost Ratio

<b>Results from BCA Toolkit:</b>	
Total Benefits from <b>FEMA</b> BCA Toolkit	\$6,304,835
Other Benefits (Not Recreation)	\$9,834,376
Recreation Benefits	\$0
Discounted Total Costs from <b>TWDB</b> Spreadsheet	\$33,036,230
Total Benefits	\$16,139,211
Net Benefits	-\$16,897,020
<b>Final BCR</b>	<b>0.19</b>
<b>Final BCR with Other Benefits</b>	<b>0.49</b>

---

**Appendix 5-4AT:  
Poor Farm Ditch**

---

# **POOR FARM DITCH CONVEYANCE PRELIMINARY ENGINEERING REPORT**

Prepared for:

**Harris County Flood Control District**

September 27, 2017

Prepared by:

**FREESE AND NICHOLS, INC.**  
10497 Town and Country Way, Suite 600  
Houston, Texas 77024  
713-600-6800

# POOR FARM DITCH CONVEYANCE PRELIMINARY ENGINEERING REPORT

Prepared for:

**Harris County Flood Control District**



FREESE AND NICHOLS, INC.  
TEXAS REGISTERED  
ENGINEERING FIRM  
F-2144



FREESE AND NICHOLS, INC.  
TEXAS REGISTERED  
ENGINEERING FIRM  
F-2144

[For Hydrology and Hydraulics]

Prepared by:

**FREESE AND NICHOLS, INC.**  
10497 Town and Country Way, Suite 600  
Houston, Texas 77024  
713-600-6800

HCF15148

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- APPENDIX C: GEOTECHNICAL ANALYSIS
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- APPENDIX E: STORMWATER ANALYSIS
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## EXECUTIVE SUMMARY

On July 23, 2015, the Harris County Flood Control District (HCFCD) issued a contract for Freese and Nichols, Inc. (FNI) to develop the construction documents for improvements to HCFCD Unit Number D111-00-00 (Poor Farm Ditch).

Poor Farm Ditch is a tributary to Brays Bayou (D100-00-00) and provides drainage to approximately 1,330 acres of developed watershed. The project reach is situated between the cities of Southside Place (SSP) on the west side of the channel and West University Place (WUP) on the east side of the channel between University Boulevard and Bellaire Boulevard. On July 16, 2014, an Approved Jurisdictional Determination (AJD) was issued for this reach of Poor Farm Ditch by the United States Army Corps of Engineers (USACE). This AJD (SWG-2009-00591), which expires on July 16, 2019, indicates that Poor Farm Ditch is non-jurisdictional by USACE.

The HCFCD right-of-way (ROW) within the project reach varies from 45 feet to 80 feet. For the first 420 feet of the most downstream reach, the HCFCD ROW width varies between 60 feet and 80 feet. For the next 615 feet upstream, the ROW width is 55 feet. The ROW then narrows to 50 feet for 2,030 feet further upstream, of which 20 feet is an easement within SSP and 30 feet is a joint-use agreement with the city of WUP. For the remaining 40 feet of the project reach, the HCFCD ROW is 45 feet wide.

This portion of Poor Farm Ditch is over 55 years old, and the reinforced concrete slope pavement has deteriorated significantly and buckled at many locations. HCFCD has historically performed spot repairs to prevent an overall failure of the channel, but these repairs are only short-term solutions. Some property owners within SSP have encroached into the easement by placing fill and various structures along the channel, which has exacerbated the issues. Existing conditions are further discussed in Section 2.0. Due to the continued deterioration of the channel, a full rehabilitation is required.

Multiple efforts were undertaken to evaluate options for this full rehabilitation as described further in Section 1.0. On October 9, 2014, HCFCD held an audit committee meeting to discuss the project. There were three options discussed along with a new concept developed internally within HCFCD, which was based on the information provided as part of previous evaluations. This new concept included two 7-foot wide by 9-foot tall reinforced concrete box culverts (RCBs) placed on the outside edges of a 40-foot wide corridor with a concrete lined open channel (approximately 15-foot wide) in between.

After performing a geotechnical investigation as well as a topographic survey of the project reach, FNI identified multiple concerns associated with the culvert design concept. Discussions were held with HCFCF to present the preliminary findings and determine a path forward. HCFCF issued a contract amendment on September 9, 2016, authorizing FNI to proceed with developing a Preliminary Engineering Report (PER) to identify and evaluate channel cross-section alternatives associated with improving Poor Farm Ditch. This work was authorized under Purchase Order P250265 of the Professional Service Agreement (PSA) Number 2016-07.

This PER presents conceptual level designs for the following seven alternatives associated with improving the identified project reach of Poor Farm Ditch:

- Alternative 1A: Installation of two 7x7 RCBs separated by a rectangular open channel configuration that includes a slab on grade constructed using an excavation stabilized with temporary soil nails;
- Alternative 1B: Installation of two 7x7 RCBs separated by a rectangular open channel configuration that includes a slab on grade constructed using a vertical excavation stabilized with shoring methods;
- Alternative 2A: Cast-in-place rectangular channel constructed using a sloped excavation stabilized with temporary soil nails;
- Alternative 2B: Cast-in-place rectangular channel constructed using a vertical excavation stabilized with vertical shoring methods;
- Alternative 2C: Cast-in-place rectangular channel constructed using both sloped and vertical excavation stabilized by a combination of temporary soil nails and vertical shoring methods;
- Alternative 3A: Trapezoidal channel with reinforced concrete slope pavement anchored by permanent soil nails extending to the existing 50-foot HCFCF ROW; and
- Alternative 3B: Trapezoidal channel with reinforced concrete slope pavement anchored by permanent soil nails extending to the proposed 40-foot HCFCF ROW.

A geotechnical analysis was performed for the temporary excavations required during construction and is further discussed in Section 3.0. The design concepts are presented with additional detail in Section 4.0. Each feasible channel cross-section alternative was evaluated regarding hydraulic capacity, project cost, design life, maintenance, construction duration, and impact of construction activities as further discussed in Section 5.0. Evaluations included analyzing the alternatives using both a weighted factors method and a Pairwise method.

Using the weighted factors method to evaluate the five alternatives, Alternatives 3A and 3B were both

ranked the highest. Using the Pairwise method, Alternative 3B was ranked the highest with Alternative 3A as the second highest.

Alternative 3B was ranked high based upon the following:

- Decrease in WSELs when compared to both the Effective Model and Corrected Effective Model for all storm events;
- Lowest cost for the items associated with the design configuration; and
- Least impact of construction activities to nearby residences.

The most significant tradeoffs associated with this alternative when compared to others is that the desired HCFCFCD maintenance access along the channel is not feasible, the time of construction is longer than all other alternatives, the hydraulic benefits are not as great when compared to Alternative 3A, and the design life is slightly less than other alternatives.

Alternative 3A is similar in geometry to Alternative 3B but has a wider cross section with permanent soil nails utilizing the full 50-foot HCFCFCD ROW. The only difference in scoring was that this alternative had more of a significant impact of construction activities to nearby residences due to the extended soil nails; however, this alternative provided greater hydraulic benefits when compared to Alternative 3B, as it lowered WSELs by an additional 0.2 feet on average within the study reach.

For HCFCFCD to evaluate the implementation of either of these alternatives and coordinate with each of the cities, total project costs were developed for Alternatives 3A and 3B. A breakout of each total project cost is included as Appendix G. The total project costs for Alternatives 3A and 3B are \$23,740,768 and \$20,350,561, respectively. The following assumptions are noted:

- The Opinion of Probable Construction Costs (OPCCs) for Alternative 3A and 3B were determined to be \$20,904,585 and \$17,644,770, respectively. The OPCCs include a 30% contingency factor to account for:
  - Uncertainties associated with the contractor's care of water plan, as well as dealing with limited site access and staging opportunities; and
  - Adjusting, or working around, existing and proposed structures and facilities adjacent to the channel. Specific items already identified include a proposed concrete-lined swale feature within SSP, and an existing sanitary sewer lift station as well as a group of

maintenance boxes associated with ATT underground cables within WUP.

- The total engineering design fee, inclusive of FNI's contract as well as previous studies, was set equal to \$2,000,000.00; and
- The anticipated construction management fees were set equal to 4 percent of the respective OPCCs.

On April 20, 2017, a meeting was held with HCFCD's Engineering Review Board (ERB) to consider the findings, existing conditions, conveyance, and encroachment issues identified during the preliminary engineering phase of the project. An additional objective of this meeting was to solicit concurrence for moving forward with the final design of Alternative 3B. At the conclusion of this meeting, the recommendation to move forward with the final design of Alternative 3B was unanimously approved by the ERB.

After establishing Alternative 3B as the preferred alternative, FNI performed a preliminary analysis at the request of HCFCD to determine if additional volume would be required in the Meyer Basin to mitigate the proposed channel improvements. The memorandum documenting this analysis is provided in Appendix I. While there are several variables which will impact final design and, ultimately, the final mitigation volume required, it is expected that the volume previously allocated within the Meyer Basin is adequate in mitigating the proposed channel improvements associated with Alternative 3B.

Based on the feedback received at the ERB meeting, as well as per subsequent direction given by HCFCD, the following items reflect activities that will be incorporated into the final design of Alternative 3B:

- Based on the anticipated needs of HCFCD's Infrastructure Department, incorporate at least two permanent maintenance access points;
- Incorporate provisions for public safety and deterrence of trespassing along the project reach; and
- Perform an expanded Impact Analysis to include:
  - Development of a detailed steady state hydraulic model which incorporates topographic survey data to reflect the current channel condition;
  - An evaluation of Brays Bayou backwater conditions for the Current Effective and Brays

Bayou Conditional Letter of Map Revision (CLOMR) modeling;

- Development of an unsteady state hydraulic model to evaluate potential for increases in flows and WSE downstream of the project reach; and
- An evaluation of potential impacts to storm sewer outfalls downstream of the project reach.

At the request of HCFCFCD's stormwater quality department, FNI evaluated the feasibility of implementing water quality enhancements along the project reach. FNI specifically consulted the document entitled, "HCFCFCD Water Quality Enhancement Section for Preliminary Engineering Report (PER) or Project Design Report (PDR)" to determine its applicability to the content presented in this PER. It was determined by HCFCFCD and FNI project team members that the project reach does not have sufficient opportunities for water quality enhancements. It was further concluded that such enhancements would not be required along the project reach given:

- The total footprint of impervious cover is not being increased by more than one acre from its current condition; and
- The project reach is not located within unincorporated Harris County or the City of Houston.

During final design, the project team will coordinate with SSP and WUP as appropriate to verify that the cities will not require specific provisions for water quality enhancements.

The outline of the PER is summarized as follows:

- Section 1.0 – Introduction
- Section 2.0 – Existing Conditions
- Section 3.0 – Temporary Excavations
- Section 4.0 – Channel Design Alternatives
- Section 5.0 – Evaluation of Alternatives
- Section 6.0 – Summary and Recommendation

## **1.0 INTRODUCTION**

### **1.1 BACKGROUND**

Poor Farm Ditch is a tributary to Brays Bayou (D100-00-00) and provides drainage to approximately 1,330 acres of developed watershed. The project reach is situated between the cities of Southside Place (SSP) on the west side of the channel and West University Place (WUP) on the east side of the channel between University Boulevard and Bellaire Boulevard. On July 16, 2014, an Approved Jurisdictional Determination (AJD) was issued for this reach of Poor Farm Ditch by the United States Army Corps of Engineers (USACE). This AJD (SWG-2009-00591), which expires on July 16, 2019, indicates that Poor Farm Ditch is non-jurisdictional by USACE.

The Harris County Flood Control District (HCFCD) right-of-way (ROW) within the project reach varies from 50 feet to 75 feet. For the first 420 feet of the most downstream reach, the HCFCD ROW width is 75 feet. The ROW then narrows to 55 feet for 615 feet further upstream. For the remainder of the upstream section, the HCFCD ROW is 50 feet wide, of which 20 feet is an easement within SSP and 30 feet is an easement within WUP. Reference Appendix A, page A-1, showing this reach of Poor Farm Ditch in relation to SSP, WUP, and Brays Bayou.

The cross-section of the channel is comprised of a 10-foot wide by 2.5-foot deep rectangular pilot channel. Above the pilot channel, the channel banks extend at 1.5H:1V side slopes, defining a top width of approximately 28 feet. Reinforced concrete pavement armors the rectangular pilot channel as well as approximately 4.5 vertical feet of the side slopes. Figure 1-1 provides a generalized cross-section of the constrained portions of the project reach with select dimensions shown.



**Figure 1-1: Cross-Section Depicting Constrained Portions of Poor Farm Ditch**

This portion of Poor Farm Ditch is over 55 years old, and the reinforced concrete pavement has deteriorated significantly and buckled at many locations. HCFCD has historically performed spot repairs to prevent an overall failure of the channel, but these repairs were intended to be temporary solutions.

Some property owners within SSP have encroached into the easement by placing fill and various structures along the channel, which has exacerbated the issues. Further discussion of the existing conditions of Poor Farm Ditch is included in Section 2.0. Due to the continued deterioration of the channel, a full rehabilitation is required.

HCFCD has engaged subconsultants to perform studies to determine what the best solution is to fully rehabilitate Poor Farm Ditch. Each of the studies performed had different constraints, as HCFCD was trying to implement the project with minimal impacts and obtain consensus from numerous stakeholders on the path forward. The following discussion serves to summarize these previous efforts.

In a 2004 feasibility study, performed by Claunch & Miller, Inc. titled *Poor Farm Kilmarnock Regional Study*, a recommendation was made to increase the existing hydraulic capacity of Poor Farm Ditch between Bellaire and University Boulevards. This increase would improve stormwater conveyance in the area as this reach was estimated to convey only a 10 percent annual exceedance probability storm event.

In 2009, HCFCD contracted with Tolunay-Wong Engineers, Inc. to perform geotechnical investigations along Poor Farm Ditch and submit a report.

In a January 2012 report prepared by Binkley and Barfield, Inc. (BBI), the six following alternatives were presented to rehabilitate the project reach:

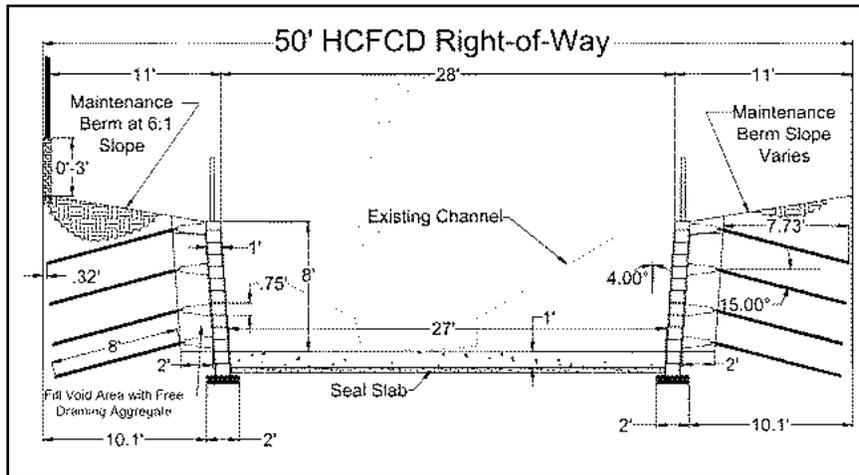
- Existing channel repair only;
- Trapezoidal channel with low flow section;
- Enclosed box channel;
- Open box channel with concrete berms;
- Open box channel with grass berms; and
- Enclosed box channel.

Hydrologic and hydraulic analyses, which were the main focus of the 2012 BBI report, were performed for each alternative, and each alternative was also evaluated in terms of mitigation, construction cost, constructability, environmental impacts, and channel conveyance. Also, this report noted that over 8,000 linear feet (LF) of fence, several trees and several structures of varying size would have to be removed or relocated. A technical stakeholder group (TSG), including representatives from HCFCD, SSP, WUP, City of Houston (COH), and the neighborhoods involved, was created to discuss project status, technical issues, gather public input, and address public concerns. This process did not yield consensus for a final design alternative.

In an October 2013 report prepared by Parsons Brinckerhoff (PB), the constructability of the three following alternatives was evaluated (each spanning across the full 50-foot wide HCFCD ROW):

- U-shaped, cast in place concrete channel (22 feet wide) with 8-foot tall vertical walls, referred to as the “HCFCD preferred alternative;”
- U-shaped, cast in place concrete channel (24 feet wide) with a 12.5-foot vertical wall on the SSP side of the channel and a 9.3-foot tall vertical wall on the WUP side, referred to as the “SSP preferred alternative;” and
- Various geometric configurations of a soil nailed wall with a block face.

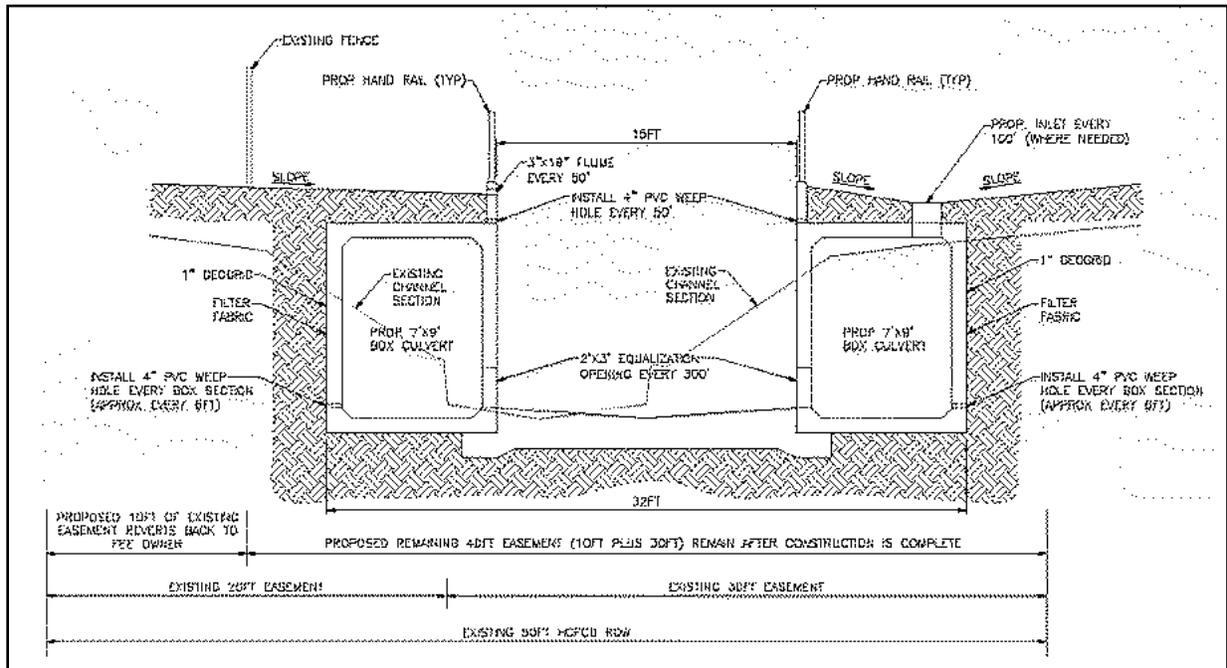
The recommendation presented in PB’s report was an 8-foot tall soil nail wall with the nails extending across the full 50-foot HCFCD ROW. See Figure 1-2 for the cross section of this configuration.



**Figure 1-2: Parson Brinckerhoff's Recommended Channel Configuration**

On October 9, 2014, HCFCD held an internal meeting to discuss the channel rehabilitation alternatives. Options that were included as part of this briefing were the 22-foot wide U-shaped channel (HCFCD Preferred Alternative), the 24-foot wide U-shaped channel with varying wall heights (SSP Preferred Alternative), the 8-foot tall soil nail wall (PB Report Recommendation), and a new concept developed internally within HCFCD, using the information provided by BBI as a basis for the additional alternative. This new concept included two 7-foot wide by 9-foot tall reinforced concrete box culverts (RCBs) placed on the outside edges of a 40-foot wide corridor with a concrete lined open channel (approximately 15-foot wide) in between. See Figure 1-3 showing this design concept.

The HCFCD new design concept would require only a 40-foot wide total ROW width. As a result, the western most ten feet of HCFCD's existing easement would not be required long term after construction is complete.



**Figure 1-3: HCFCO New Design Concept**

On July 23, 2015, HCFCO issued a contract for Freese and Nichols, Inc. (FNI) authorized under Purchase Order P250265 of the Professional Service Agreement (PSA) Number 2016-07. Per this original contract, FNI was tasked with developing construction drawings to implement HCFCO's new design concept along the project reach, limited to the 40-foot proposed ROW width. The requirements of FNI's original scope of work are generally defined as follows:

- Develop the communication strategy for SSP and WUP;
- Develop construction documents to implement HCFCO's new design concept within the proposed 40-foot wide corridor;
- Include provisions (e.g., cut-outs) for receiving flow from the channel overbanks, pipe drains, and storm sewers that outfall into the existing channel, as well as for equalizing flow with the rectangular channel section;
- Include parapet walls atop the box culverts to retain the earthen material associated with the channel overbanks; and
- Include a concrete-lined swale feature located near the intersection of Harper Street and Edloe Street.

HCFCO's design concept was formulated based upon several data gathering and preliminary engineering design efforts, as well as correspondence with the project stakeholders. A list of the documents that were provided can be found in Appendix B.

To supplement and field verify the data compiled from previous efforts, FNI engaged sub-consultants to perform a geotechnical investigation, as well as a topographic survey of the project reach. Upon receipt and review of the data obtained from the subconsultants, FNI identified multiple concerns associated with HCFCFCD's new design concept.

Based on the anticipated pressures of the soils along the project reach, preliminary stability calculations indicated that the RCBs would require significant bracing to be stable against overturning and sliding. Furthermore, vertical shoring would be required for the excavation necessary to install the RCBs at the indicated widths. Use of trench boxes to install the RCBs would not be feasible given the width of the excavation and the slope stability concerns.

Using the topographic data obtained, FNI created an existing surface model and inserted the HCFCFCD design cross section. It was found that the 7-foot wide by 9-foot tall RCBs were too tall to provide adequate cover while leaving enough room within the 40-foot wide corridor to perform the necessary backslope grading for drainage.

Meetings were held with HCFCFCD to present FNI's preliminary findings and determine a path forward. Based on the collective discussions at these meetings, HCFCFCD authorized FNI to identify and develop additional alternatives for consideration and evaluate the tradeoffs associated with each alternative.

## **1.2 PURPOSE**

On September 9, 2016, HCFCFCD issued a notice to proceed authorizing FNI to proceed with developing a Preliminary Engineering Report (PER) to identify and evaluate channel cross-section alternatives associated with improving HCFCFCD Unit Number D111-00-00 (Poor Farm Ditch). This work was authorized under Purchase Order P250265 of the PSA Number 2016-07.

This PER serves as the contract deliverable for Project Task 1.E of the Basic Services of Purchase Order P250265. This report identifies and evaluates seven channel cross section alternatives for repairs to the identified project reach of Poor Farm Ditch. Each feasible alternative was evaluated based on hydraulic capacity, project cost, design life, maintenance, construction duration, and impact of construction activities. Because the concrete-lined swale feature located near the intersection of Harper Street and Edloe Street is required for any of the alternatives considered, the design or cost for this feature was not included as part of this report.

The outline of the PER is summarized as follows:

- Section 1.0 – Introduction
- Section 2.0 – Existing Conditions
- Section 3.0 – Temporary Excavations
- Section 4.0 – Channel Design Alternatives
- Section 5.0 – Evaluation of Alternatives
- Section 6.0 – Summary and Recommendation

## 2.0 EXISTING CONDITIONS

The Poor Farm Ditch channel system is within the Brays Bayou watershed and passes through SSP, WUP, and the COH before outfalling to Brays Bayou. The project reach spans along HCFCU Unit No. D111-00-00 from the Bellaire Boulevard crossing to the University Boulevard crossing.

The following efforts were performed to define the existing conditions of the project reach:

- Review of technical data provided to FNI by HCFCU, which included the reference documents listed in Appendix B;
- Previous site inspections performed in 2015;
- A topographic and boundary survey of the project reach;
- A geotechnical investigation consisting of one boring, as well as laboratory testing of swell pressures in lieu of a second boring;
- A review of historical geotechnical testing data;
- Compilation of available LiDAR data to supplement the topographic survey data;
- Development of a HEC-RAS model using the above data to ascertain the existing hydraulic capacity of the channel; and
- Development of an existing surface model in AutoCAD Civil 3D for design purposes.

Appendix A, pages A-2 through A-7, include existing plan and profiles, from downstream to upstream, of the project reach. Additionally, the profiles also include the boring information within the project reach obtained in 2015 and historical information gathered from the geotechnical investigations performed by Tolunay-Wong, Engineers, Inc. in 2009.

## 2.1 EXISTING CONFIGURATION

### 2.1.1 Channel Reach Upstream of the University Boulevard Crossing

The cross-section of the channel reach upstream of the University Boulevard crossing is comprised of a 10-foot wide by 2.5-foot deep rectangular pilot channel. Above the pilot channel, the channel banks extend at 1.5 horizontal to 1 vertical (1.5H:1V) side slopes, defining a top width of approximately 25 feet. Reinforced concrete pavement armors the rectangular pilot channel as well as approximately 6 vertical feet of the side slopes. The channel cross-section spans a distance of approximately 80 feet as it transitions to the University Boulevard crossing.

FNI understands from HCFCFD that the channel reach upstream of the University Boulevard crossing is hydraulically adequate to convey the 50-year storm. No improvements are being proposed along this channel reach. A photograph of this channel reach is presented in Figure 2-1.



**Figure 2-1: View of Channel Reach Upstream of University Boulevard Crossing**

### 2.1.2 University Boulevard Crossing

The University Boulevard crossing consists of three, 8-foot wide by 8-foot tall RCBs, as well as multiple storm drains that outfall beneath the bridge. The existing crossing is in good overall condition, and no improvements are being proposed. A photograph of the University Boulevard crossing is presented in Figure 2-2.



**Figure 2-2: Downstream End of University Boulevard Crossing**

### 2.1.3 Channel Reach Between University Boulevard and Bellaire Boulevard

As previously discussed, the project reach has been defined as the channel reach between the University Boulevard and Bellaire Boulevard crossings. Existing utilities and ancillary structures present within the vicinity of the project reach include: a CenterPoint Energy overhead electric line that runs north-to-south within SSP and includes multiple crossings over the channel, a sanitary sewer lift station located at the end of Carnegie Street within WUP, and several outfalls associated with off-site storm drains and irrigation systems. Additionally, a significant amount of fencing and trees are located within the HCFCFCD ROW.

Downstream of the University Boulevard crossing, the channel cross-section narrows over a distance of approximately 125 feet. Immediately beyond this transition zone, the cross-section of the channel is comprised of a 10-foot wide by 2.5-foot deep rectangular pilot channel. Above the pilot channel, the channel banks extend at 1.5H:1V side slopes, defining a top width of approximately 28 feet. Reinforced concrete pavement armors the rectangular pilot channel as well as approximately 4.5 vertical feet of the side slopes.

The reinforced concrete pavement has deteriorated significantly and buckled at many locations. The damages have been exacerbated by the surcharge loading from several properties that have encroached into HCFCF ROW. HCFCF has performed spot repairs, such as constructing steel beams to stabilize the pilot channel and placing flowable fill along portions of the channel, where reinforced concrete pavement has been lost. Visual observations from January 2017 indicate that the steel beams are no longer bracing the channel and are laying in the bottom of the pilot channel.

Photographs of this channel reach are presented in Figure 2-3 through Figure 2-7.



**Figure 2-3: View of Transition Zone Downstream of University Boulevard Crossing**



**Figure 2-4: View of Concrete Buckling Damage Along Project Reach**



**Figure 2-5: View of Concrete Pavement Damages Along Project Reach**



Figure 2-6: View of Temporary Stabilization Measures Along Project Reach (2015)

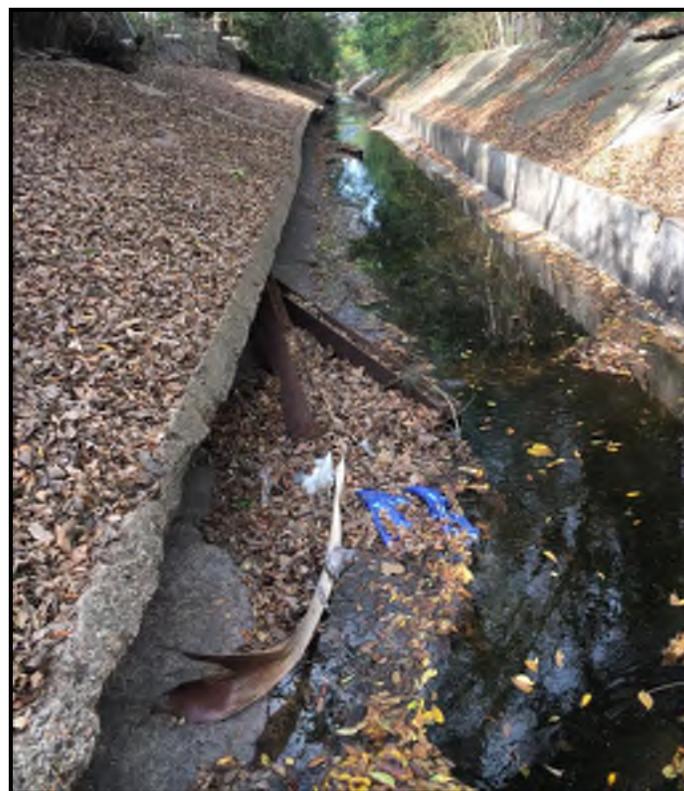


Figure 2-7: View of Temporary Stabilization Measures Along Project Reach (2017)

A full rehabilitation of the project reach has not been performed, and merely maintaining the channel will continue to become more difficult. As the channel continues to deteriorate and become more unstable, the damages induced from major storm events will become more significant. Eventually, portions of the channel would require a full replacement. Staging the equipment and materials necessary to make isolated repairs would be extremely difficult and costly given the access constraints of the channel. Undermining of the existing slope pavement will further compromise the stability of the slopes increasing the risk of damages to adjacent structures.

#### 2.1.4 Bellaire Boulevard Crossing

The Bellaire Boulevard crossing consists of a 36-foot wide, 10-foot tall B-Series ConSpan arch opening, as well as multiple storm drains that outfall beneath the bridge, including a box culvert that serves College Street and other local drainage. The existing crossing is in good overall condition, and no improvements are being proposed. Photographs of the Bellaire Boulevard crossing are presented in Figure 2-8 and Figure 2-9.



**Figure 2-8: Upstream End of Bellaire Boulevard Crossing**



**Figure 2-9: Downstream End of Bellaire Boulevard Crossing**

#### 2.1.5 Channel Reach Downstream of Bellaire Boulevard Crossing

From the Bellaire Boulevard crossing, the channel cross-section narrows over a distance of approximately 90 feet. Immediately beyond this transition zone, the cross-section of the channel reach downstream of the Bellaire Boulevard crossing is comprised of a 20-foot wide by 3.5-foot deep rectangular pilot channel. Above the pilot channel, the channel banks extend at 2.5H:1V side slopes, defining a top width of approximately 38 feet. Reinforced concrete pavement armors the rectangular pilot channel as well as approximately 3.5 vertical feet of the side slopes.

FNI understands from HCFCFD that the channel reach downstream of the Bellaire Boulevard crossing is hydraulically adequate to convey the 100-year storm. No improvements are being proposed along this channel reach. A photograph of this channel reach is presented in Figure 2-10.



**Figure 2-10: View of Channel Reach Downstream of Bellaire Boulevard Crossing**

## **2.2 EXISTING STORMWATER CONDITIONS**

The Current FEMA Effective (Effective) model of Poor Farm Ditch was obtained from the HCFC [www.m3models.org](http://www.m3models.org) website and reviewed for validity as a base condition for analyzing alternatives. All calculations of water surface profiles were performed using HEC-RAS version 3.0.1, and no changes to hydrology were made.

A goal of the stormwater modeling and the development of a Corrected Effective model was to minimize the need for additional cross-sections beyond what was contained within the Effective model; however, the layout of bounding cross-sections for the University Boulevard and Bellaire Boulevard crossings did not allow for the appropriate representation of the transition into and out of the bridge structures. As such, corrections were made to the Effective model layout to remove Effective model cross-sections 5588.431, and 5426.389, and add five new cross sections, 8523.372, 8421.371, 5717.684, 5619.191, and 5414.522 to better account for geometry variation within the study reach (generally Bellaire Boulevard to University Boulevard) for the Corrected Effective model. The bridge geometry was also updated at the Bellaire Boulevard and University Boulevard bridges to reflect current conditions, as the Effective model

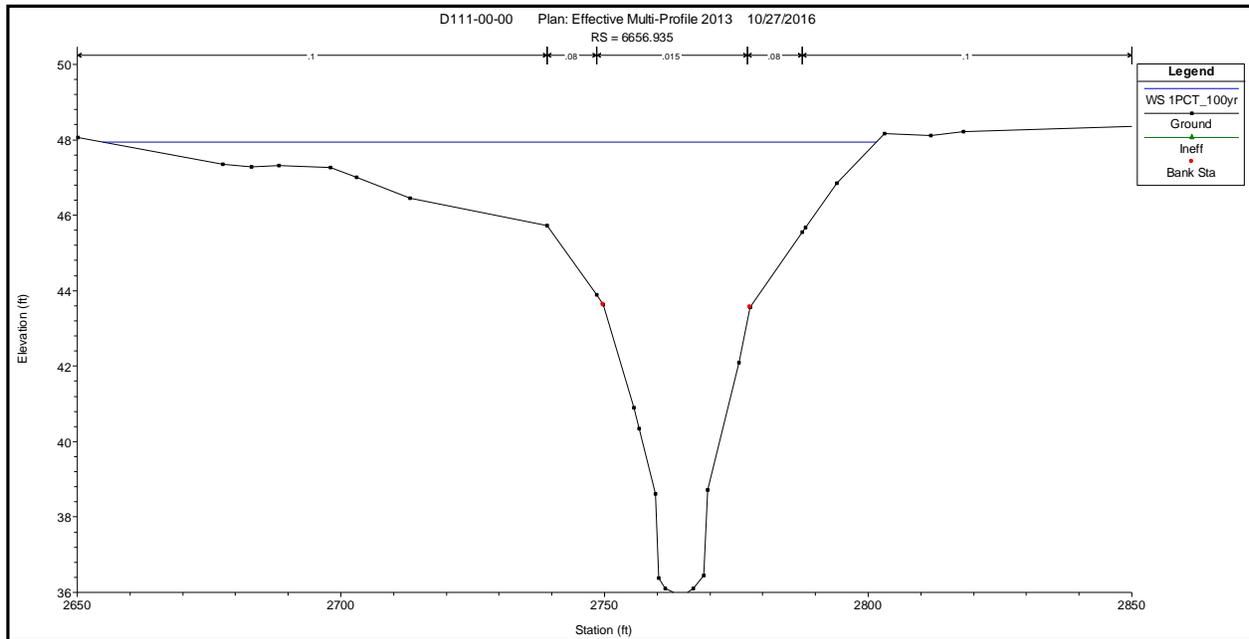
does not include the ConSpan arch opening at the Bellaire Boulevard crossing. No changes were made to the model upstream of University Boulevard or downstream of Bellaire Boulevard, with the exception of the bounding bridge cross-sections. Cross sections in the study reach (cross sections between 5414.522 and 8752.369) had channel elevation data adjusted to match survey data with 2001 HGAC LIDAR data used for the overbanks.

The modification of base conditions from the Effective to the Corrected Effective changed the water surface elevation (WSEL) in the study reach by an average of +0.02 feet for the 10-year event and -0.52 feet for the 100-year event. The maximum increase in WSEL upstream of Bellaire Boulevard was +0.91 feet in the 10-year event, +0.40 feet in the 50-year event, +0.33 feet in the 100-year event, and +0.70 feet in the 500-year event. While the addition of the ConSpan arch opening at Bellaire Boulevard served to lower WSELs in the upstream vicinity of the bridge crossing, these benefits were offset by the channel modifications within the project study reach documented in the survey efforts performed in support of FNI's PER. Including these channel modifications within the Corrected Effective model results in significantly higher channel velocities within the study reach as compared to the Effective model. Further hydraulic results are provided in Appendix E.

It is important to note that the Corrected Effective model produces higher WSELs than the Effective model upstream of the project area, as would be expected due to the channel modifications that are not reflected in the Effective Model. As such, proposed alternatives should show no adverse impacts when compared to the Corrected Effective (as would typically be the case for an impact analysis), while also producing WSELs that are below the Effective WSEL. Therefore, preferred alternatives will not only provide a "real-world" benefit to current channel conveyance but will also lower the WSEL sufficiently to be at or below the Effective Base Flood Elevation (BFE), ensuring that the current floodplain will not increase as a result of the proposed project. The comparison of WSELs for each of the alternatives against the existing condition models are discussed in Section 4.0.

### 2.2.1 Design Cross-Section

The original design cross-section from the Effective Model shown in Figure 2-11 depicts high roughness coefficient values in the overbanks (Manning's  $n$  of 0.1), moderate roughness coefficient values at the bank edges near the easement limits (Manning's  $n$  of 0.08), and low roughness coefficient values) within the channel (Manning's  $n$  of 0.015), which is reflective of the concrete lining.



**Figure 2-11: Effective Model Cross-Section 6656.935**

### 2.2.2 Existing Cross-Section

The existing cross-section from the Corrected Effective Model shown in Figure 2-12 depicts high roughness coefficient values in the overbanks (Manning's  $n$  of 0.1), moderate roughness coefficient values at the bank edges near the easement limits (Manning's  $n$  of 0.08), and low roughness coefficient values in the channel, representing the concrete lining (Manning's  $n$  of 0.015). Additionally, the fence lines and other flow obstructions from adjacent properties are represented as ineffective flow areas, which indicate there is no conveyance through this region.

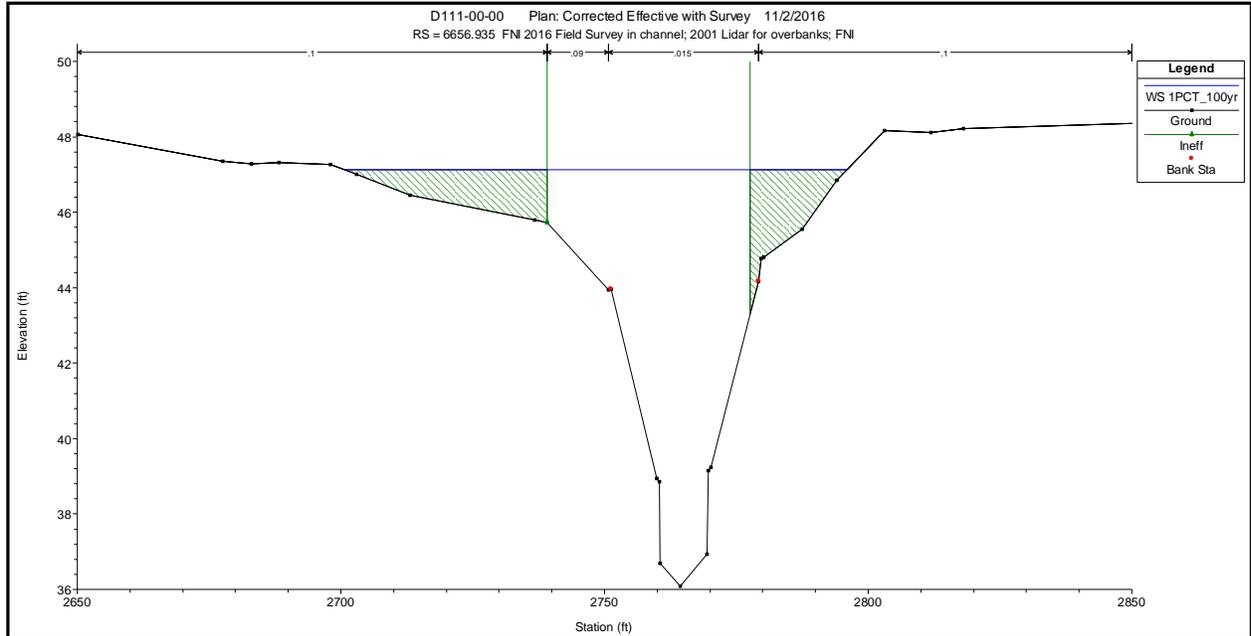


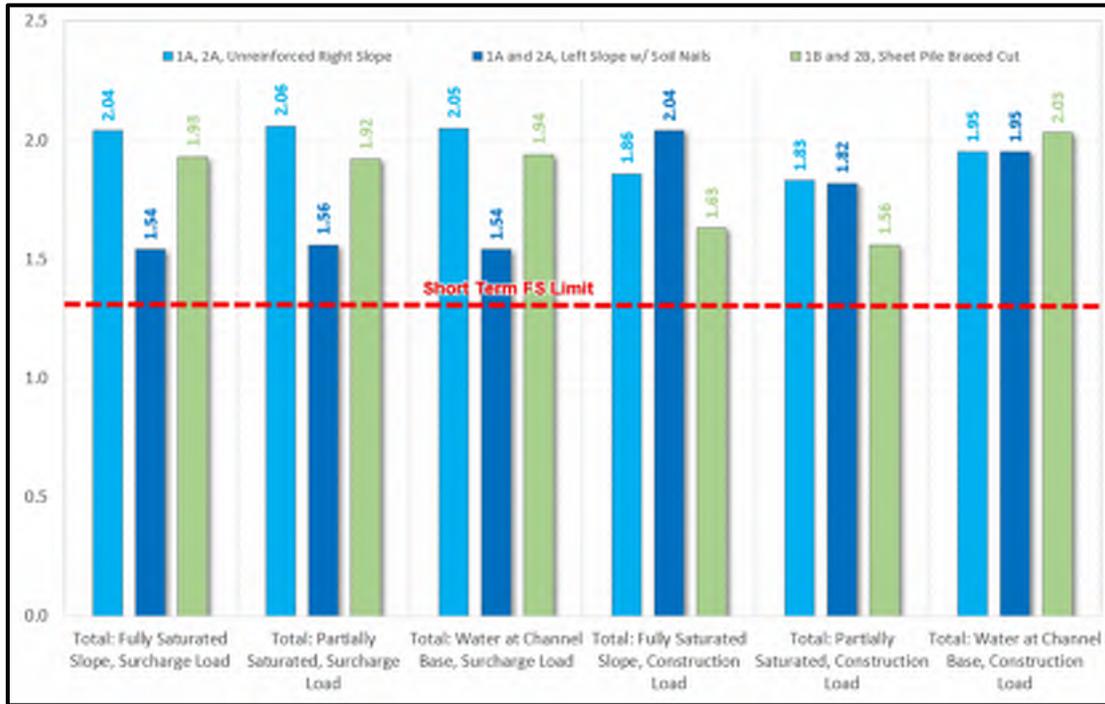
Figure 2-12: Corrected Effective Model Cross-Section 6656.935

### 3.0 TEMPORARY EXCAVATIONS

As the construction of the replacement of Poor Farm Ditch is limited by the proposed 40-foot HCFCF ROW with a project goal to maximize hydraulic capacity, the wide-spread use of unbraced, steep excavations is limited by this narrow corridor width. A temporary excavation analysis was performed assuming a maximum channel depth of 11 feet for all cases; however, the actual depth will vary. The final temporary excavation shoring design will be the ultimate responsibility of a future construction contractor, but performing the preliminary analysis now provides what reasonable constraints to consider when developing feasible channel design alternatives. Any discussion regarding temporary excavation stability is presented to inform the preliminary design process but is not intended to prescribe means and methods used by the future construction contractor. During final design, the construction documents will be prepared to require the contractor to submit a temporary excavation shoring design plan for review by HCFCF and FNI.

The three temporary excavation scenarios analyzed included an unreinforced 1H:1V slope on the east side of the channel (also referred to as right or WUP), a soil nailed 0.5H:1V slope on the west side of the channel (also referred to as left or SSP), and sheet pile braced cuts on both sides of the channel. A summary of the results is shown on Figure 3-1. Refer to the *Excavation Feasibility Analysis Project Memorandum* provided in Appendix C for the modeling process, parameter selection, analysis description, loading conditions and failure surface geometry. As the temporary soil nails would be abandoned after construction is complete, the soil nails on the SSP side of the channel were permitted to extend past the proposed 40-foot HCFCF ROW as long as they remained within the existing 50-foot HCFCF ROW.

The results indicate that all three scenarios meet the minimum factor of safety for short term and rapid drawdown (RDD) scenarios. Note that the factor of safety is 1.26 for the unreinforced right side with a slope of 1H:1V. Although this value is slightly below the 1.3 limit, the assumed full slope saturation is unlikely, and dewatering measures could be reasonably implemented to reduce the saturation levels and improve stability.



**Figure 3-1: Factor of Safety Chart for Temporary Excavations**

The existing conveyance ditch has several locations where the concrete channel linings and pilot channels display some signs of distress, including leaning toe walls, buckled slope pavement, and the previous installation of cross-channel bracing (presumably to arrest leaning of the toe walls). These damages may or may not be the result of global instabilities. However, they are at least considered potential indications of creep, where the creep is related to expansive soil and is described as small, slow-developing, incremental movements of slopes and vertical features corroborated by seasonal moisture variations. These conditions may require additional efforts beyond those presented to stabilize temporary excavations.

## 4.0 CHANNEL DESIGN ALTERNATIVES

Originally, a total of six alternatives were developed as part of the preliminary engineering effort. A seventh alternative was later added, combining temporary shoring options from two other alternatives. Reference the first two pages of Appendix D for overall configurations of these alternatives.

An in-kind replacement of the existing channel was not included as a viable alternative as the slope pavement would not provide a structural solution necessary for a stable channel. Additionally, given the channel modifications documented by the recently collected survey data within the project reach, the results of the stormwater analysis would produce higher WSELs upstream of the project area as described in Section 2.0 when comparing the Corrected Effective model to the Effective model.

The following paragraphs describe the seven design configurations, the stormwater analysis for each alternative, construction considerations, long term maintenance considerations, and the estimates of probable construction cost items.

### 4.1 BOX CULVERTS

#### 4.1.1 Conceptual Design

The first two alternatives, referred to as Alternatives 1A and 1B, consist of two 7x7 RCBs placed on a 2-foot thick reinforced concrete slab on grade. See Figure 4-1 and Figure 4-2, which show the configuration of these alternatives.

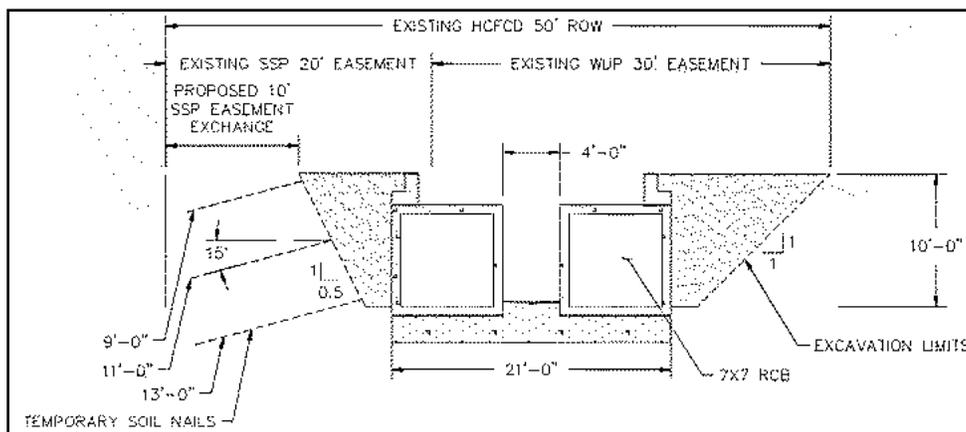
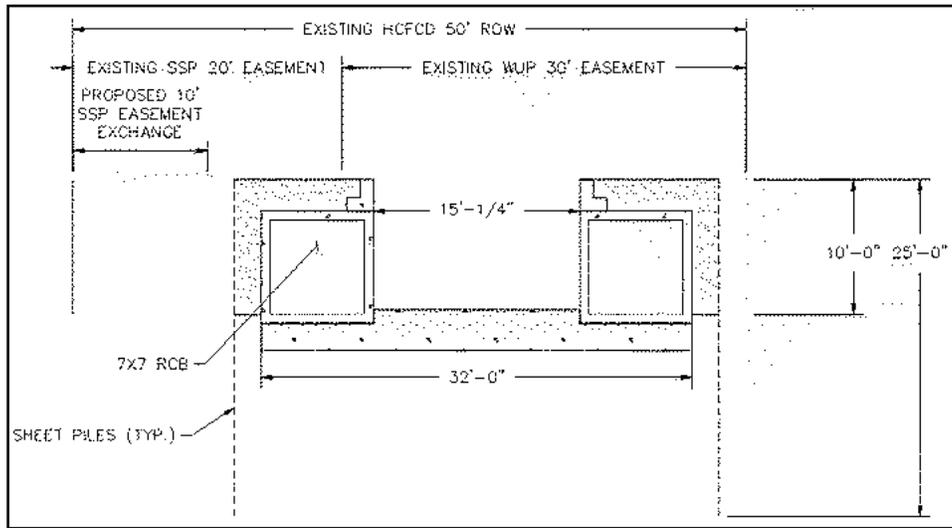


Figure 4-1: Alternative 1A Design Configuration



**Figure 4-2: Alternative 1B Design Configuration**

These alternatives were evaluated for stability against uplift and sliding. The concrete slab thickness was increased to 3 feet between the culverts to provide resistance against sliding of the culverts due to lateral earth pressures behind the culverts. Each of these alternatives will also have a small retaining wall above the culverts on each side to allow for grading of the backslopes and control of surface water runoff.

Alternative 1A could be constructed utilizing a 0.5H:1V temporarily excavated slope on the SSP side of the channel stabilized with temporary soil nails that extend underground to the western limit of the 50-foot wide HCFCO ROW. On the WUP side of the channel, a 1H:1V temporarily unreinforced excavated slope could be utilized. This results in a 21-foot wide cross section, measured from the outside edges of each of the culverts, of which approximately 4 feet is open between the culverts.

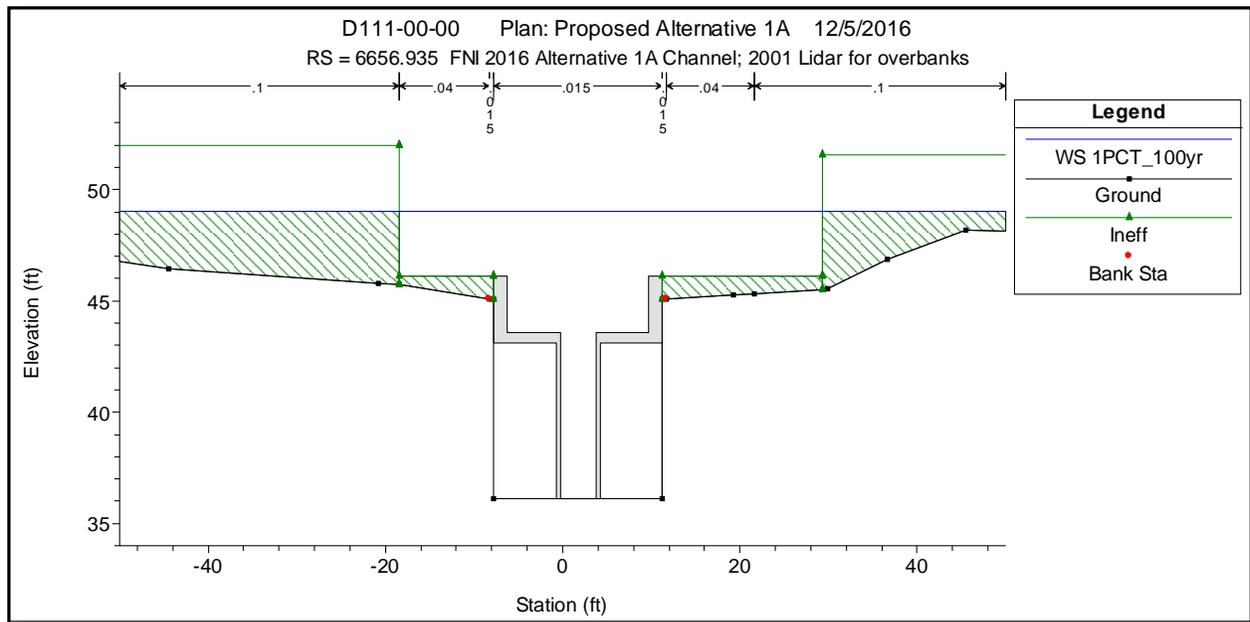
Alternative 1B could be constructed utilizing sheet pile walls to maximize the excavation and cross sectional width. These sheet piles would likely require installation to a depth that is 150 percent of the depth of excavation. Each RCB culvert would be set 2 feet from each sheet pile resulting in a 32-foot wide cross section, measured from the outside edges of each of the culverts, of which approximately 15-feet would be open between the culverts.

#### 4.1.2 Stormwater Analysis

The Corrected Effective model was modified to reflect the geometry of Alternatives 1A and 1B by use of the Channel Modification tool in HEC-RAS. The conveyance portion of the channel (between HEC-RAS

bank stations) was set to have a Manning’s n value of 0.015 for concrete, and from the conveyance portion to the limits of the ROW was set to have a manning’s n value of 0.04, reflective of maintained grass.

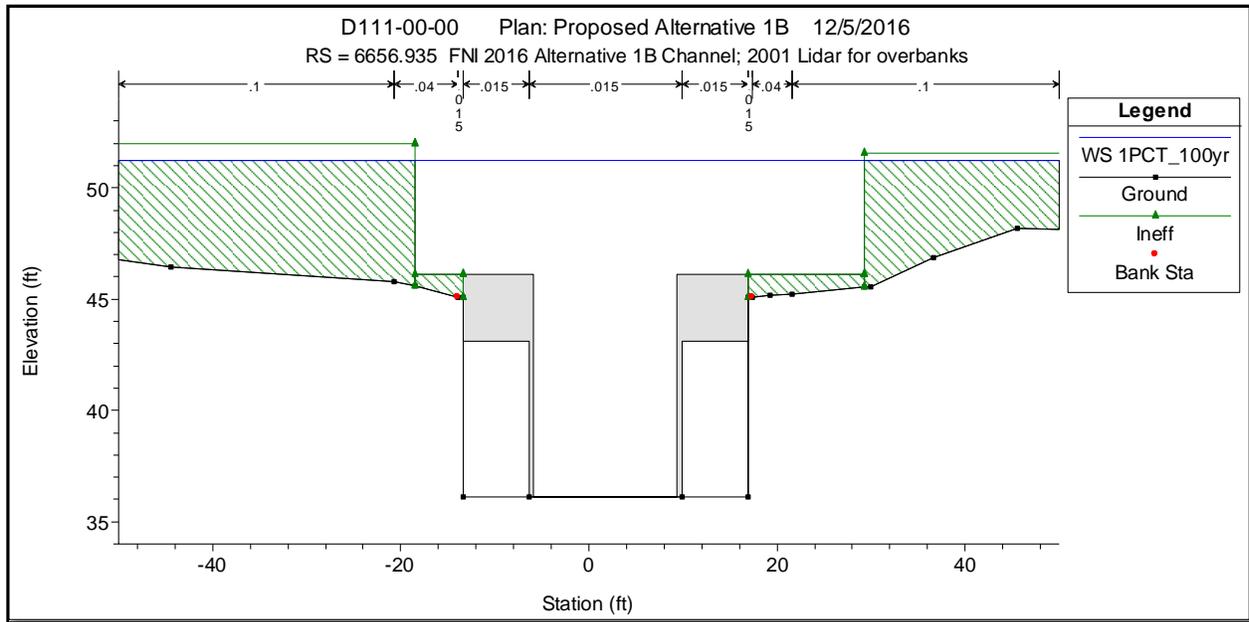
The culverts in the channel were modeled as a lid on the cross section to account for the additional wetted perimeter introduced by the culverts. The typical model cross-section for Alternative 1A is shown in Figure 4-3. The typical model cross-section for Alternative 1B is shown in Figure 4-4.



**Figure 4-3: Alternative 1A Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 1A cross-section generally increased WSELs throughout the study reach, and also produced WSEL impacts that propagated farther upstream. These increases can be attributed to the increased wetted perimeter of the cross-section. Channel velocities through the project reach range between 2.48 and 10.86 feet per second.

Relative to the Effective, the Alternative 1A cross-section also increased the WSELs both within and upstream of the study reach. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.



**Figure 4-4: Alternative 1B Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 1B cross-section Section generally increased WSELs throughout the study reach, and produced WSEL impacts that propagated farther upstream. Similarly to the Alternative 1A cross-section, the increases associated with the 1B section can be attributed to the increased wetted perimeter of the cross-section. Channel velocities through the project reach range between 1.13 and 12.20 feet per second.

Relative to the Effective, the Alternative 1B cross-section also increased the WSELs both within and upstream of the study reach. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.

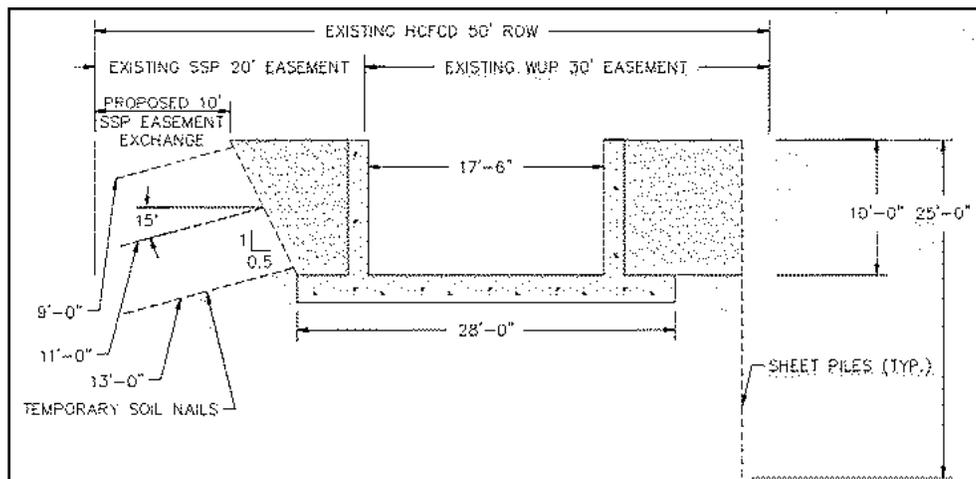
The hydraulic analysis showed that both Alternative 1A and 1B increase WSELs within and upstream of the project reach when compared to both the Current Effective Model and Corrected Effective Model. As it is not desired to create impacts to WSELs as a result of the project, and since these impacts cannot be mitigated off-site, **Alternatives 1A and 1B were not evaluated further for constructability, maintenance considerations, or cost.**



Alternative 2A utilizes a 0.5H:1V temporary excavation slope on the SSP side of the channel stabilized with temporary soil nails that extend underground within the current 50-foot wide HCFCF ROW and a 1H:1V temporary excavation slope on the WUP side of the channel. This results in a 25-foot wide cross section, of which 15 feet is open for conveyance between the walls. Reference previous Section 3.0 for further discussion of the temporary soil nail analysis and placement. The nail lengths are 9, 11 and 13 feet, spaced 5 feet along the slope and every 4 feet along the channel.

Alternative 2B utilizes sheet pile walls to maximize the excavation and cross section. These sheet piles would likely be impounded 150 percent deeper than the depth of excavation. Each cast-in-place wall would be set 5 feet from each sheet pile resulting in a 26-foot wide cross section, of which 15.5 feet would be open for conveyance between the walls. Reference previous Section 3.0. for further discussion of the sheet pile walls, which would likely be embedded up to 150 percent of the exposed channel height.

As there was not much gained from the use of sheet piles versus temporary soil nails in terms of available width for conveyance, a hybrid option 2C was created to maximize the width as shown in Figure 4-7.



**Figure 4-7: Alternative 2C Design Configuration**

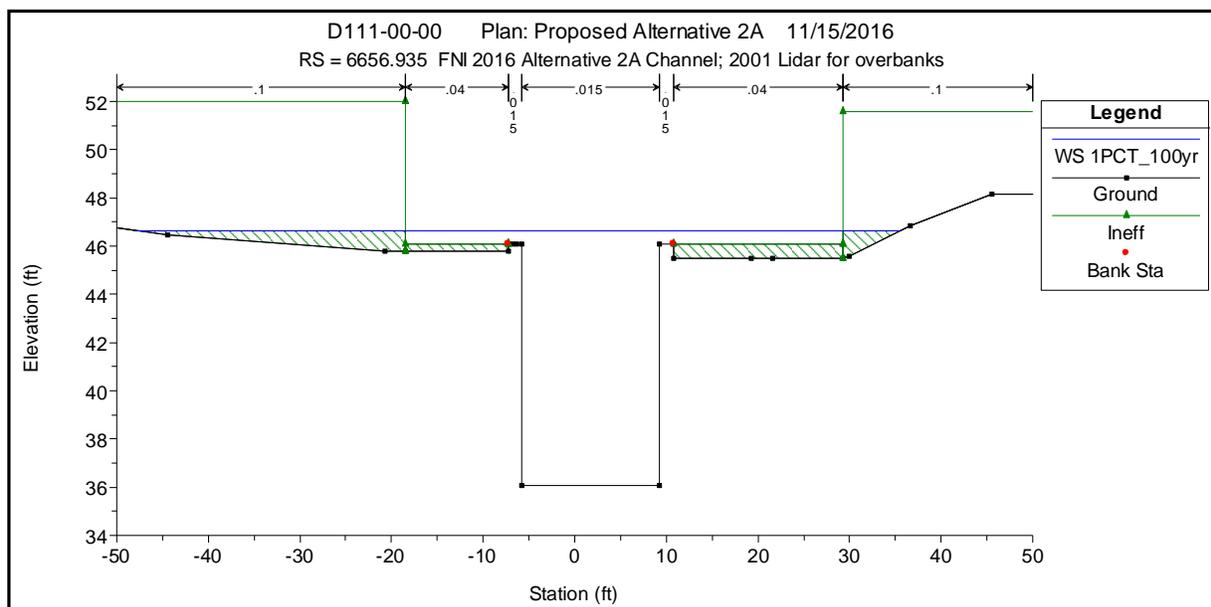
The left side utilizes a 0.5H:1V temporary excavation slope on the SSP side of the channel stabilized with temporary soil nails that extend underground within the current 50-foot wide HCFCF ROW. The right side utilizes a sheet pile wall with the cast-in place wall set 5 feet from the sheet pile. This results in a 28-foot wide cross section, of which 17.5 feet would be open for conveyance between the walls.

Appendix D shows these cross sections placed in seven representative existing sections. To obtain the full channel depth and positive drainage towards the channel, the full use of the existing 50-foot HCFCROW may be necessary. In the representative cross sections shown in Appendix D, fill is generally shown within the WUP easement limits. However, on the SSP side of the channel, most cross sections are shown with fill extents within the western-most 10 feet of the HCFCROW. Shifting the channel to the east (towards WUP) for those reaches where there is a wider easement may address some of the fill placement issues; however, there will be many locations where the full ROW is needed until construction is complete.

#### 4.2.2 Stormwater Analysis

The Corrected Effective model was modified to reflect the geometry of Alternatives 2A, 2B, and 2C by use of the Channel Modification tool in HEC-RAS. The conveyance portion of the channel (between HEC-RAS bank stations) was set to have a Manning’s n value of 0.015 for concrete, and from the conveyance portion to the limits of the ROW was set to a Manning’s n value of 0.04, reflective of maintained grass.

The typical model cross-section for Alternative 2A is shown in Figure 4-8. The typical model cross-section for Alternative 2B is shown in Figure 4-9. The typical model cross-section for Alternative 2C is shown in Figure 4-10.

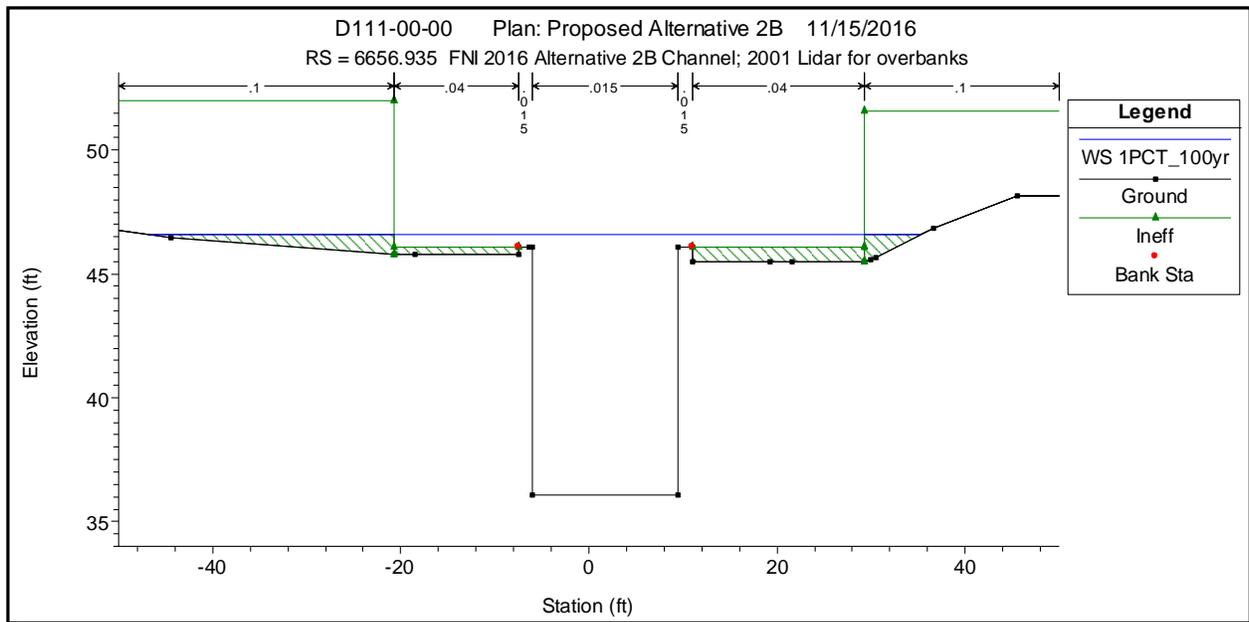


**Figure 4-8: Alternative 2A Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 2A cross-section generally decreased WSELs throughout the study reach; however, there were very minor increases upstream of the study reach for

some frequency events. Channel velocities through the project reach range between 5.67 and 9.69 feet per second.

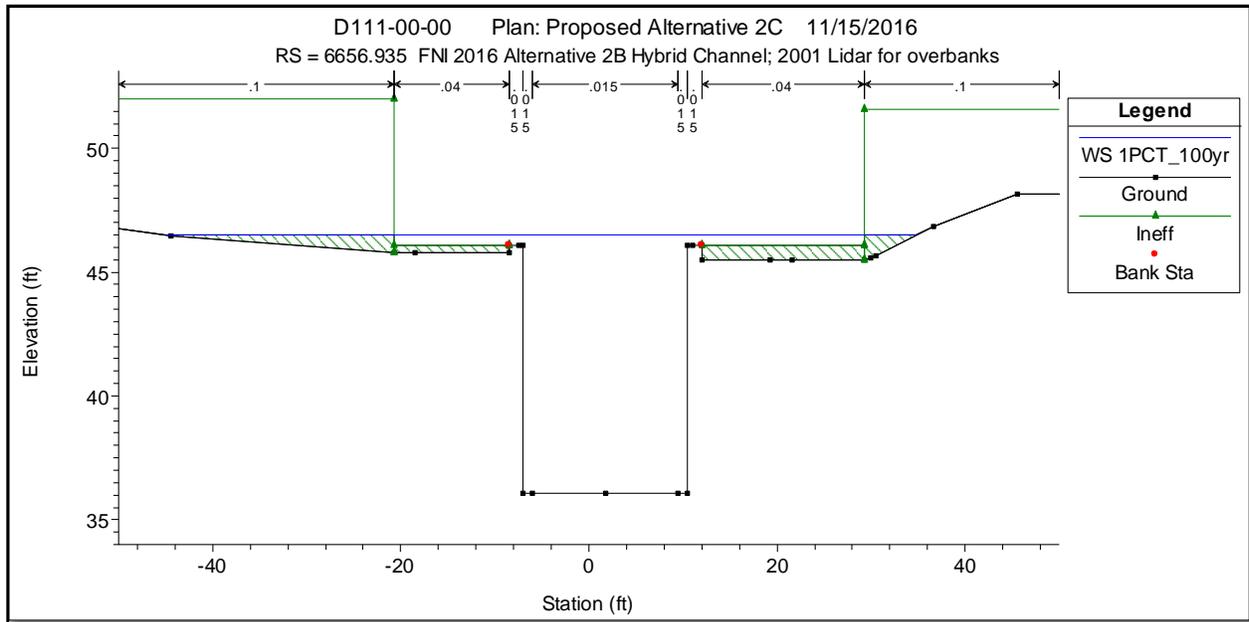
Relative to the Effective, the Alternative 2A cross-section generally decreased WSELs within the study reach, but did produce impacts upstream of the study reach. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.



**Figure 4-9: Alternative 2B Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 2B cross-section decreased WSELs throughout the study reach, and produced insignificant impacts upstream of the study area as compared to the Corrected Effective model. Channel velocities through the project reach range between 5.69 and 9.41 feet per second.

Relative to the Effective, the Alternative 2B cross-section still produced decreased WSELs within the study reach, although there were impacts generated upstream of the study reach. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.



**Figure 4-10: Alternative 2C Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 2C cross-section decreased WSELs within the study reach, and produced negligible impacts upstream of the study reach. Channel velocities through the project reach range between 5.28 and 8.61 feet per second.

Relative to the Effective, the Alternative 2C cross-section also decreased WSELs throughout the study reach and produced negligible impacts upstream of the study reach. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.

Although alternatives 2A and 2B generally provide reductions in WSEL relative to the Corrected Effective model and would provide a benefit to actual current flooding conditions, the alternatives produced isolated impacts in relation to Effective WSELs for the 100- and 500-year events.

Alternative 2C produced benefits throughout and upstream of the study reach, showing no adverse impact to WSELs relative to both the Corrected Effective and Effective models for all storm events up to and including the 100-year event. However, Alternative 2C appears to produce impacts compared to both the Current and Corrected Effective models for the 500-year storm event.



The slope pavement ties into a reinforced concrete slab with a thickness of 2 feet at the flowline of the channel and ties into small reinforced concrete retaining walls at the top of the slope.

Alternative 3A consists of 1H:1V slopes with permanent soil nails extending to the limits of the current 50-foot easement. This would require maintaining an easement to allow the nails to remain in place, including the 10 feet of easement on the SSP side of the channel.

Alternative 3B consists of each slope at a 1H:1V with permanent soil nails extending only to the limits of the proposed 40-foot easement. As the SSP channel overbank and side slope is shown above the existing channel, some fill will be required prior to installing the nails. During design, an alternative approach could be evaluated to install permanent soils nails as part of the initial excavation, placing and compacting fill over the nails, and then placing the concrete slope pavement.

Permanent soil nails were analyzed for both sides of the channel with a summary of the results is shown on Figure 4-13. Refer to the *Excavation Feasibility Analysis Project Memorandum* provided in Appendix C for the detailed analysis description, loading conditions, sections, results and failure surface geometry.

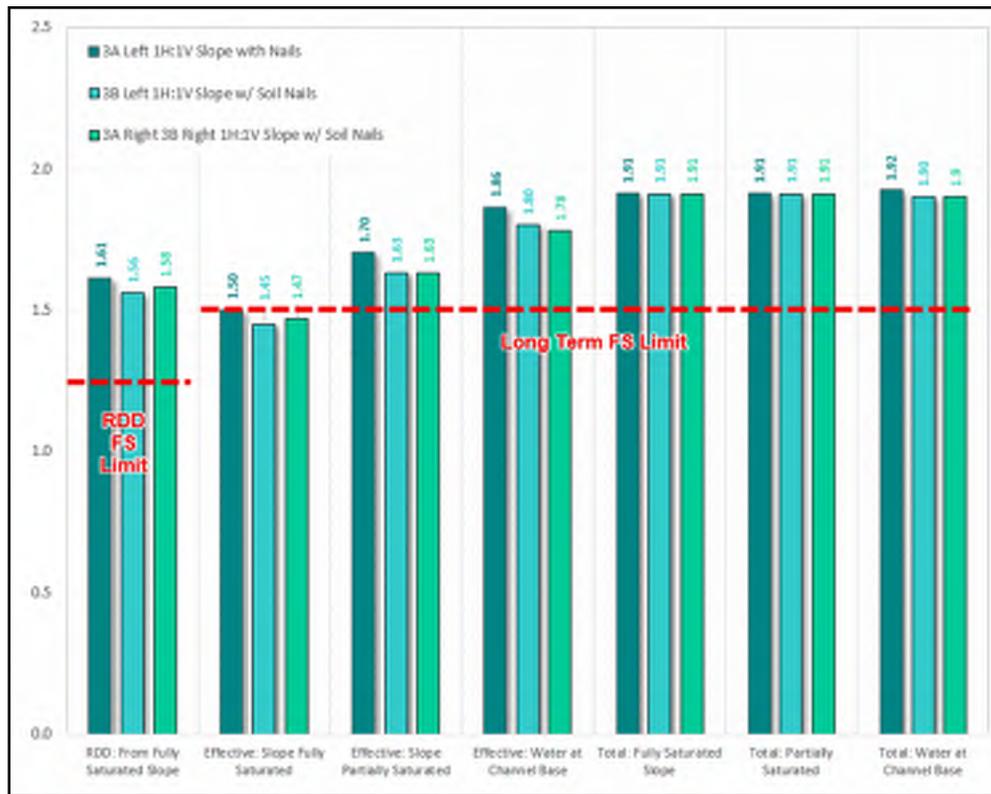


Figure 4-13: Factor of Safety Chart for Permanent Excavations

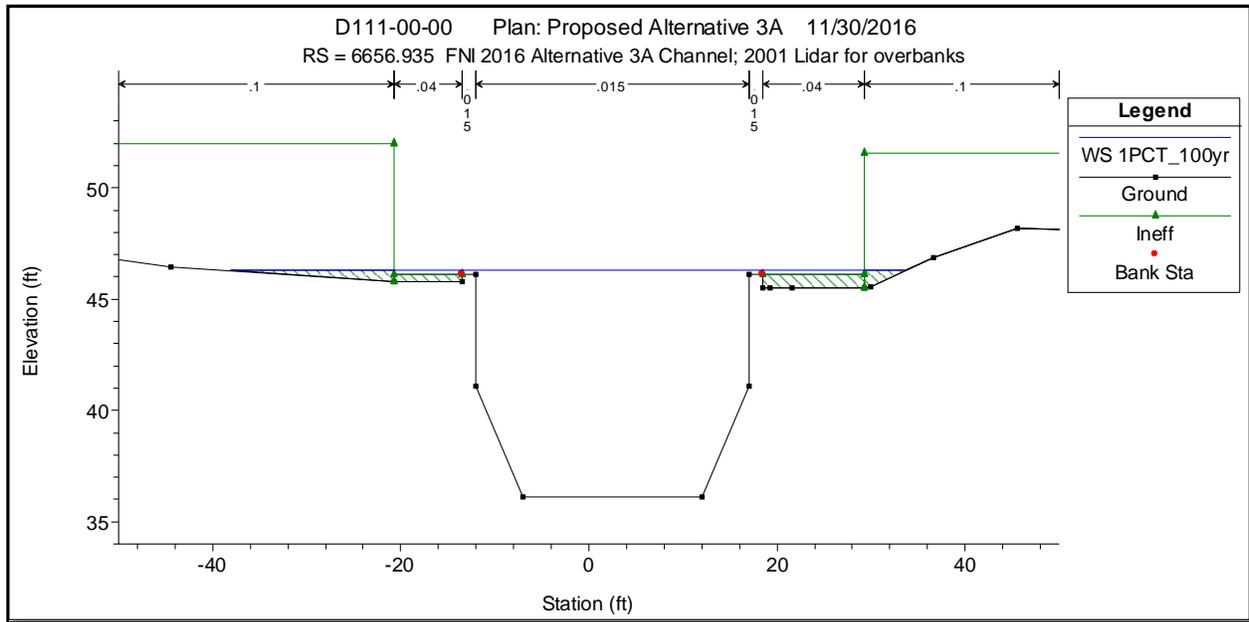
The results indicate generally acceptable factors of safety for these permanent excavations with the addition of soil nail reinforcements. However, the safety factors are slightly below those typically used for the fully saturated slope for effective stress conditions. Since full saturation of the slope is a conservative assumption, it appears that reasonable measures can be included in the design process to improve stability. The permanent soil nail lengths shown in Figure 4-11 and Figure 4-12 have a spacing of 5 feet along the slope and every 2 feet along the channel. If necessary, the channel geometry could be adjusted to allow for a greater length of soil nail within the limits of the HCFCF existing and proposed ROW.

Appendix D shows these cross sections placed in seven representative existing sections. To obtain the full channel depth and positive drainage towards the channel, the full use of the existing 50-foot HCFCF ROW may be necessary. In the representative cross sections shown in Appendix D, fill is generally shown within the WUP easement limits. However, on the SSP side of the channel, most cross sections are shown with fill extents within the western-most 10 feet of the HCFCF ROW. Shifting the channel to the east (towards WUP) for those reaches where there is a wider easement may address some of the fill placement issues; however, there will be many locations where the full ROW is needed until construction is complete.

#### 4.3.2 Stormwater Analysis

The Corrected Effective model was modified to reflect the geometry of Alternatives 3A and 3B by use of the Channel Modification tool in HEC-RAS. The geometry was adjusted to reflect the proposed geometry of each alternative. The conveyance portion of the channel (between HEC-RAS bank stations) was set to have a Manning's n value of 0.015 for concrete, and from the conveyance portion to the limits of the ROW was set to have a Manning's n value of 0.04, reflective of maintained grass.

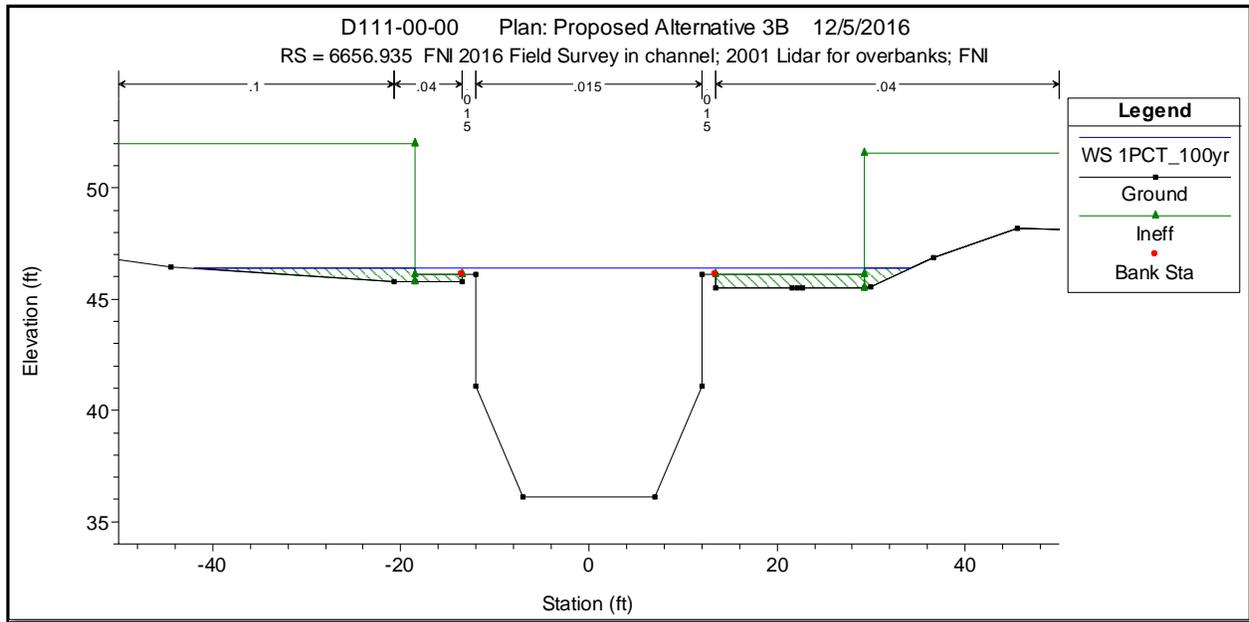
The typical model cross-section for Alternative 3A is shown in Figure 4-14. The typical model cross-section for Alternative 3B is shown in Figure 4-15.



**Figure 4-14: Alternative 3A Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 3A cross-section generally decreased WSELs both within and upstream of the study reach, with no significant impacts produced. Channel velocities through the project reach range between 4.16 and 6.39 feet per second.

Relative to the Effective, the Alternative 3A cross-section also decreased WSELs both throughout the study reach and upstream, and did not produce any adverse impacts to WSELs. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.



**Figure 4-15: Alternative 3B Typical Model Cross-Section**

The change from the Corrected Effective to the Alternative 3B cross-section decreased WSELs both throughout and upstream of the study reach, and did not produce any adverse impacts to WSELs. Channel velocities through the project reach range between 4.94 and 7.75 feet per second.

Relative to the Effective, the Alternative 3B cross-section also decreased WSELs both throughout and upstream of the study reach, and did not produce any adverse impacts to WSELs. See Table 4-1 through Table 4-3 for summaries of changes to WSELs. Further hydraulic results are provided in Appendix E.

Both Alternatives 3A and 3B are the only alternatives to reduce WSELs for all storm events when compared to both the Effective Model and Corrected Effective Model. Furthermore, Alternatives 3A and 3B produce the lowest channel velocities through the project reach in comparison to all other alternatives. Therefore, when comparing all alternatives solely based on hydraulic performance, Alternatives 3A and 3B are the best solutions for the project area.

#### 4.4 STORMWATER ANALYSIS SUMMARY

For each design alternative, Table 4-1 shows the maximum WSEL increases for the 10-, 50-, 100-, and 500-year events within both the Effective and Corrected Effective Models. Generally, HCFCFD regulates projects for events up to, and including the 100-year event. From a regulatory perspective, only Alternatives 2C,

3A and 3B meet the required criteria, as they do not produce any impacts to the Effective 100-year BFE, and Alternative 3B is the only alternative to show no impact in the 10- and 100-year events.

While Alternative 2C produces increases to 500-year WSELs, which are likely due to modeling issues rather than an impact driven by the channel geometry, HCFCD does not typically regulate to this event. Additionally, while Alternatives 2B, 2C, and 3A show minor impacts (less than 0.1 foot for the 10-year event) through the transition section near the Bellaire bridge, these increases are contained within the channel banks, as well as the HCFCD ROW.

**Table 4-1: Summary of Maximum WSEL Increases Within or Upstream of the Study Reach (feet)**

	Effective				Corrected Effective			
	10 yr	50 yr	100 yr	500 yr	10 yr	50 yr	100 yr	500 yr
<b>Alt 1A</b>	2.85	2.59	2.44	1.88	2.42	2.45	2.28	1.81
<b>Alt 1B</b>	4.37	4.36	4.45	1.77	3.98	3.97	4.18	3.34
<b>Alt 2A</b>	0.00	0.10	0.37	0.77	0.01	0.00	0.06	0.08
<b>Alt 2B</b>	0.00	0.00	0.15	0.64	0.01	0.00	0.00	0.01
<b>Alt 2C</b>	0.00	0.00	0.00	0.46	0.06	0.00	0.00	0.46
<b>Alt 3A</b>	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
<b>Alt 3B</b>	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4-2 summarizes the maximum benefit of each alternative by showing the maximum WSEL decrease.

**Table 4-2: Summary of Maximum WSEL Decreases Within or Upstream of the Study Reach (feet)**

	Effective				Corrected Effective			
	10 yr	50 yr	100 yr	500 yr	10 yr	50 yr	100 yr	500 yr
<b>Alt 1A</b>	-1.11	-2.18	-1.80	-3.00	-1.08	-1.31	-0.89	-0.61
<b>Alt 1B</b>	-1.13	-2.45	-1.54	-3.15	-1.10	-1.58	-0.34	-0.86
<b>Alt 2A</b>	-1.08	-2.03	-1.84	-3.08	-1.53	-1.16	-0.93	-0.74
<b>Alt 2B</b>	-1.15	-1.98	-1.80	-3.07	-1.66	-1.11	-0.89	-0.82
<b>Alt 2C</b>	-1.61	-1.74	-1.63	-2.97	-2.03	-1.45	-1.20	-1.20
<b>Alt 3A</b>	-2.80	-2.74	-2.45	-2.92	-3.11	-2.81	-2.66	-2.50
<b>Alt 3B</b>	-2.20	-2.07	-1.85	-3.06	-2.50	-2.14	-1.98	-1.86

Table 4-3 summarizes the changes caused by each alternative within the study reach by showing the average WSEL change.

**Table 4-3: Summary of Average WSEL Changes in Study Reach (feet)**

	Current Effective				Corrected Effective			
	10 yr	50 yr	100 yr	500 yr	10 yr	50 yr	100 yr	500 yr
<b>Alt 1A</b>	1.24	0.78	0.65	-0.29	1.21	1.26	1.18	0.85
<b>Alt 1B</b>	2.15	1.59	1.71	-0.16	2.13	2.08	2.24	0.99
<b>Alt 2A</b>	-0.78	-0.88	-0.82	-1.44	-0.80	-0.40	-0.29	-0.29
<b>Alt 2B</b>	-0.87	-0.98	-0.90	-1.51	-0.89	-0.50	-0.38	-0.36
<b>Alt 2C</b>	-1.09	-1.28	-1.17	-1.73	-1.11	-0.80	-0.64	-0.59
<b>Alt 3A</b>	-1.64	-1.95	-1.88	-2.36	-1.66	-1.47	-1.35	-1.21
<b>Alt 3B</b>	-1.40	-1.70	-1.62	-2.10	-1.43	-1.21	-1.10	-0.95

Table 4-4 provides a comparison of the level of service of all alternatives to the level of service within the study reach for the proposed existing channel based on the corrected effective model. The level of service was determined by comparing the water surface elevation to both the bank stations and the right-of-way limits.

**Table 4-4: Approximate Level of Service of Each Alternative**

Scenario	Level of Service
Corrected Effective	~ 10-yr
Alt 1A	< 10-yr
Alt 1B	< 10-yr
Alt 2A	~ 50-yr
Alt 2B	~ 50-yr
Alt 2C	~ 50-yr
Alt 3A	~ 50-yr
Alt 3B	~ 50-yr

It is also worth noting that floodplain mapping within the study reach is partially driven by Brays Bayou backwater elevation. When modeling the Poor Farm hydraulic reach, a normal depth outfall condition is assumed. Modeling of tributaries to major waterways using this approach often produces lower water surface elevations at the confluence location than those generated by the major waterway. In the case of Poor Farm Ditch, Brays Bayou produces a 100-year WSEL that extends upstream past the Bellaire bridge and into the study reach. While improvements through the study reach may improve local flooding

conditions, they may not impact floodplain mapping and Brays Bayou-driven flooding where the Poor Farm Ditch WSELs are lower than the Brays Bayou BFE.

Additionally, HCFCD is currently updating the model and mapping for D100-00-00 (Brays Bayou) as a part of the Risk Map 6 Study. Because the downstream boundary condition for the Poor Farm model is not based on a known water surface elevation, any update to the backwater mapping due to the Risk Map 6 Study will not impact the results of this analysis.

## **4.5 CONSTRUCTION CONSIDERATIONS**

The following sections describe the construction considerations for Alternatives 2A, 2B, 2C, 3A and 3B with respect to mobilization, demolition, care and control of water, procurement of construction, and construction duration. These sections do not include considerations for Alternatives 1A and 1B as those alternatives were eliminated due to hydraulic impacts.

### **4.5.1 Mobilization**

Implementing any of the channel cross-section alternatives will require significant mobilization efforts, including but not necessarily limited to: establishment of a lay-down area, installation of construction access points, and acquisition of temporary construction easements (TCEs). Provisions for mobilization efforts are generally described as follows:

- SSP owns the vacant lot between 6401 and 6409 Edloe Street. A key project assumption is that SSP will allow use of this vacant lot during construction. This location would likely serve as both a lay-down area and a construction access point;
- Along the eastern edge of the upstream end of the channel, there exists a parking lot owned by the West University United Methodist Church. A contractor could secure a portion of this parking lot for a TCE, thereby affording additional space for a lay-down area as well an additional construction access point;
- There are multiple streets running parallel to the channel (e.g., Virginia Court and Duke Street). A contractor could secure additional construction access points; and
- Though a significant amount of traffic control would be required, a contractor could secure a portion of Bellaire Boulevard and the property located along the eastern edge of the downstream end of the channel for TCEs, thereby affording space for an additional construction access point.

With the proximity of numerous structures adjacent to the channel, the contractor should be required to perform a pre-construction survey to document the existing conditions during the mobilization period prior to any construction activities.

#### 4.5.2 Demolition

As part of the existing channel demolition, existing trees, fencing, and existing storm drain outfall structures would require removal. The recent survey shows that the canopies of many of these trees overhang over both private property and HCFCO ROW. There is the potential that partial tree removal may harm the trees that are not fully within existing HCFCO ROW. Fencing would have to be replaced as a safety measure along the channel after construction, and existing storm drain outfall structures would be replaced in kind.

#### 4.5.3 Concrete Placements

Implementation of all alternatives require the placement of cast-in-place concrete. Given the constraints associated with accessing and navigating the existing channel, concrete placement would likely be accomplished by pumping operations. Typically, the maximum distance concrete can be pumped is approximately 2,500 feet. To maintain the desired mix design criteria, various measures would be required to keep concrete from flashing within the pump hose, which could include: working at night, placing wet burlap sacks over the pump hose, temporarily burying the pump hose, increasing the cement content in the concrete mix, and providing adequate space for a wash out area. When possible, pumping distances should be minimized during construction by phasing out the projects into manageable sections. Given the provisions for mobilization discussed previously, there would be the opportunity to phase the construction into three segments: (1) an approximately 880-foot long channel reach between University Boulevard and the vacant lot along Edloe Street, (2) an approximately 1,110-foot long channel reach starting at the vacant lot along Edloe Street and continuing downstream, and (3) an approximately 1,110-foot long channel reach starting at Bellaire Boulevard and continuing upstream.

#### 4.5.4 Procurement of Construction

For a project of this nature with significant risks related to care of water, complex project phasing, and high visibility with nearby residents, awarding the construction contract based on a one-step or two-step Competitively Sealed Proposal (CSP) rather than Low Bid should be considered. This procurement strategy would allow contractors to be ranked based on evaluation criteria specified by HCFCO that could include

a workplan, phasing, and care of water. Proposals would be ranked according to these criteria in order to select the most qualified, best value contractor. Stakeholders could also be included on the evaluation team to provide input on the most highly qualified contractor.

#### 4.5.5 Care and Control of Water

The normal water depth within the channel is approximately 8- to 10-inches, and based on observations made during the geotechnical investigation, the groundwater table ranges from 1- to 12-feet below the flowline of the channel. Given these conditions, the construction documents should be developed to require the contractor to prepare a care of water plan as part of their proposal (for which a separate pay item should be assigned) sufficient to safeguard the project site from the 10-year event. Additionally, groundwater and surface water would have to be controlled through the use of dewatering system, which could include well points or a sump collection area. Groundwater would be draw down below the depth of excavation. Requiring contractors to include a care of water plan in the proposals and providing a separate pay item for care of water could provide the following benefits:

- The existing hydraulic capacity of the channel could be maintained through construction;
- The contractor would provide protective measures for materials, equipment, and work progress for a specific level of risk;
- The contractor would be less likely to distribute extra costs among the other pay items due to anticipated risk associated with care of water; and
- The contractor's understanding of care of water as it relates to the successful construction of the project could be used as a metric by which HCFCD could evaluate potential contractors.

There are several feasible configurations for implementing a care of water plan as described above. Examples of various methods are generally described as follows:

- Open channel system.
  - Although no features would be constructed to control stormwater, the contractor could move along the channel keeping apprised of any storm events. In the event of a storm, the contractor would remove all equipment and materials from the channel, secure any work in-progress, and minimize any damage.
- Sheet pile system.
  - After demolition of the channel and performing the necessary excavation, a sheet pile system could be used to divide the channel. The sheet piles would be used to route any flows along one side of the over-excavated channel while constructing the other side.

- An earthen cofferdam system.
  - An earthen cofferdam system could be utilized and placed across the channel to dewater the construction area in multiple segments with bypass pumping. Placement of earthen cofferdams would require ample space to ensure they are constructed with stable slopes. The quantity of water required during the ten-year event may preclude the feasibility of bypass pumping. Additionally, redundancy would have to be accounted for in the system to account for any potential mechanical failure.

#### 4.5.6 Construction Duration

Construction durations for each alternative were estimated based on anticipated work required for mobilization, initial earthwork and shoring, concrete placement, backfill, final grading and site cleanup.

All alternatives require some element of mobilization and initial earthwork/shoring. A time of 4 weeks was assumed for each of these activities. For Alternative 3B, an additional 3 weeks was added to the initial earthwork because additional fill is necessary along the SSP side of the channel prior to placing the sloped pavement.

Alternatives 2A, 2B, and 2C require two separate concrete placements – one for the bottom slab and one for the vertical walls after the minimum curing time has been reached for the slab. Assumptions to develop the concrete placement time are generalized as follows:

- Approximately 6 working days would be required to deliver materials, erect scaffolding/framing, and tie rebar; however, these activities would generally work in parallel to others;
- Concrete placements for 40 feet of the channel could be made in 1 day with a 7-day minimum curing time; and
- Placements of concrete for both the slab and vertical walls would likely take a total of 16 calendar days to place 200 feet of channel;

Over a channel length of 3,100 LF, a total time of 248 calendar days (approximately 35 weeks) would be required for concrete placement.

Alternatives 3A and 3B require at least three separate concrete placements for the bottom slab, slope pavement/bottom section of retaining wall, and vertical section of retaining wall. Assumptions to develop the time are generalized as follows:

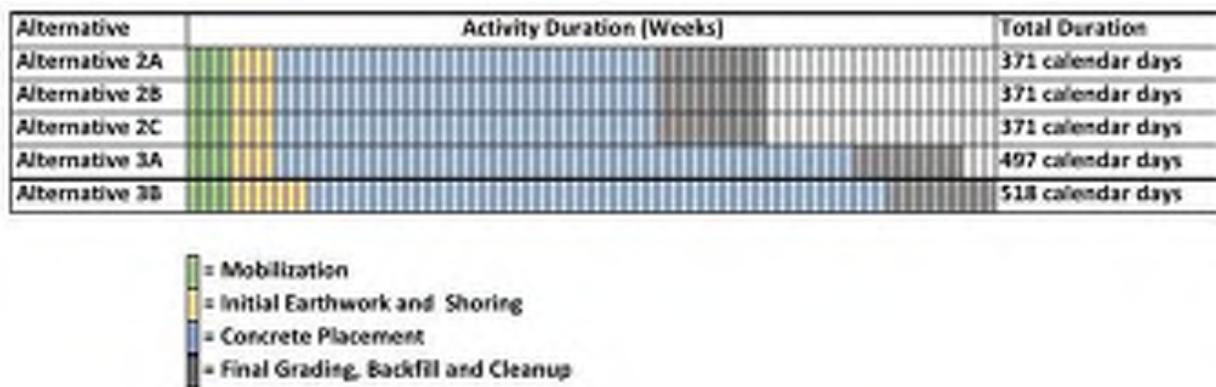
- Approximately 6 working days would be required to deliver materials, erect scaffolding/framing, and tie rebar; however, these activities would generally work in parallel and not on the critical path;

- Concrete placements for 40 feet of the channel could be made in 1 day with a 7-day minimum curing time; and
- For placements of concrete for both the slab, slope pavement/bottom section of retaining wall, and vertical section of retaining wall, a total of 24 calendar days would likely be required to place 200 feet of channel;

Over a channel length of 3,100 LF, a total time of 372 calendar days (approximately 53 weeks) would be required for concrete placement.

A total of 10 weeks was assumed for final grading, backfill and site cleanup activities.

A summary of the activity durations and estimated amount of calendar days is shown in Figure 4-16.



**Figure 4-16: Estimated Construction Duration**

#### 4.6 LONGTERM MAINTENANCE CONSIDERATIONS

With the cast-in-place components of all alternatives, the concrete would be designed to meet American Concrete Institute (ACI) 350 to provide the serviceability, e.g. crack control, and there would be control over the location of horizontal and vertical joints. Groundwater would be drawn down no less than 2- to 3-feet below the maximum depth of excavation when the foundation is installed to minimize the potential for local heave.

Alternatives 2A, 2B and 2C include areas along the top of channel that could be utilized for HCFCD maintenance access. The areas on the WUP side of the channel are more than 10-feet wide. However, final design would have to take in to consideration the grade constraints required for positive drainage towards the channel, which may allow access but preclude a safe driving surface.

Due to the trapezoidal shape of the channel in alternatives 3A and 3B, there would be minimal access for HCFCFCD maintenance staff along the top of the channel. There is also less width to transition grades within the channel overbanks, potentially leading to steeper slopes to tie the proposed section back to existing grade. One alternative would be to design some level of access, e.g. a ramp, down in to the channel where there is additional HCFCFCD ROW.

Alternative 3A includes soil nails that extend past the proposed 40-foot HCFCFCD, which would require HCFCFCD to continue monitoring for encroachments and improvements by property owners that could include large excavations that may undermine the stability of the channel by damaging the permanent soil nails.

Drainage along the back side of the retaining walls for all alternatives would have to be accounted for through cutouts or outfall pipes through the wall. These openings would need to be routinely cleaned out regardless of which alternative is implemented.

#### **4.7 COMPARISON OF PROBABLE CONSTRUCTION COST ITEMS**

For the five remaining alternatives (2A, 2B, 2C, 3A, and 3B), a cost estimate for items associated with each cross-section configuration was developed. These estimates are not intended to be all inclusive of the cost of the project and only include the costs for the channel portion (e.g., approximately 2,800 linear feet, which excludes the transition sections) to provide a basis of comparison. The following assumptions were made in the development of the cost estimate for each alternative:

- Quantities for temporary excavation measures and new construction activities correspond to the configurations shown in Figure 4-5, Figure 4-6, Figure 4-7, Figure 4-11, Figure 4-12 and as illustrated in Appendix D. For sheet piling, the overall unsupported wall height is subject to modification during final design. For cost estimating purposes, an unsupported wall height of 10 feet and an embedment depth of 15 feet were assumed. It was further assumed that 25 percent of all sheet piling would be suitable for re-use during construction;
- The costs of excavation and off-site disposal were developed to account for double-handling the movement of earthen material, which is driven by the access constraints associated with the channel. It is anticipated that excavated earthen material will need to be temporarily stored on-site (presumably within the property near Harper Street and Edloe Street) and subsequently loaded onto a truck to be hauled off-site;
- The costs of placement and compaction of imported fill material were developed in a similar manner to that of excavation and off-site disposal;

- The costs of all reinforced concrete features were developed to reflect the unit pricing observed on similar projects, with additional contingencies to account for pumping operations that extend for distances in excess of 500 feet. Concrete unit pricing was further sub-divided as follows:
  - The following reinforced concrete features are anticipated to be constructed with horizontal formwork:
    - The flowline slab associated with Alternatives 2A, 2B, 2C, 3A, and 3B;
    - The slope pavement comprising the trapezoidal channel associated with Alternatives 3A and 3B; and
    - The lower portion of the retaining walls necessary to facilitate the earthwork along the maintenance berms associated with Alternatives 3A and 3B.
  - The following reinforced concrete features are anticipated to be constructed with vertical formwork:
    - The walls that comprise the rectangular channel associated with Alternatives 2A, 2B, and 2C; and
    - The upper portion of the retaining walls necessary to facilitate the earthwork along the maintenance berms associated with Alternatives 3A and 3B.

Cost estimates for the main channel portion of each alternative can be found in Appendix F and serve to provide a basis of comparison. A summary of each estimate for probable construction cost items for each design alternative is presented in Table 4-5. These costs exclude the following pay items: mobilization, care of water, clearing and grubbing, traffic control, stormwater pollution prevention plan measures, final grading activities, demolition of existing structures, installation of new fencing, construction of the upstream and downstream transition sections, outside drainage features, and utility relocations. Additionally, the construction of a concrete-lined swale feature along the center of the vacant lot near Edloe Street and Harper Street within SSP and relocation of a sanitary sewer lift station at the western end of Carnegie Street within WUP were excluded from the cost estimate.

**Table 4-5: Summary of Probable Construction Cost Items**

Cross Section Alternative	Channel Cost*
2A	\$14,191,400
2B	\$19,864,750
2C	\$17,993,400
3A	\$12,473,450
3B	\$11,071,900

\*Channel cost estimates not intended to be all inclusive of project costs

## 5.0 EVALUATION OF ALTERNATIVES

Two different methods were used to evaluate each of the alternatives to allow for greater opportunity for capturing input into the decision-making process. The two methods utilized included weighted factors and a Pairwise analysis, which are further described subsequently. For both methods, the following criteria were used:

- Hydraulic Capacity
- Project Cost
- Design Life
- Maintenance
- Construction Duration
- Impact of Construction Activities

The criteria are further defined in subsequent sections.

### 5.1 METRICS FOR EVALUATION CRITERIA

#### 5.1.1 Hydraulic Capacity

It is critical to the project to ensure that there are no adverse impacts for the 100-year BFE in the Effective Model, as well as the other storm events. While the current channel has an approximate 10-year capacity and there exists a goal of improving the condition and conveyance capacity of the channel, the main constraint is driven by ensuring no adverse impacts to WSELs. Table 5-1 reflects the scoring criteria for the hydraulic capacity of each alternative. The average WSEL reductions reflected in the higher ranked criteria are compared to the Corrected Effective model, which represents the “true” benefits as that model considers the most recent topographic data for the channel.

**Table 5-1: Hydraulic Capacity Scoring Criteria**

Weighting Support	Score
Adverse impacts to 100-year WSEL on Effective and Corrected Effective models	0
Adverse impacts to 100-year WSEL on the Effective or Corrected Effective models	3
No impacts to 100-yr WSEL. Average WSEL reduction from Corrected Effective model less than 0.50' within study reach	6
No impacts to 100-yr WSEL. Average WSEL reduction from Corrected Effective model between 0.50' and 0.75' within study reach	7
No impacts to 100-yr WSEL. Average WSEL reduction from Corrected Effective model between 0.75' and 1.0' within study reach	8
No impacts to 100-yr WSEL. Average WSEL reduction from Corrected Effective model between 1.0' and 1.25' within study reach	9
No impacts to 100-yr WSEL. Average WSEL reduction from Corrected Effective model greater than 1.25' within study reach	10

5.1.2 Project Cost

Table 5-2 provides scoring for ranges of project costs provided in the cost summary for each alternative. Note that for this metric, each alternative was evaluated as a function of the costs presented in Section 4.7.

**Table 5-2: Project Cost Scoring Criteria**

Weighting Support	Score
Greater than \$20,000,000	2
\$17,500,000 to \$20,000,000	4
\$15,000,000 to \$17,500,000	6
\$12,500,000 to \$15,000,000	8
Less than or equal to \$12,500,000	10

5.1.3 Design Life

Major factors considered when estimating the design life include complexity of design, the methods of construction, the ability to ensure quality during construction, and the ease of inspection and maintenance. Table 5-3 defines the scoring associated with design life.

**Table 5-3: Design Life Scoring Criteria**

Weighting Support	Score
50 to 75 years	8
75 years or more	10

#### 5.1.4 Maintenance

The biggest concern regarding maintenance is the ability to access the channel from the top. Table 5-4 defines the scoring associated with maintenance.

**Table 5-4: Maintenance Scoring Criteria**

Weighting Support	Score
No maintenance access along the top of the channel	5
Maintenance access along the top of the channel	10

#### 5.1.5 Construction Duration

Table 5-5 defines the scoring associated with construction duration.

**Table 5-5: Construction Time Scoring Criteria**

Weighting Support	Score
Greater than 15 months	5
15 months or less	10

#### 5.1.6 Impact of Construction Activities

The potential impacts of construction activities, both real and perceived, to adjacent homes and properties have been the most significant concern raised by property owners. Additionally, SSP property owners do not want to lose use of the portion of their properties that are currently fenced off. Table 5-6 shows how the scoring was applied to each alternative for impact of construction activities.

**Table 5-6: Impact of Construction Activities Scoring Criteria**

Weighting Support	Score
Major disturbances to property owners (e.g., sheet piles) and existing 50-foot wide HCFCF ROW permanently required	2
Major disturbances to property owners (e.g., sheet piles) and proposed 40-foot wide HCFCF ROW permanently required	4
Minor disturbances to property owners (e.g., soil nails or sloped excavation) and existing 50-foot wide HCFCF ROW permanently required	8
Minor disturbances to property owners (e.g., soil nails or sloped excavation) and proposed 40-foot wide HCFCF ROW permanently required	10

## 5.2 WEIGHTED FACTORS ANALYSIS

The weighted factors analysis allows identified criteria to be weighted based on percentages that sum to 100 percent. This method provides a clear, transparent way for the importance of each individual criteria to be established, and produces clear results where a total weighted score of “10” represents an alternative where all criteria were met and a total weighted score of “0” shows that no criteria were met. Each of the criteria was given a percentage weighting as follows:

- Hydraulic Capacity – 30 percent
- Project Cost – 20 percent
- Design Life – 10 percent
- Maintenance – 15 percent
- Construction Duration – 10 percent
- Impact of Construction Activities – 15 percent

Using the criteria, weights, and metrics previously identified, Table 5-7 presents a ranking of all alternatives. The metrics defined in Section 5.1 were used to score each of the criteria. Each score is multiplied by the criteria weight and added together for a total sum.

**Table 5-7: Weighted Factor Ranking of Channel Cross-Section Alternatives**

Alternative	Hydraulic Capacity	Project Cost	Design Life	Maintenance	Construction Duration	Impact of Construction Activities	Weighted Sum	Rank
<b>Criteria Weight</b>	<b>0.30</b>	<b>0.20</b>	<b>0.10</b>	<b>0.15</b>	<b>0.10</b>	<b>0.15</b>		
Alternative 2A	0	8	10	10	10	10	6.60	4
Alternative 2B	3	4	10	10	10	4	5.80	5
Alternative 2C	7	4	10	10	10	4	7.00	3
Alternative 3A	10	10	8	5	5	8	8.25	1
Alternative 3B	9	10	8	5	5	10	8.25	1

Using the weighted factor ranking of channel cross-section alternatives, Alternatives 3A and 3B are both ranked the highest. Alternative 3A is ranked high based upon no adverse hydraulic impacts and best average WSEL reduction within the study reach; however, it scored lower in the impact of construction activities because the full 50-foot HCFCD ROW would still be required. Alternative 3B is ranked high based upon no adverse hydraulic impacts, low project cost, and low impact of construction activities.

### 5.3 PAIRWISE ANALYSIS

To supplement the weighted factors analysis, a Pairwise Analysis was performed to determine the tradeoffs between evaluation criteria as a function of their relative importance. Though the same criteria were used as done in the previous exercise (i.e., hydraulic capacity, project cost, etc.), the relative weightings differ because a Pairwise analysis has more objectivity. The process of determining a total sum for each alternative, like the weighted factors analysis, involves attributing a score to each of the criteria and then multiplying each score by the applicable criteria weight. The scores are then added together for a total sum. The alternative yielding the highest total sum is recognized as the most favorable.

Table 5-8 presents how each of the factors were weighted for each evaluation criteria using this method. The identified evaluation criteria are presented across the top row and left column. The solid blocks down the middle are where the criteria intersect themselves. If the criteria on the top are more important than the criteria on the left, a value of 1 is populated. If they are equally important, a value of 2 is populated. If the criteria on the left are more important than the criteria on the top, a value of 3 is populated. The

sum of all values for a given row then becomes the weighting factor of the respective evaluation criteria. Using the Pairwise analysis typically provides a greater separation between each alternative.

**Table 5-8: Calculation of Pairwise Weighting Factors for Evaluation Criteria**

		1	2	3	4	5	6		
Criteria		Hydraulic Capacity	Project Cost	Design Life	Maintenance	Construction Duration	Impact of Construction Activities	Sum	Rank
1	Hydraulic Capacity		3.00	3.00	3.00	3.00	3.00	15.00	1
2	Project Cost	1.00		3.00	3.00	3.00	3.00	13.00	2
3	Design Life	1.00	1.00		1.00	2.00	1.00	6.00	5
4	Maintenance	1.00	1.00	3.00		3.00	2.00	10.00	3
5	Construction Duration	1.00	1.00	2.00	1.00		1.00	6.00	5
6	Impact of Construction Activities	1.00	1.00	3.00	2.00	3.00		10.00	3

Using the criteria, weights established in Table 5-8, and the metrics defined in Section 5.1, each of the alternatives were scored. Each score is multiplied by the criteria weight and added together for a total sum. Table 5-9 presents the results of the overall scores and ranking for each channel cross-section alternative.

**Table 5-9: Pairwise Ranking of Channel Cross-Section Alternatives**

Alternatives	Criteria						Sum	Rank
	Hydraulic Capacity	Project Cost	Design Life	Maintenance	Construction Duration	Impact of Construction Activities		
<b>Criteria Weight</b>	<b>15</b>	<b>13</b>	<b>6</b>	<b>10</b>	<b>6</b>	<b>10</b>		
Alternative 2A	0	8	10	10	10	10	424	3
Alternative 2B	3	4	10	10	10	4	357	5
Alternative 2C	7	4	10	10	10	4	417	4
Alternative 3A	10	10	8	5	5	8	462	2
Alternative 3B	9	10	8	5	5	10	493	1

The Pairwise analysis ranks Alternatives 3B and 3A the highest confirming the highest ranked results of the weighted factor method; however, Alternative 3B is ranked higher than Alternative 3A due to lower impact of construction activities.

## 6.0 SUMMARY AND RECOMMENDATION

Using the weighted factors method to evaluate the five alternatives, Alternatives 3A and 3B were both ranked the highest. Using the Pairwise method, Alternative 3B was ranked the highest with Alternative 3A as the second highest.

Alternative 3B consists of a trapezoidal channel with reinforced slope pavement anchored by permanent soil nails extending to the proposed 40-foot HCFCF ROW limit. This alternative was ranked high based upon the following:

- Decrease in WSELs when compared to both the Effective Model and Corrected Effective Model for all storm events;
- Lowest cost for the items associated with the design configuration; and
- Least impact of construction activities to nearby residences.

The most significant tradeoffs associated with this alternative when compared to others is that the desired HCFCF maintenance access along the channel is not feasible, the time of construction is longer than all other alternatives, the hydraulic benefits are not as great when compared to Alternative 3A, and the design life is slightly less than other alternatives.

Alternative 3A is similar in geometry to Alternative 3B but has a wider cross section with permanent soil nails utilizing the full 50-foot HCFCF ROW. The only difference in scoring was that this alternative had a more significant impact of construction activities to nearby residences due to the extended soil nails; however, this alternative provided greater hydraulic benefits when compared to Alternative 3B, as it lowered WSELs by an additional 0.2 feet on average within the study reach, as reflected in Table 4-3.

For HCFCF to evaluate the implementation of either of these alternatives and coordinate with each of the cities, total project costs were developed for Alternatives 3A and 3B. A breakout of each total project cost is included as Appendix G. The total project costs for Alternatives 3A and 3B are \$23,740,768 and \$20,350,561, respectively. The following assumptions are noted:

- The Opinion of Probable Construction Costs (OPCCs) for Alternative 3A and 3B were determined to be \$20,904,585 and \$17,644,770, respectively. The OPCCs include a 30% contingency factor to account for:
  - Uncertainties associated with the contractor's care of water plan, as well as dealing with

limited site access and staging opportunities; and

- Adjusting, or working around, existing and proposed structures and facilities adjacent to the channel. Specific items already identified include a proposed concrete-lined swale feature within SSP, and an existing sanitary sewer lift station as well as a group of maintenance boxes associated with ATT underground cables within WUP.
- The total engineering design fee, inclusive of FNI's contract as well as previous studies, was set equal to \$2,000,000.00; and
- The anticipated construction management fees were set equal to 4% of the respective OPCCs.

On April 20<sup>th</sup>, 2017, a meeting was held with HCFCD's Engineering Review Board (ERB) to consider the findings, existing conditions, conveyance, and encroachment issues identified during the preliminary engineering phase of the project. An additional objective of this meeting was to solicit concurrence for moving forward with the final design of Alternative 3B. At the conclusion of this meeting, the recommendation to move forward with the final design of Alternative 3B was unanimously approved by the ERB. A 3D rendering generally depicting Alternative 3B, which was developed concurrent to the ERB process is presented in Figure 6-1.

After establishing Alternative 3B as the preferred alternative, FNI performed a preliminary analysis at the request of HCFCD to determine if additional volume would be required in the Meyer Basin to mitigate the proposed channel improvements. The memorandum documenting this analysis is provided in Appendix I. While there are several variables which will impact final design and, ultimately, the final mitigation volume required, it is expected that the volume previously allocated within the Meyer Basin is adequate in mitigating the proposed channel improvements associated with Alternative 3B.

# PREFERRED CROSS SECTION

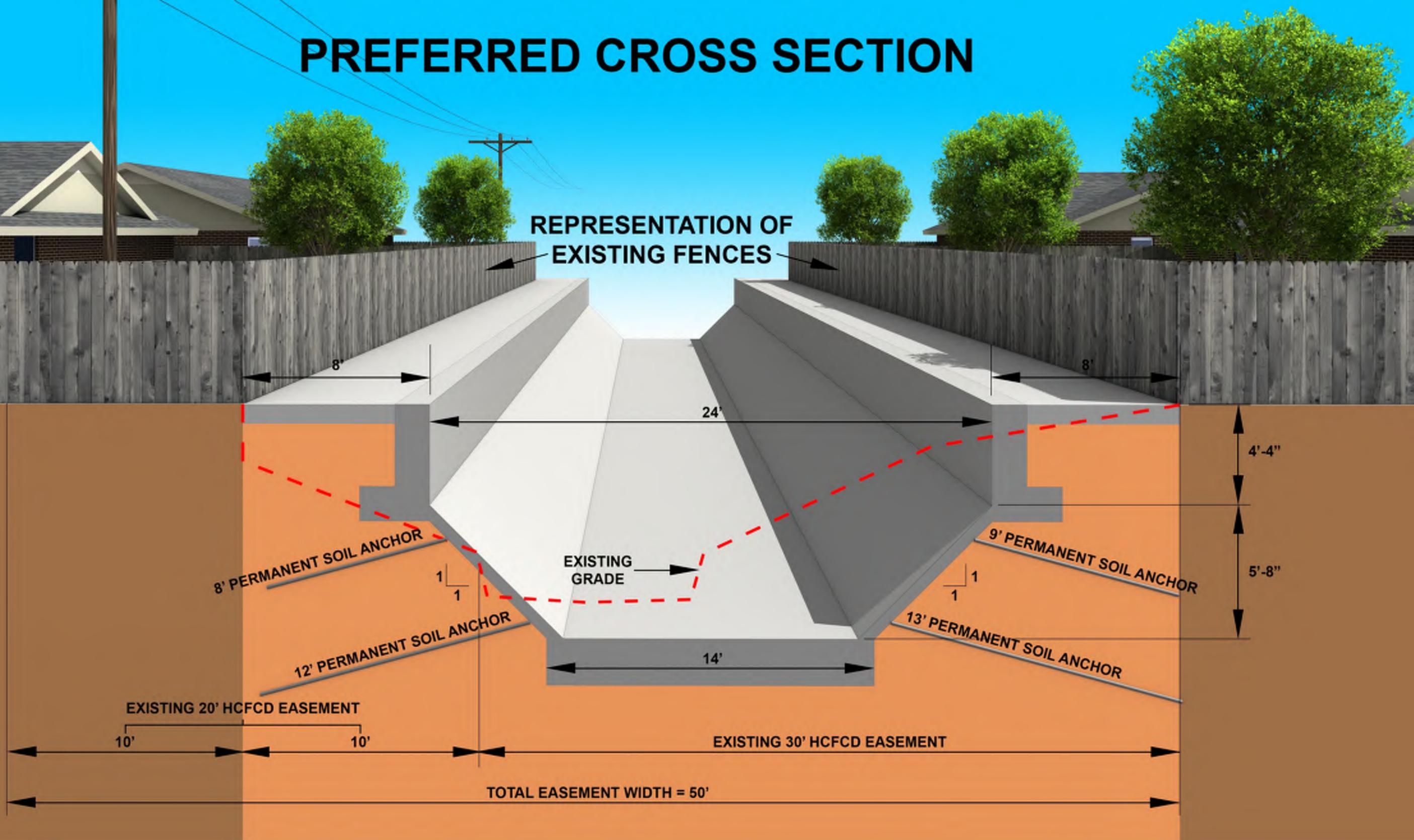


Figure 6-1

Based on the feedback received at the ERB meeting, as well as per subsequent direction given by HCFCD, the following items reflect activities that will be incorporated in the final design of Alternative 3B:

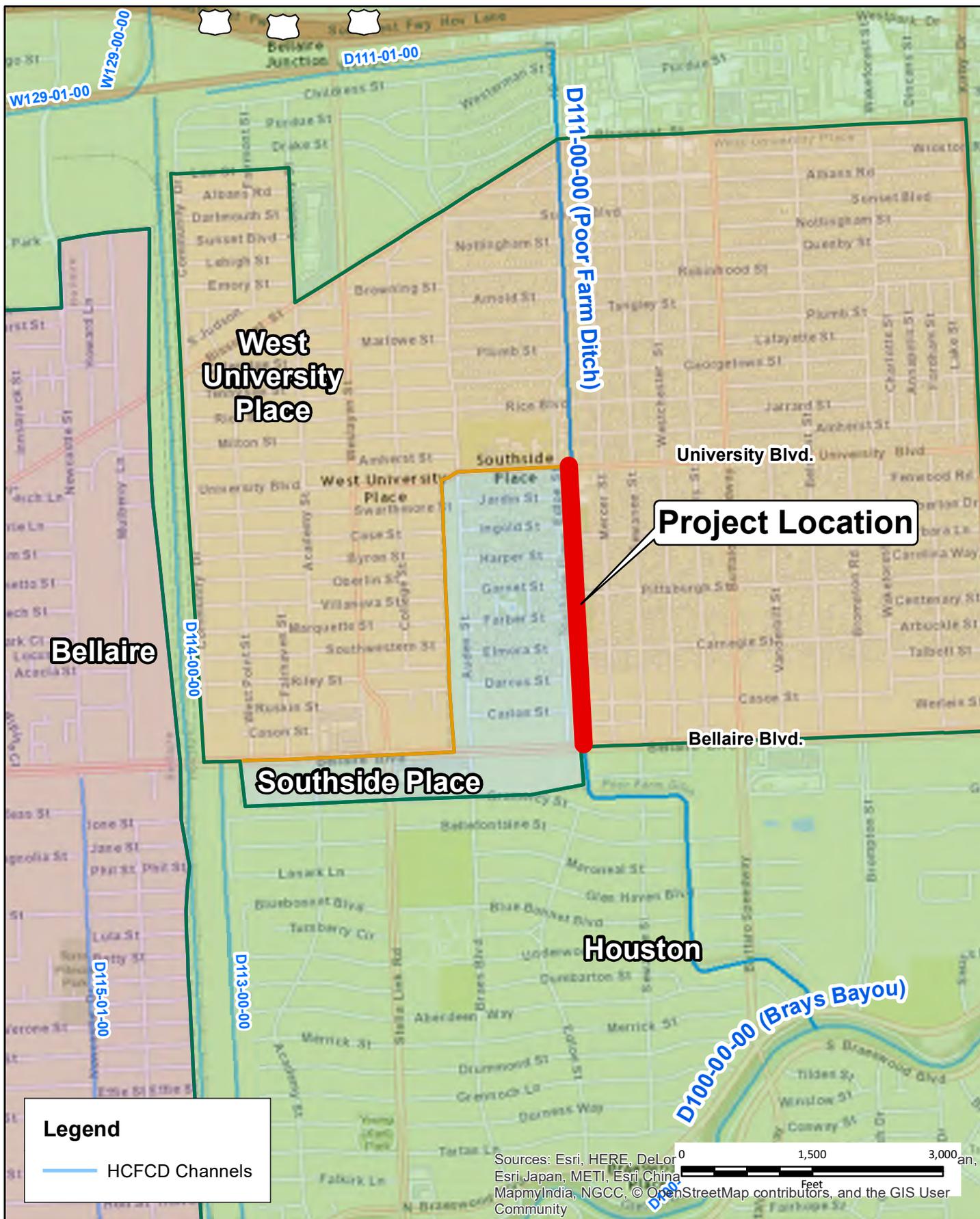
- Based on the anticipated needs of HCFCD’s Infrastructure Department, incorporate at least two permanent maintenance access points;
- Incorporate provisions for public safety and deterrence of trespassing along the project reach; and
- Perform an expanded Impact Analysis to include:
  - Development of a detailed steady state hydraulic model which incorporates topographic survey data to reflect the current channel condition;
  - An evaluation of Brays Bayou backwater conditions for the Current Effective and Brays Bayou Conditional Letter of Map Revision (CLOMR) modeling;
  - Development of an unsteady state hydraulic model to evaluate potential for increases in flows and WSE downstream of the project reach; and
  - An evaluation of potential impacts to storm sewer outfalls downstream of the project reach.

At the request of HCFCD’s stormwater quality department, FNI evaluated the feasibility of implementing water quality enhancements along the project reach. FNI specifically consulted the document entitled, “HCFCD Water Quality Enhancement Section for Preliminary Engineering Report (PER) or Project Design Report (PDR)” to determine its applicability to the content presented in this PER. It was determined by HCFCD and FNI project team members that the project reach does not have sufficient opportunities for water quality enhancements. It was further concluded that such enhancements would not be required along the project reach given:

- The total footprint of impervious cover is not being increased by more than one acre from its current condition; and
- The project reach is not located within unincorporated Harris County or the City of Houston.

During final design, the project team will coordinate with SSP and WUP as appropriate to verify that the cities will not require specific provisions for water quality enhancements.

## **APPENDIX A: EXISTING CONDITIONS**



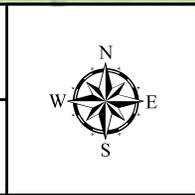
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DATE CREATED	Date: 12/7/2016
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Name: D111-00-00
PREPARED BY	DML

**FREESE AND NICHOLS, INC.**  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
 OFFICE: 713-600-6800  
 FAX: 713-600-6801

H.C.F.C.D.  
**Poor Farm Ditch**

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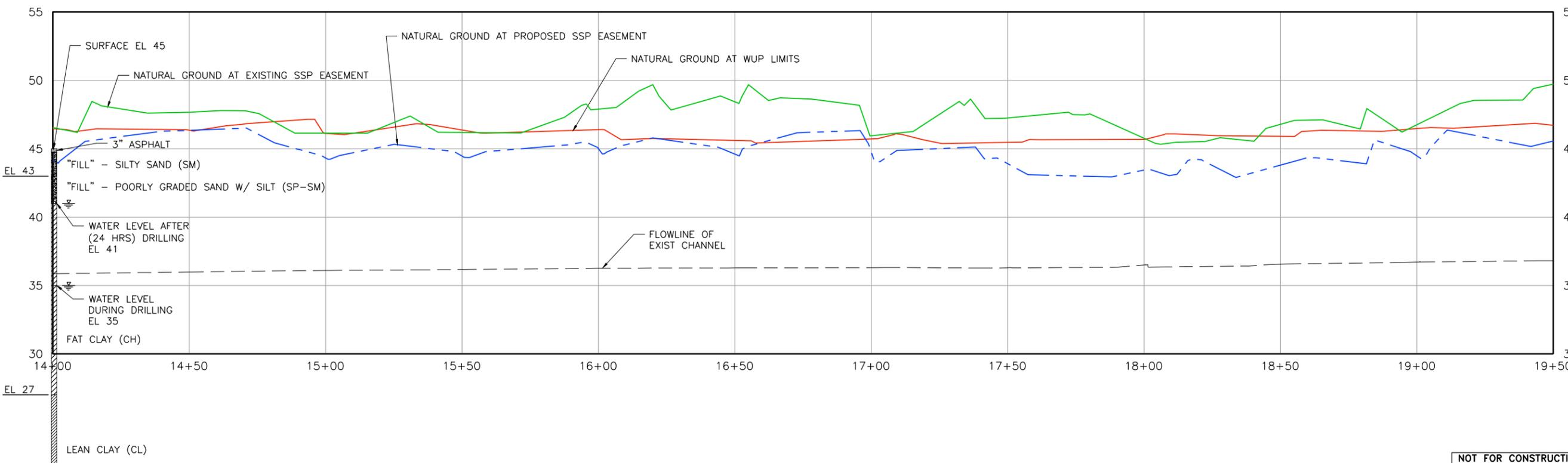
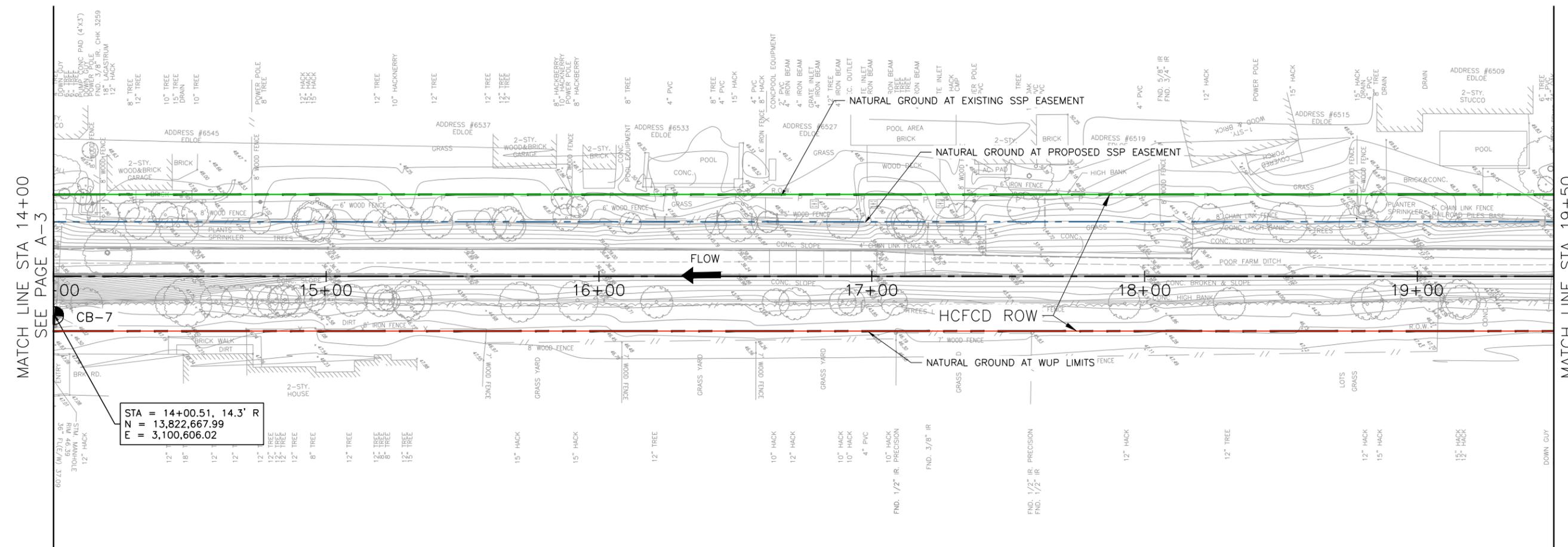
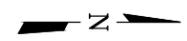
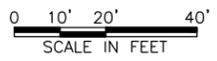
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APPENDIX A	POOR FARM DITCH IMPROVEMENTS HARRIS COUNTY FLOOD CONTROL
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<b>F. FREESE &amp; NICHOLS</b> 10497 Town and Country Way, Suite 600 Houston, Texas 77024 Phone - (713) 600-6800 Fax - (713) 600-6801	<b>HARRIS COUNTY FLOOD CONTROL DISTRICT</b> 9900 Northwest Freeway Houston, Texas 77092
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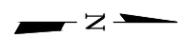
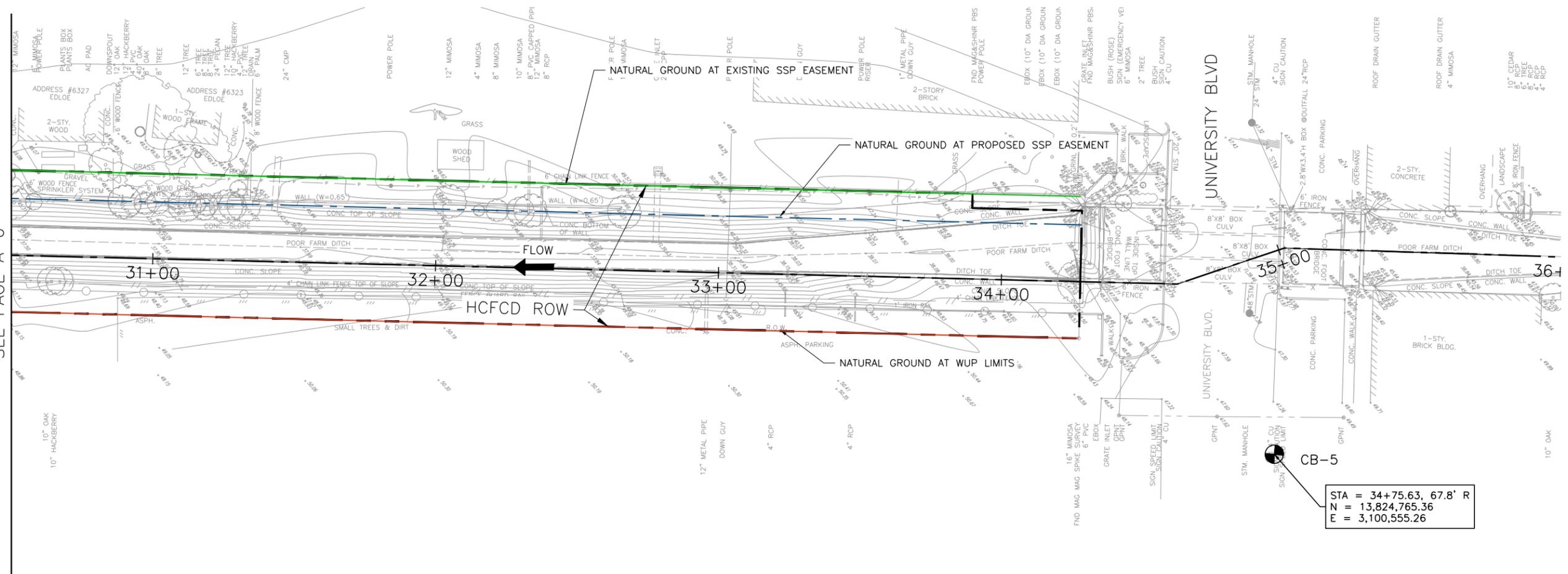
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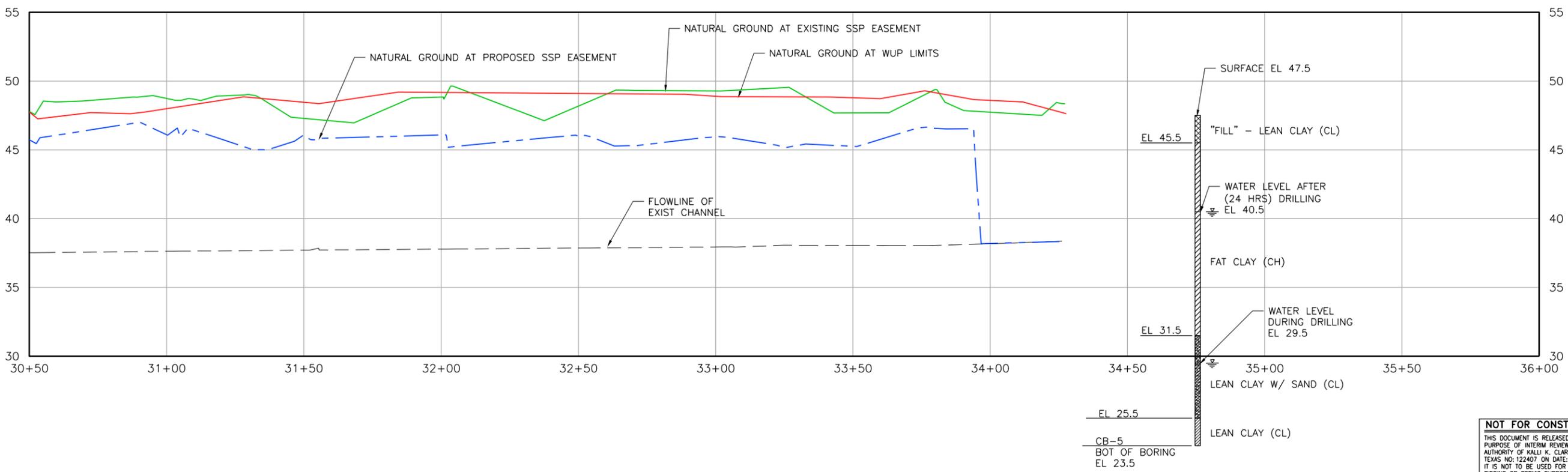


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 E = 3,100,555.26



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APPENDIX A	PREPARED:
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HARRIS COUNTY FLOOD CONTROL	APPROVED:
EXISTING PLAN AND PROFILE	

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<p>9900 Northwest Freeway          Houston, Texas 77092</p>

DATE: DECEMBER 2016  
 SCALE: AS SHOWN

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## **APPENDIX B: REFERENCES**

## References

1. Draft Report – Geotechnical Evaluation of Poor Farm (HCFCD D111-00-00) and Kilmarnock (HCFCD D113-00-00) Channel Improvements, Tolunay-Wong Engineers, Inc., January 31, 2003.
2. Feasibility Study – Development of Concepts, Claunch & Miller, June 2004.
3. Final Report – Geotechnical Evaluation of Poor Farm (HCFCD D111-00-00) Channel Transition & Box Culverts, Tolunay-Wong Engineers, Inc., April 25, 2007.
4. Report – Geotechnical Evaluation of Poor Farm (HCFCD D111-00-00) and Kilmarnock (HCFCD D113-00-00) Channel Improvements, Tolunay-Wong Engineers, Inc., November 16, 2009.
5. Draft Report – Geotechnical Evaluation of Poor Farm (HCFCD D111-00-00) and Kilmarnock (HCFCD D113-00-00) Channel Improvements, Tolunay-Wong Engineers, Inc. (TWEI), January 31, 2003
6. Hydrologic and Hydraulic Impact Analysis of Bellaire Bridge Over Poor Farm Ditch (D111-00-00), Binkley & Barfield, Inc., March 2010.
7. Amendment to Hydrologic and Hydraulic Impact Analysis of Bellaire Bridge Over Poor Farm Ditch (D111-00-00), Binkley & Barfield, Inc., October 2010.
8. Project Development Report – Poor Farm Ditch Conveyance Improvements Bellaire Boulevard to University Boulevard, Binkley and Barfield, January 2012.
9. Technical Review – Proposed Channel Improvement Alternatives Along HCFCD Channel D111-00-00 “Poor Farm Ditch” Between Bellaire Boulevard and University Boulevard, Parsons Brinckeroff, October 2013.

## **APPENDIX C: GEOTECHNICAL ANALYSIS**

# PROJECT MEMORANDUM



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**TO:** File HCF15148  
**CC:** Kalli Clark-Egan, P.E.  
**FROM:** Hande Gerkus, Ph.D., E.I.T. and Marc Miller, P.E.  
**DATE:** February 21, 2017  
**PROJECT:** HCF15148- Poor Farm Ditch Conveyance  
**SUBJECT:** Excavation Feasibility Analysis

## DRAFT

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW UNDER THE AUTHORITY OF MARC T. MILLER, P.E., TEXAS NO. 87824 ON FEBRUARY 21, 2017. IT IS NOT TO BE USED FOR CONSTRUCTION, BIDDING OR PERMIT PURPOSES.

FREESE AND NICHOLS, INC.  
TEXAS REGISTERED ENGINEERING  
FIRM F- 2144

Design of the conveyance improvements for Poor Farm Ditch includes a variety of channel configurations. The existing easement is relatively narrow, and it is desirable to consider a variety of excavation alternatives. The following sections present the modeling approach, proposed temporary and permanent excavation alternative geometries, soil strength conditions and water levels selected, and the results of the stability analysis. The results of the stability analysis are presented in terms of the factor of safety values and discussed within the context of the Harris County Flood Control District (HCFCD) Policy Criteria and Procedure Manual for Approval and Acceptance of Infrastructure (PCPM) (2010) factor of safety requirements.

### Summary of Section Alternatives

The project includes three channel alternatives: box culverts with an intermediate open channel (Alternative 1), a concrete U-shaped open channel (Alternative 2), and a concrete lined trapezoidal channel (Alternative 3). A variety of options are proposed for the temporary excavations required to construct these alternatives, and these are described as “A”, “B” and “C”. These can be broadly described as a sloped excavation, a soil nail reinforced cut slope, and a sheet pile braced vertical face. Table 1 summarizes the main features of each alternative. Typical sections for these alternatives are presented in Attachment A. Note that “left” corresponds to the west side of the channel, and “right” corresponds to the east side of the channel.

**Table 1. Summary of Design Alternatives, Slope Stability Analysis**

Alternative	Alternative Description	Excavation Description
1	1A: Left	0.5H: 1V Slope with temporary soil nails
	1A: Right	1H: 1V Slope, unreinforced
	1B: Left & Right	Sheet pile braced vertical excavation
2	2A: Left	0.5H: 1V Slope with temporary soil nails
	2A: Right	1H: 1V Slope, unreinforced
	2B: Left & Right	Sheet pile braced vertical excavation
	2C: Left	0.5H: 1V Slope with temporary soil nails
	2C: Right	Sheet pile braced vertical excavation
3	3A: Left & Right	1H:1V Slope, permanent soil nails partially in fill material
	3B: Left & Right	1H:1V Slope, permanent soil nails partially in fill material (more than 3A)



## **Stability Modeling**

### Parameter and Loading Case Selection

The near-surface soil profile along the channel is dominated by Fat Clay (CH) above approximate elevation 28 feet, and by Lean Clay (CL) below this elevation. Strength parameters have been developed for these materials, and are documented in the *Material Parameter Selection for Soils for Excavation Stability Analysis (November 3, 2016)*. The short-term conditions are analyzed by assigning the undrained shear strength parameters ( $\phi_u$ ,  $c_u$ ) and the long-term conditions are analyzed by assigning the effective shear strength parameters ( $\phi'$ ,  $c'$ ) to the soil layers. The cyclic wetting and drying weathers soils and reduces the shear strength due to small strains that occur during swelling and shrinkage. Generally, this weakening of soils due to seasonal changes reduces the effective cohesion of clays. For the selection of shear strength parameters, it is considered that the concrete channel linings protects the soils from seasonal moisture changes and reduces weakening of soil due to weathering.

Both short-term (total/undrained) and long-term (effective/drained) conditions pertain to design of permanent excavations. Short-term (total/undrained) conditions are assumed to govern stability for temporary excavations. The permanent slope stability cases consider both short-term and long-term loading conditions. The slope stability under rapid drawdown loading was also analyzed for permanent excavations using the three-stage method developed by Duncan, Wright and Wong (1990). This method assumes total stress conditions (consolidated-undrained) in slow-draining materials unless the results exceed the effective stress condition (in which case effective stress governs). The analyzed loading cases are presented for rapid drawdown, effective strength, and total strength loading conditions.

The stability cases include a uniformly distributed load of 250 psf on the top of the slope as required by the HCFC, PCPM (2010) for long-term conditions. The short-term conditions are analyzed for two loading cases on the top of the slope: construction load and traffic load. Due to restricted easement, heavy construction equipment is not expected to operate close to the top of the slope. Thus, a small bobcat or a pickup truck load is modelled with two 2,000 lbs point loads, 6 feet from each other, to represent the rear axle load. If construction equipment is not blocking access, and if HCFC desires to open the easements to traffic, the slopes can be subjected to traffic loading. This traffic load is modelled by applying a uniform surcharge load of 250 psf.

### Modeling Approach

The proposed alternatives provide excavation stability using temporary or permanent structural solutions. The alternatives are analyzed for an excavation height of 11 feet, but the actual height will vary from about 8 to 11 feet. The channel width, height and the easement are driving factors for the proposed alternatives. The proposed easement width is 50 feet, but the channel centerline is not centered on the easement. Refer to Attachment A for typical sections for each proposed alternative and the limits of the proposed easement.

The stability of the proposed alternatives was calculated by analyzing a two-dimensional model for each alternative using the SLOPE/W module of the GeoStudio 2016 developed by the GEO-SLOPE International Ltd. The factor of safety was evaluated with a limit equilibrium analysis to calculate force equilibrium and moment equilibrium using the Morgenstern-Price (1965) procedure. The entry/exit routine was used to develop circular failure surfaces, and optimized, non-radial failure geometry is allowed. Tension cracks are not included in the analysis. The results of the analyses are presented in terms of the factor of safety (FS), which represents the ratio of shear strength to the shear stresses along the failure surface.

The FS slope stability criteria requirement is listed as 1.3 for the short-term, 1.5 for the long-term, and 1.25 for the rapid drawdown conditions in the HCFC PCPM (2010). The calculated FS values are presented in two decimal



points to allow for the comparison of cases, but note that the FS values are generally considered accurate to one decimal.

The phreatic surfaces are included by drawing the piezometric lines to model the following cases:

- Fully saturated slope: Piezometric line at the top of the slope, then follows the slope face and continues to the channel bottom, resulting in a 11-foot tall section.
- Partially saturated slope: Piezometric line at elevation 45 feet within the slope, then follows the slope face and continues at elevation 40 feet at the channel bottom.
- Water at channel base: Piezometric line at constant elevation 40 feet at the base of the slope and along the channel bottom.

### Soil Nails

For cases that include soil nails, the slopes are reinforced with rows of temporary or permanent soil nails. The number of rows and spacing for the rows are stated with the results of each analysis. The nail lengths are calculated for the nail inclination of 15 degrees. The nail lengths vary by location. The pullout resistance (ultimate bond strength) was estimated at 627 psf assuming soft soil conditions based on guidance in FHWA (2015). A resistance reduction factor of 2 is applied at the pullout resistance. The bond diameter is assigned as 0.5 feet assuming installation with augers. The tensile capacity of each nail of 45,000 lbs is calculated assuming a #7 Grade 75 steel bar, and a tensile capacity reduction factor of 1.67 is applied. Shear resistance of the nails is ignored in the analysis. The alternatives that include soil nails are also analyzed with the proposed geometry but without using the soil nails to show the effect of soil nails on the slope stability.

### **Slope Stability Analysis Results**

#### Alternative 1A,2A, and 2C Left Slopes Reinforced with Temporary Soil Nails

The temporary excavations for Alternative 1A, 2A, and 2C Left Slopes are essentially identical and analyzed with the same SLOPE/W model. The 0.5H:1V temporary slope has an assumed height of 11 feet. The model includes three rows of soil nails spaced 5 feet in the in-plane direction and 4 feet in the out-of-plane direction. The nail lengths in the model are 9 feet, 11 feet and 13 feet from the top nail row to the bottom nail row. The results of the slope stability analyses are summarized in Table 2. The SLOPE/W output showing the calculated factor of safety for each analyzed loading case is presented in the attached exhibits.

**Table 2. Stability of Alternative 1A, 2A, and 2C Left Slopes**

<b>Analysis Case</b>	<b>Loading Condition</b>	<b>Calculated FS with Soil Nails</b>	<b>Calculated FS without Soil Nails</b>	<b>Required FS</b>
Total Strength, with surcharge load	Fully Saturated Slope	1.54	0.95	1.3
	Partially Saturated Slope	1.56	0.11	1.3
	Water at Channel Base	1.54	0.26	1.3
Total Strength, with construction load	Fully Saturated Slope	2.04	1.34	1.3
	Partially Saturated Slope	1.82	1.23	1.3
	Water at Channel Base	1.95	1.33	1.3



Alternative 1A, 2A, Right Slopes, Unreinforced

The temporary excavations for Alternative 1A and 2A Right Slopes are essentially identical and analyzed with the same SLOPE/W model. The 1H:1V temporary slope is unreinforced and has an assumed height of 11 feet. The results the slope stability analyses are summarized in Table 3. The SLOPE/W output showing the calculated factor of safety for each analyzed loading case is presented in the attached exhibits.

**Table 3. Stability of Alternative 1A and 2A, Right Slopes**

Analysis Case	Loading Condition	Calculated FS	Required FS
Total Strength, with surcharge load	Fully Saturated Slope	2.04	1.3
	Partially Saturated Slope	2.06	1.3
	Water at Channel Base	2.05	1.3
Total Strength, with construction load	Fully Saturated Slope	1.86	1.3
	Partially Saturated Slope	1.83	1.3
	Water at Channel Base	1.95	1.3

Alternative 1B, 2B, and 2C Right Slope, Sheet Pile Wall

The Alternative 1B and 2B, both the Left and Right Slopes, and 2C Right Slope are essentially identical and analyzed with the same SLOPE/W model. The assumed height of the vertical cut is 11 feet.

The sheet pile stability calculations are conducted to analyze the required minimum sheet pile wall embedment depth for an approximate cut height of 11 feet. The sheet pile embedment depth is calculated assuming the sheet pile is embedded into undrained Fat Clay (CH). The FS of 1.3 is applied to the undrained cohesion of the Fat Clay (CH) to calculate active and passive soil resistances. The analysis considers a uniform surcharge load of 250 psf acting on the top of the slope. The pressure distributions proposed by Teng (1962) are used to calculate active and passive earth pressures acting on the sheet pile wall. The results show that sheet pile embedment length of approximately 150 percent of the height of sheet pile above dredge line prevents overturning of the sheet pile wall. The sheet pile wall stability calculation is presented in the Attachment B of the Excavation Stability Analysis memorandum.

The sheet pile is modelled by using the pile reinforcement tool of the SLOPE/W. The parameters used to model the sheet pile are the shear force, shear reduction factor, pile spacing and application direction of the pile shear force. The embedment length of the sheet pile in the model is chosen such that the pile is embedded only into the Fat Clay (CH) layer. To account for the reduced embedment length in the model and adapt a more conservative approach, the passive resistance calculated as a part of sheet pile wall stability calculations is reduced with FS of 1.7 and applied as the sheet pile shear force. As the software factors the applied shear force with the pile spacing, the pile spacing of 1-foot is introduced into the model to eliminate the effect of this parameter. The shear force application direction of “perpendicular to the reinforcement” option is found appropriate for this case.

Since the limit equilibrium approach calculates the forces and moments acting on individual soil slices to calculate the stability of the slope surface, the structural analysis of the sheet pile is beyond the scope of the software. On the other hand, commercially available sheet piles are checked to verify that the shear force introduced to the slope stability analysis as the sheet pile resistance can be obtained without reaching the allowable yielding or



bending limits of the steel. The results the slope stability analysis are summarized in Table 4. The SLOPE/W output showing the calculated factor of safety for each analyzed loading case is presented in the attached exhibits.

**Table 4. Stability of Alternative 1B, 2B, and 2C Right Slope**

Analysis Case	Loading Condition	Calculated FS	Required FS
Total Strength, with surcharge load	Fully Saturated Slope	1.93	1.3
	Partially Saturated Slope	1.92	1.3
	Water at Channel Base	1.94	1.3
Total Strength with construction load	Fully Saturated Slope	1.63	1.3
	Partially Saturated Slope	1.56	1.3
	Water at Channel Base	2.03	1.3

Alternative 3A Left Slope Reinforced with Permanent Soil Nails

The alternative 3A Left slope has a cut with a 1H:1V slope that is reinforced with permanent soil nails. The slope is reinforced with two rows of permanent soil nails spaced 5 feet in the in-plane direction and 2 feet in the out-of-plane direction. The nail lengths are 11 feet and 13 feet for the top and bottom row of soil nails respectively. The concrete retaining wall is modeled as a concrete region to account for its weight as a dead load applied on the slope. The results of the slope stability analyses are summarized in Table 5, both with and without the soil nails. The SLOPE/W output showing the calculated factor of safety for each analyzed loading case is presented in the attached exhibits.

**Table 5. Stability of Alternative 3A, Left Slope**

Analysis Case	Loading Condition	Calculated FS with Soil Nails	Calculated FS without Soil Nails	Required FS
Rapid Drawdown	From Fully Saturated Slope Level to Base	1.56	1.07	1.25
Effective Strength	Fully Saturated Slope	1.46	1.01	1.5
	Partially Saturated Slope	1.64	1.13	1.5
	Water at Channel Base	1.80	1.15	1.5
Total Strength, with surcharge load	Fully Saturated Slope	1.56	1.51	1.5
	Partially Saturated Slope	1.58	0.30	1.5
	Water at Channel Base	1.51	0.57	1.5
Total Strength with construction load	Fully Saturated Slope	1.94	0.20	1.5
	Partially Saturated Slope	1.75	0.21	1.5
	Water at Channel Base	1.85	0.44	1.5

Alternative 3B Left Slope Reinforced with Permanent Soil Nails

The alternative 3B left slope includes a cut with a 1H:1V slope reinforced with permanent soil nails. The main difference from the Alternative 3A left slope is the 5 feet offset of the reinforced slope into the channel with addition of backfill material between the cut and the reinforced slope. The slopes are reinforced with two rows of



permanent soil nails spaced 5 feet in the in-plane direction and 2 feet in the out-of-plane direction. The nail lengths are 8 feet and 12 feet for the top and bottom row of soil nails respectively. The concrete retaining wall is modeled as a concrete region to account for its weight as a dead load applied on the slope. The results of the slope stability analysis are summarized in Table 6, both with and without the soil nails. The SLOPE/W output showing the calculated factor of safety for each analyzed loading case is presented in the attached exhibits.

**Table 6: Stability of Alternative 3B Left Slope**

Analysis Case	Loading Condition	Calculated FS with Soil Nails	Calculated FS without Soil Nails	Required FS
Rapid Drawdown	From Fully Saturated Slope Level to Base	1.54	1.43	1.25
Effective Strength	Fully Saturated Slope	1.43	1.04	1.5
	Partially Saturated Slope	1.63	1.30	1.5
	Water at Channel Base	1.77	1.45	1.5
Total Strength, with surcharge load	Fully Saturated Slope	1.78	1.51	1.5
	Partially Saturated Slope	1.68	1.52	1.5
	Water at Channel Base	1.64	1.43	1.5
Total Strength, with construction load	Fully Saturated Slope	1.66	0.10	1.5
	Partially Saturated Slope	1.80	0.10	1.5
	Water at Channel Base	1.79	0.10	1.5

Alternative 3A and 3B Right Slopes Reinforced with Permanent Soil Nails

The alternative 3A right slope and 3B right slopes include a cut with a 1H:1V slope reinforced with permanent soil nails. The main difference from the Alternative 3B left slope the reinforced slope is the distance from slope face to the right of way. The slopes are reinforced with two rows of permanent soil nails spaced 5 feet in the in-plane direction and 2 feet in the out-of-plane direction. The nail lengths are 9 feet and 13 feet for the top and bottom row of soil nails respectively. The results of the slope stability analysis are summarized in Table 7, both with and without the soil nails. The concrete retaining wall is modeled as a concrete region to consider its weight as a dead load applied on the slope. The SLOPE/W output showing the calculated factor of safety for each analyzed loading case is presented in the attached exhibits.



**Table 7: Stability of Alternatives 3A and 3B Right Slopes**

Analysis Case	Loading Condition	Calculated FS with Soil Nails	Calculated FS without Soil Nails	Required FS
Rapid Drawdown	From Fully Saturated Slope Level to Base	1.56	1.26	1.25
Effective Strength	Fully Saturated Slope	1.46	1.10	1.5
	Partially Saturated Slope	1.60	1.22	1.5
	Water at Channel Base	1.75	1.48	1.5
Total Strength, with surcharge load	Fully Saturated Slope	1.69	0.18	1.5
	Partially Saturated Slope	1.66	0.94	1.5
	Water at Channel Base	1.67	0.54	1.5
Total Strength, with construction load	Fully Saturated Slope	1.77	0.98	1.5
	Partially Saturated Slope	1.80	0.84	1.5
	Water at Channel Base	1.63	0.94	1.5

**Summary of Results**

The following lists summarize the results of the slope stability analysis for each of the proposed alternatives:

Alternative 1A and 2A:

- This alternative includes a 0.5H:1V slope with temporary soil nails on the left slope and a 1H:1V unreinforced right slope. The results show that alternatives 1A and 2A have acceptable short-term slope stability with FS values for water levels representative of saturated channel, partially saturated channel and the water level at the channel base. The results also show that temporary soil nails improve the slope stability and provide the required FS for short-term stability.

Alternative 1B and 2B:

- These alternatives include sheet pile walls at the both sides of the channel. Results indicate the sheet pile wall provides short-term slope stability with FS greater than 1.3 for the analyzed water levels representative of fully saturated channel, partially saturated channel, and the water level at the channel base.
- The results show that sheet pile embedment length of approximately 150% of the height of the sheet pile above dredge line is required to prevent overturning of the sheet pile wall.

Alternative 2C:

- This alternative includes a 0.5H:1V slope with temporary soil nails on the left slope and sheet pile wall on the right side of the channel. The results show that this alternative has acceptable short-term slope stability with FS values for water levels representative of saturated channel, partially saturated channel and the water level at the channel base.



- The results also show that temporary soil nails improve the slope stability and provide the required FS for short-term stability.
- Additionally, sheet pile embedment length of approximately 150% of the height of the sheet pile above dredge line is required to prevent overturning of the sheet pile wall.

#### Alternative 3A and 3B

- The alternative 3A and 3B right and left slopes are 1H:1V and reinforced with permanent soil nails. The results indicate that both options are acceptable for the analyzed water levels of fully saturated channel, partially saturated channel and the water level at the channel base with FS values having equal or greater than 1.5 for both short-term and long-term. Results indicate that including additional backfill at the back of the slope for alternative 3A right slope and 3B left and right slopes does not make a significant difference in the calculated factor of safety values.
- The cases that have slightly lower factor of safety values (1.46 and 1.43) than the required minimum (1.5) are the fully saturated slope with effective strength parameters assigned to the Fat Clay (CH) layer of the 3B Left slope (FS of 1.43), and 3A right slope and 3B right slope (FS of 1.46). The factor of safety values of 1.43 and 1.46 represents the worst-case scenario for the tallest expected slope with the highest water load and lowest soil shear strength. Also, the clay is not likely to develop drained shear strength, especially when the slope is saturated. Given that this analysis is intended to demonstrate feasibility of system, and not provide final design, the results are considered acceptable.

#### **References**

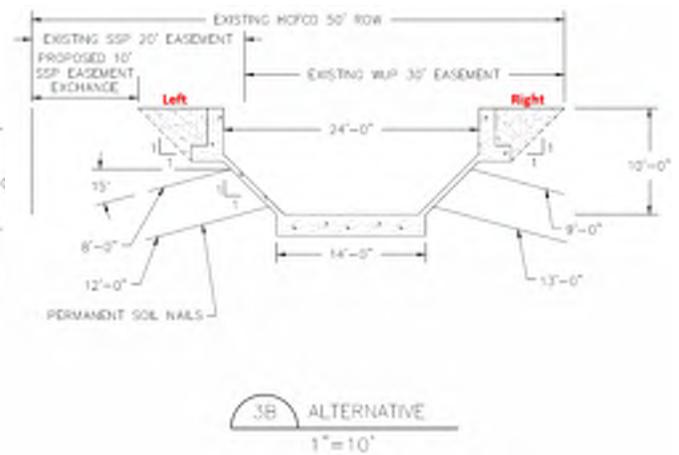
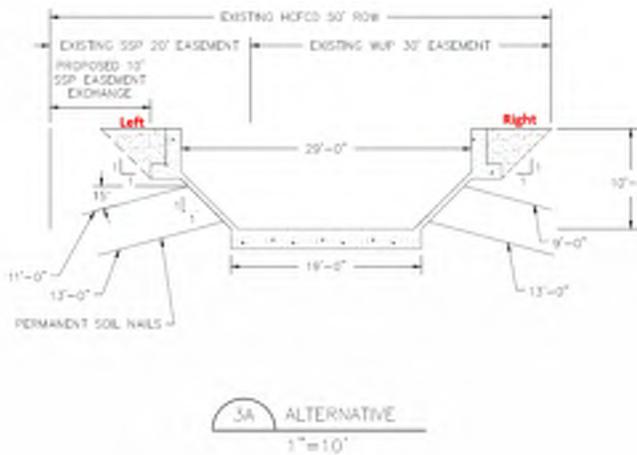
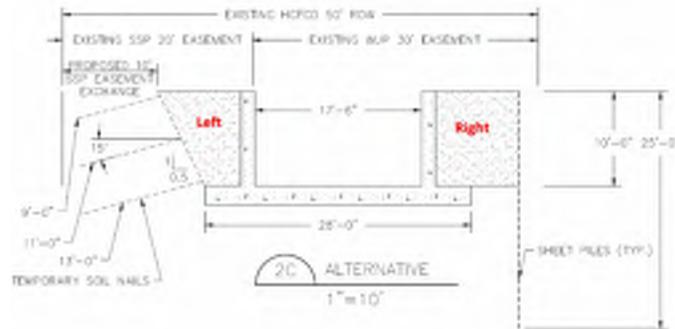
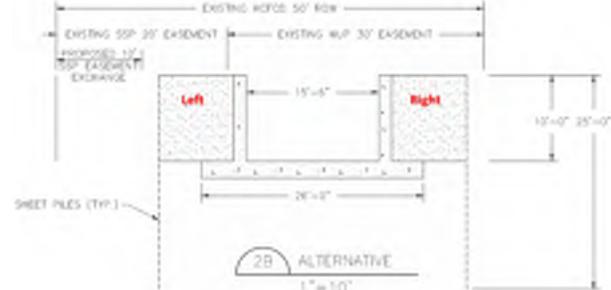
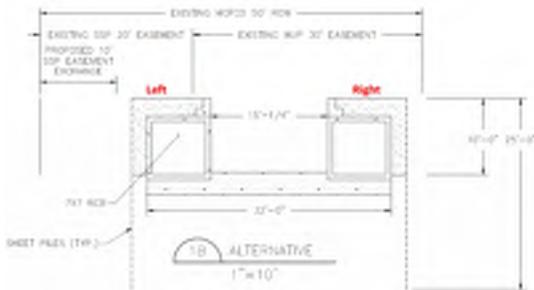
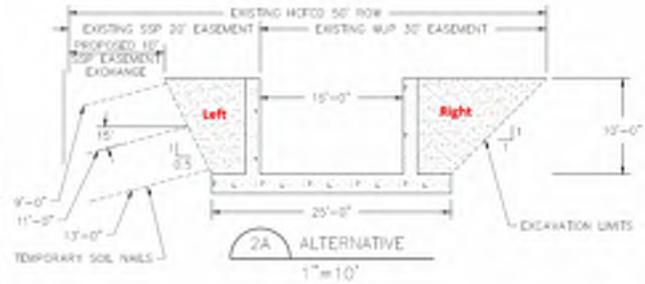
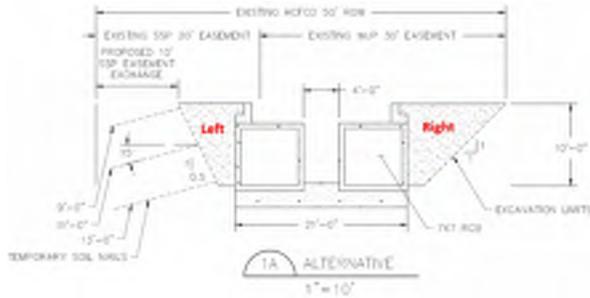
Lazarte, C. A., Robinson, H., Gomez, J. E., Baxter, A., Cadden, A., & Berg, R. (2015, February). *Soil Nail Walls Reference Manual*. FHWA-NHI-14-007, U.S. Department of Transportation Federal Highway Administration.

Storey, A. L., Talbott, M. D., & Fitzgerald, S. (2010, December). *Policy, Criteria, and Procedure Manual for Approval and Acceptance of Infrastructure*. Harris County Flood Control District.

Teng, W. C. (1962). *Foundation Design*. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

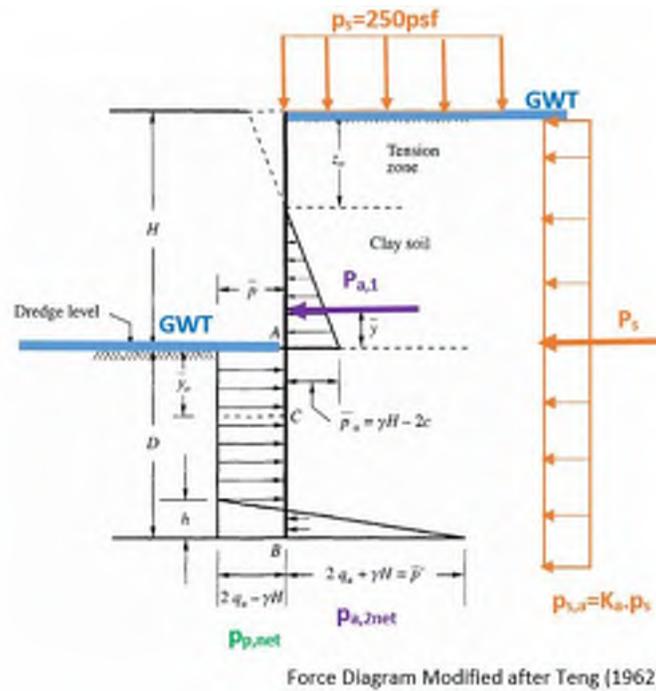


ATTACHMENT A. ALTERNATIVES, LEFT AND RIGHT SLOPES





ATTACHMENT B. SHEET PILE WALL STABILITY CALCULATION



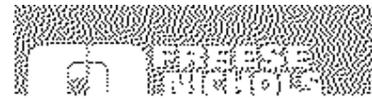
Calculation Input Parameters:

Surcharge load (psf)	250
H (ft)	11
$\gamma_{sat}$ (pcf)	129
$c_u$ (psf)	700
$\phi_u$ (deg)	0
$K_a$	1
$K_p$	1
FS	1.3
Factored $c_u$ (psf)	538

The factored  $c_u$  is used as the  $c$  value in the calculation. The embedment depth,  $D$  was increased until the sheet pile wall is stable. The calculations presented below consider **D of 18** feet for unit width. The calculations are conducted assuming the sheet pile is embedded into Fat Clay (CH) layer only.

$$\text{Critical Height: } H_c = \frac{4c}{\gamma} = \frac{4 \cdot 538 \text{ psf}}{129 \text{ pcf}} = 16.7 \text{ feet} > 11 \text{ feet}$$

$$\text{Tension Crack: } z_0 = \frac{2c}{\gamma} = \frac{2 \cdot 538 \text{ psf}}{129 \text{ pcf}} = 8.35 \text{ feet}$$



Resulting Active Soil Pressures:

$$p_a = \gamma H - 2c = (129 * 11) - (2 * 538) = 342.13 \text{ psf}$$

$$p_{a,2net} = 4c + \gamma H = (4 * 538) + (129 * 11) = 3572.8 \text{ psf}$$

Resulting Passive Soil Pressure:  $p_{p,net} = 4c - \gamma H = (4 * 538) - (129 * 11) = 734.8 \text{ psf}$

Active Pressure due to Surcharge load:  $p_{s,a} = K_a \cdot p_s = 250 \text{ psf}$

The h distance is calculated from the equilibrium of forces in the horizontal direction:  $\sum F_h = 0$

$$\sum F_h = \left[ \frac{1}{2} (H - z_0) p_a \right] + [p_{s,a} (H + D)] + \left[ \frac{8c(h)}{2} \right] - [(4c - \gamma H) D] = 0$$

$$\sum F_h = \left[ \frac{1}{2} (11 - 8.35) 342.1 \right] + [250 * (11 + 18)] + \left[ \frac{8 * 538 * h}{2} \right] - [(4 * 538 - 129 * 11) 18] = 0$$

$$\mathbf{h = 2.6 \text{ ft}}$$

Moments with respect to Point B:

Overturning Moments:

$$M_o = \frac{1}{2} (H - z_0) p_a \cdot \left( D + \frac{(H - z_0)}{3} \right) + \left( \frac{8ch^2}{6} \right) + \left( p_{s,a} \frac{(H + D)^2}{2} \right) = 115,835 \text{ lbs} - \text{ft}$$

Restoring Moments:

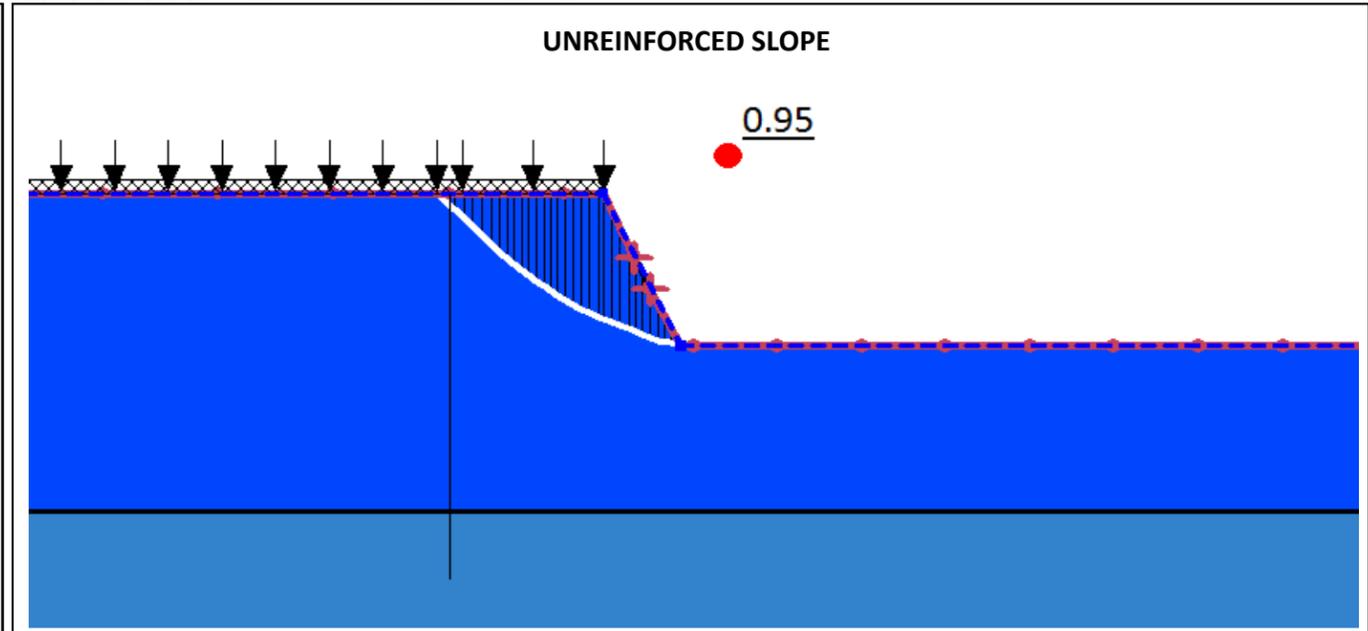
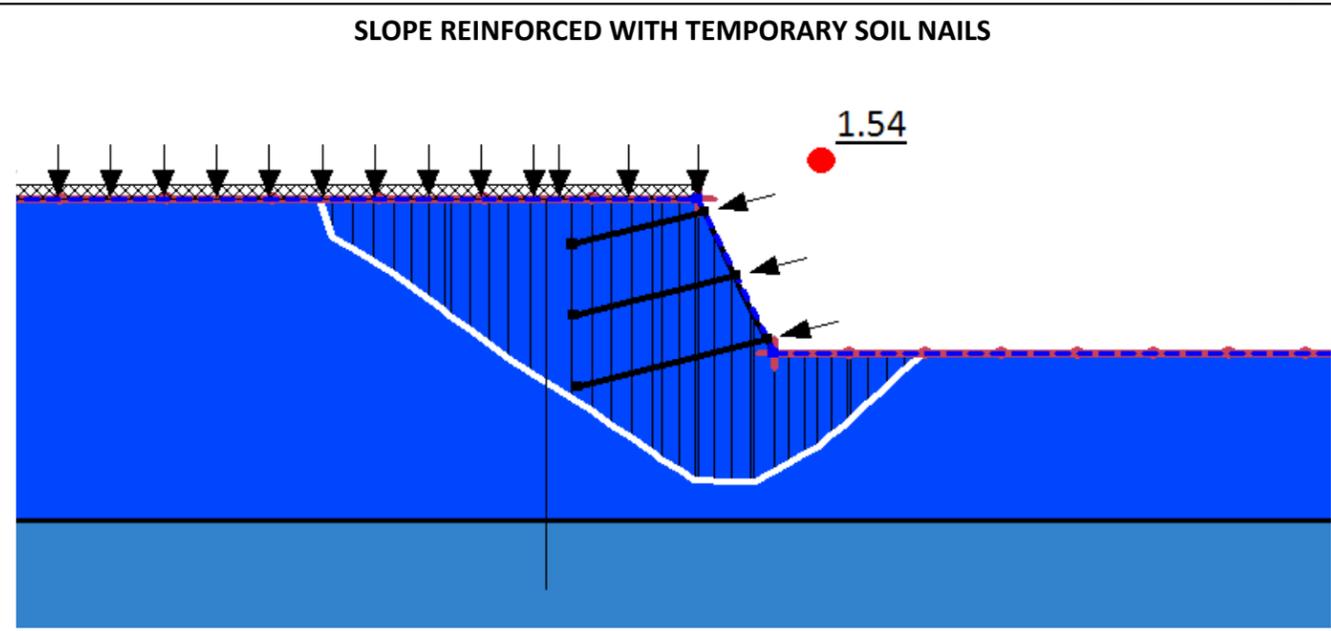
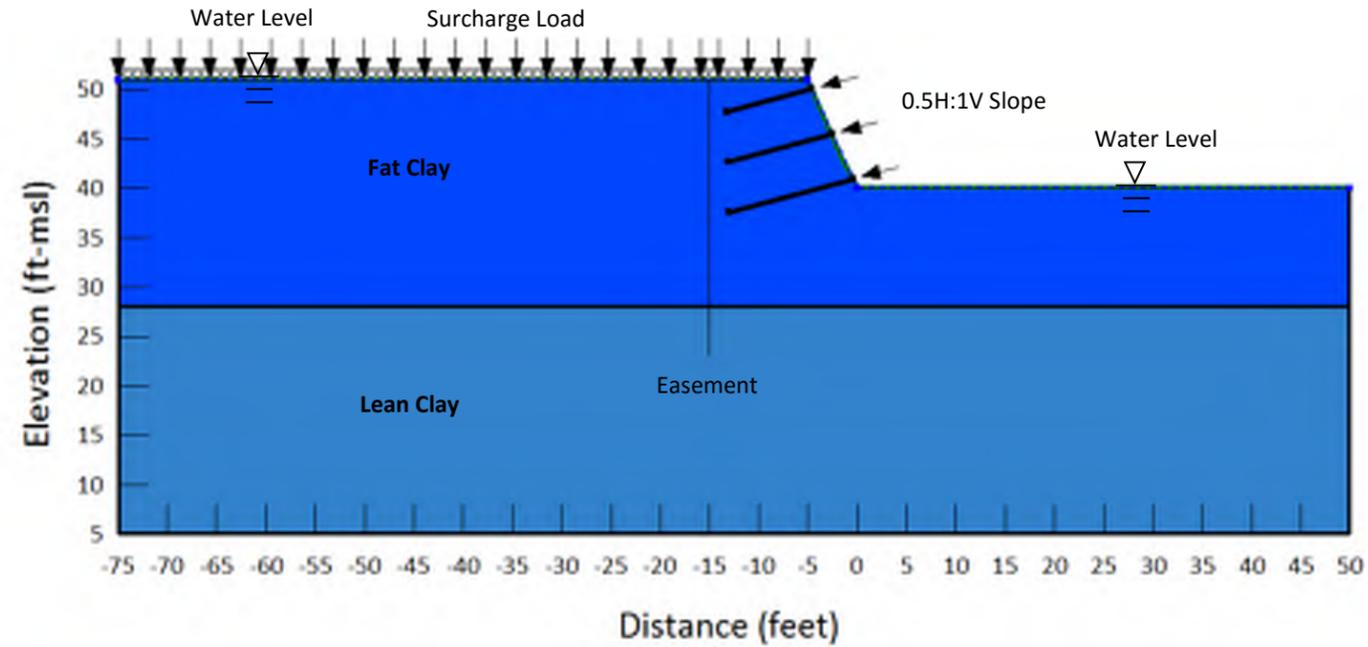
$$M_r = \left[ (4c - \gamma H) \frac{D^2}{2} \right] = 119,045 \text{ lbs} - \text{ft}$$

$$\frac{M_r}{M_o} = 1.03 \text{ with FS}=1.3 \text{ applied at the } c_u$$

Net Passive Soil Resistance calculated for the sheet pile with embedment depth of 18 ft:

$$P_p = (D - f) \times p_{pnet} = (18 - 2.6) \text{ft} \times 734.8 \text{ psf} = 11,315 \text{ lbs}$$

ALTERNATIVE 1A, 2A and 2C LEFT SLOPES REINFORCED WITH TEMPORARY SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

General Notes:

1. All elevations are in NAVD88 feet mean sea level (feet-msl).
2. Foundation stratigraphy is approximate and presented for illustrative purposes only.

FN PROJECT NO. HCF16148  
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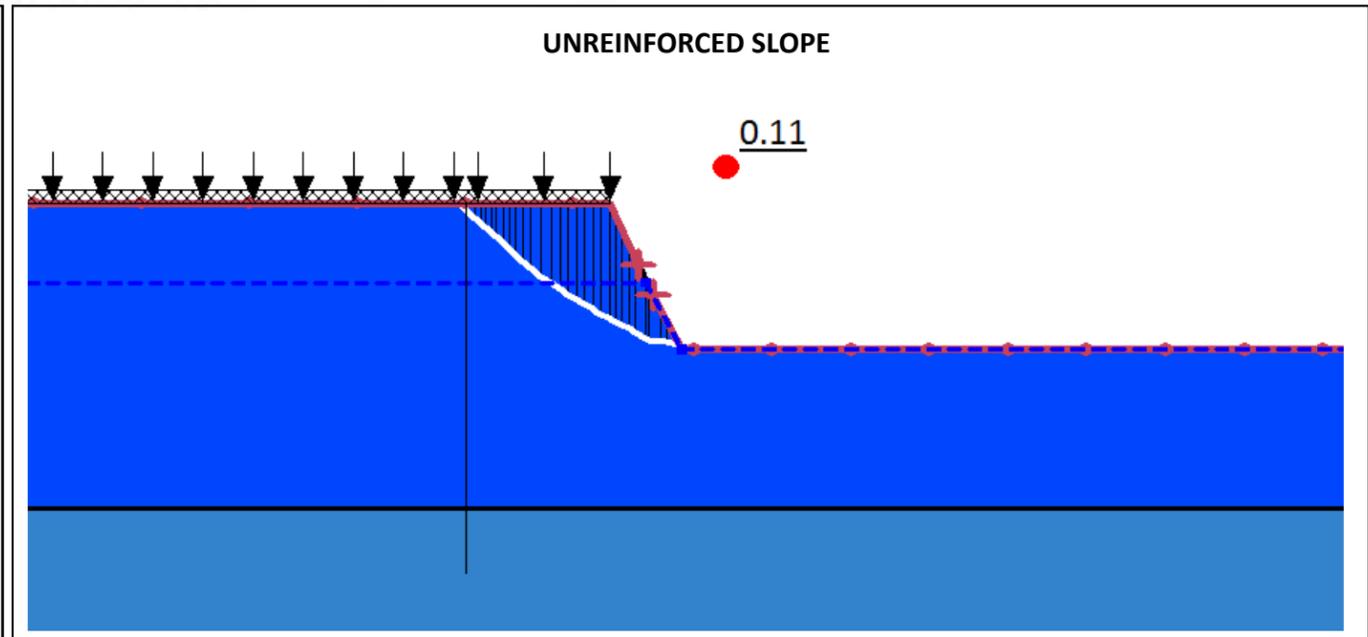
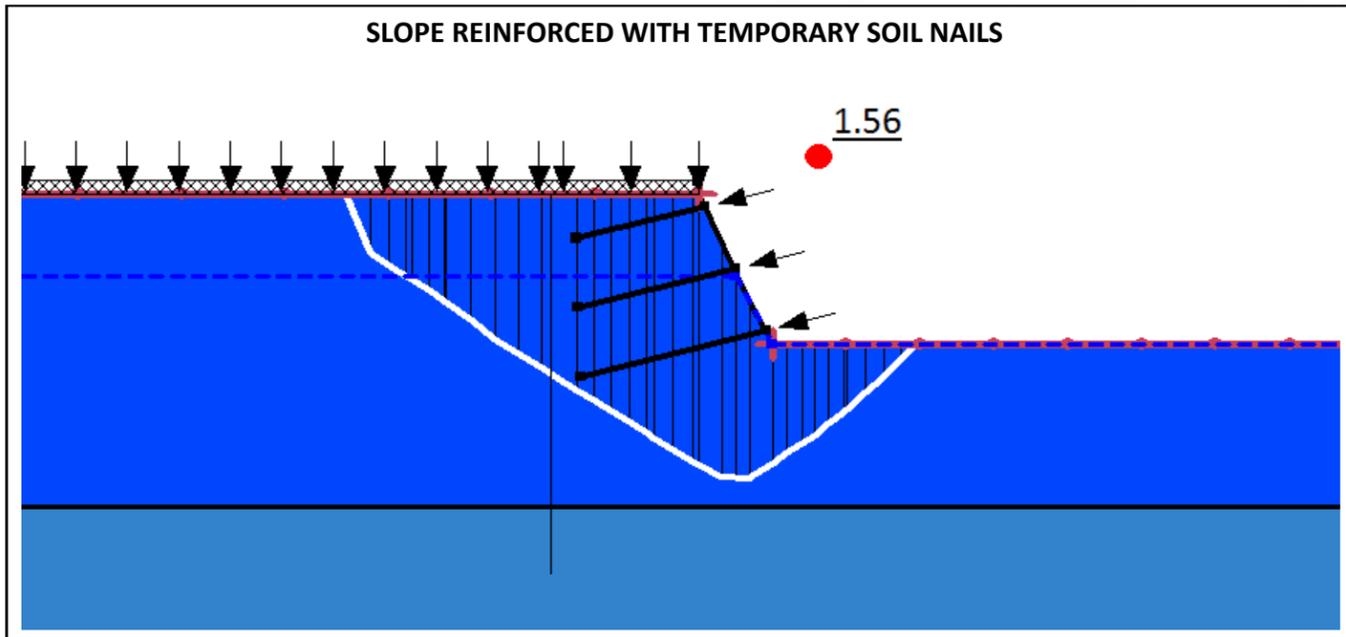
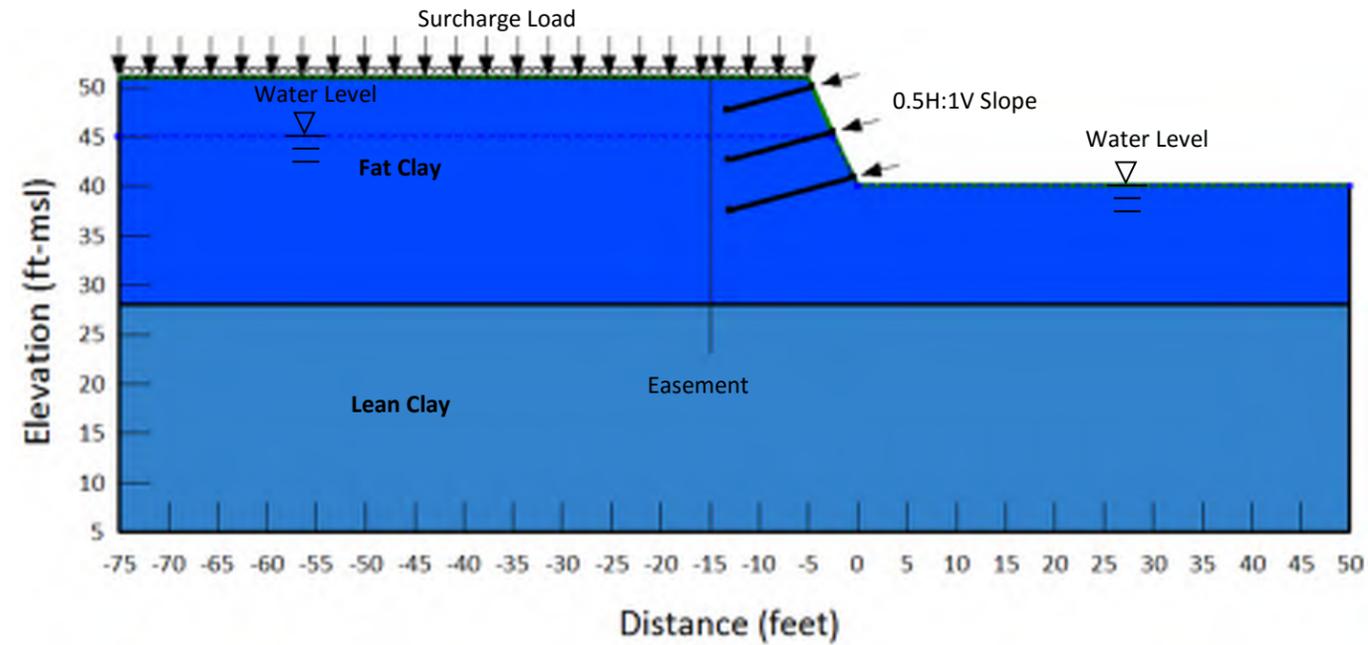
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 1A, 2A, 2C Left Slopes**

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**HARRIS COUNTY FLOOD CONTROL DISTRICT**

9900 Northwest Freeway  
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ALTERNATIVE 1A, 2A and 2C LEFT SLOPES REINFORCED WITH TEMPORARY SOIL NAILS INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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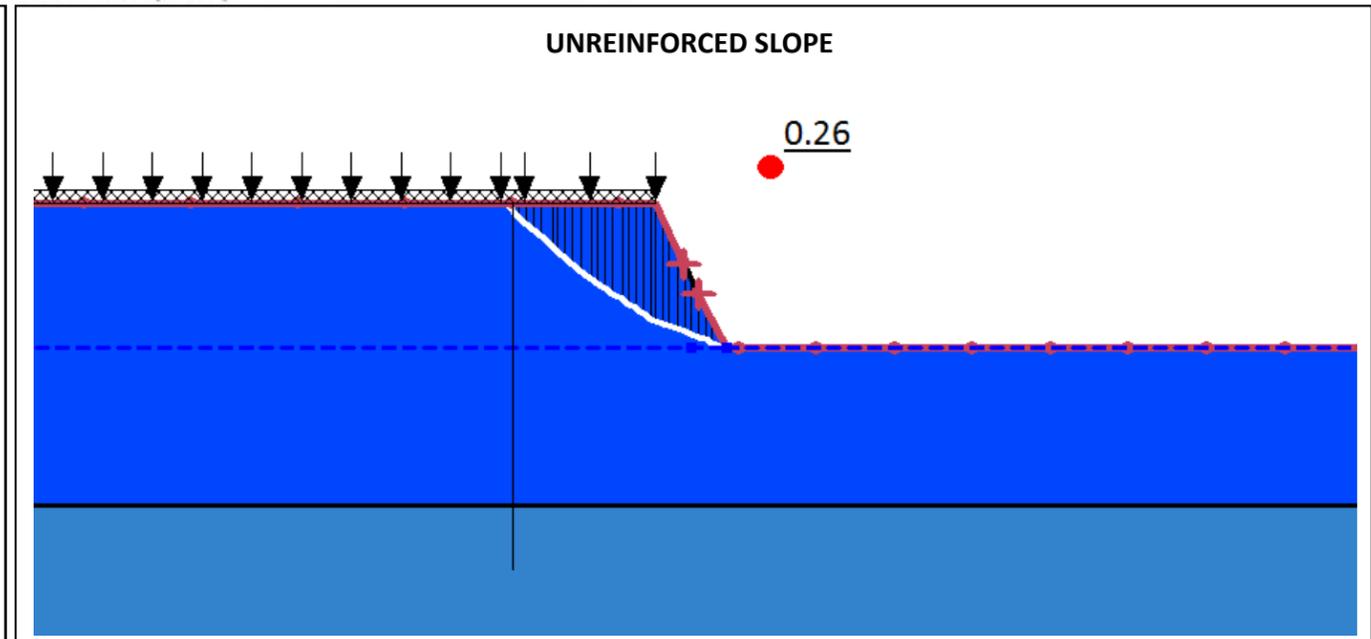
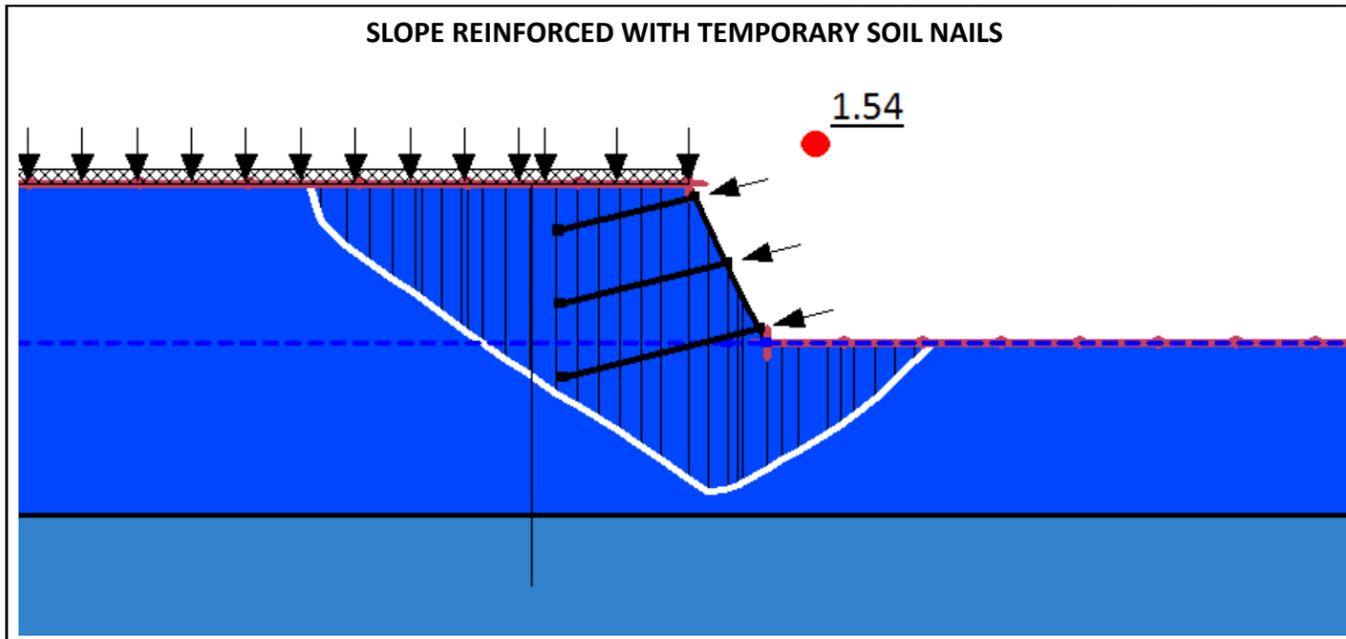
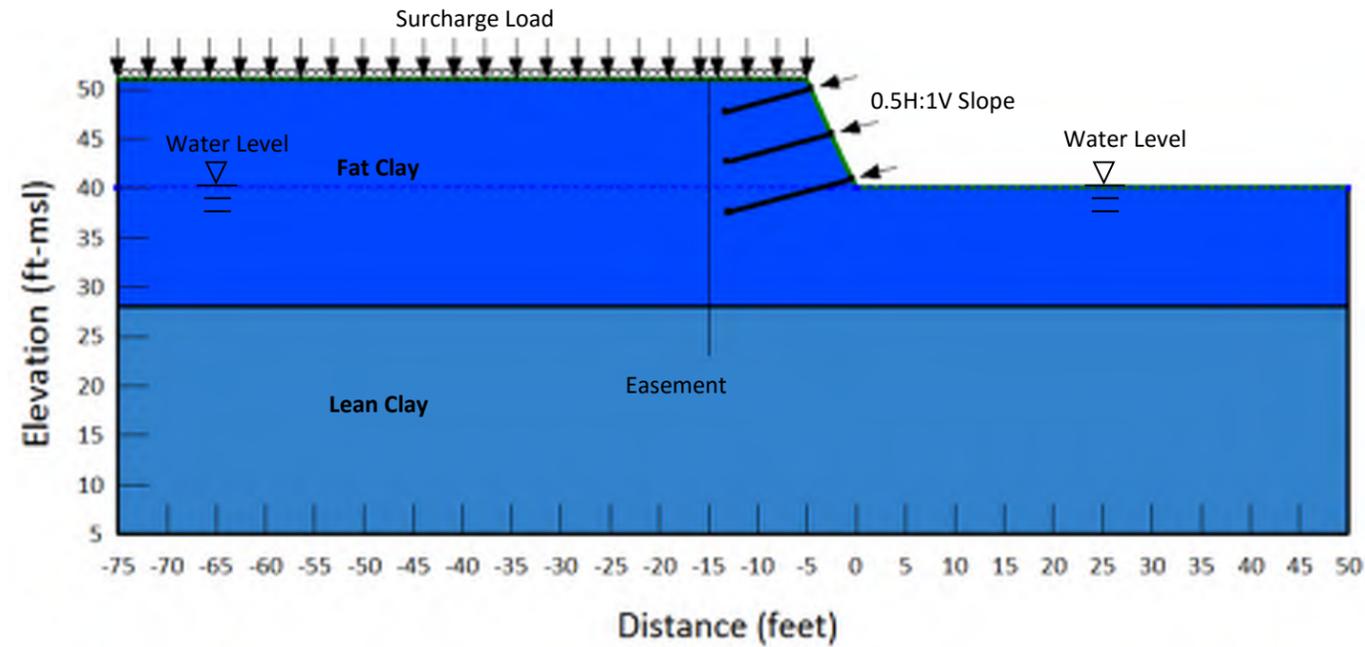
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ALTERNATIVE 1A, 2A and 2C LEFT SLOPES REINFORCED WITH TEMPORARY SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

**General Notes:**

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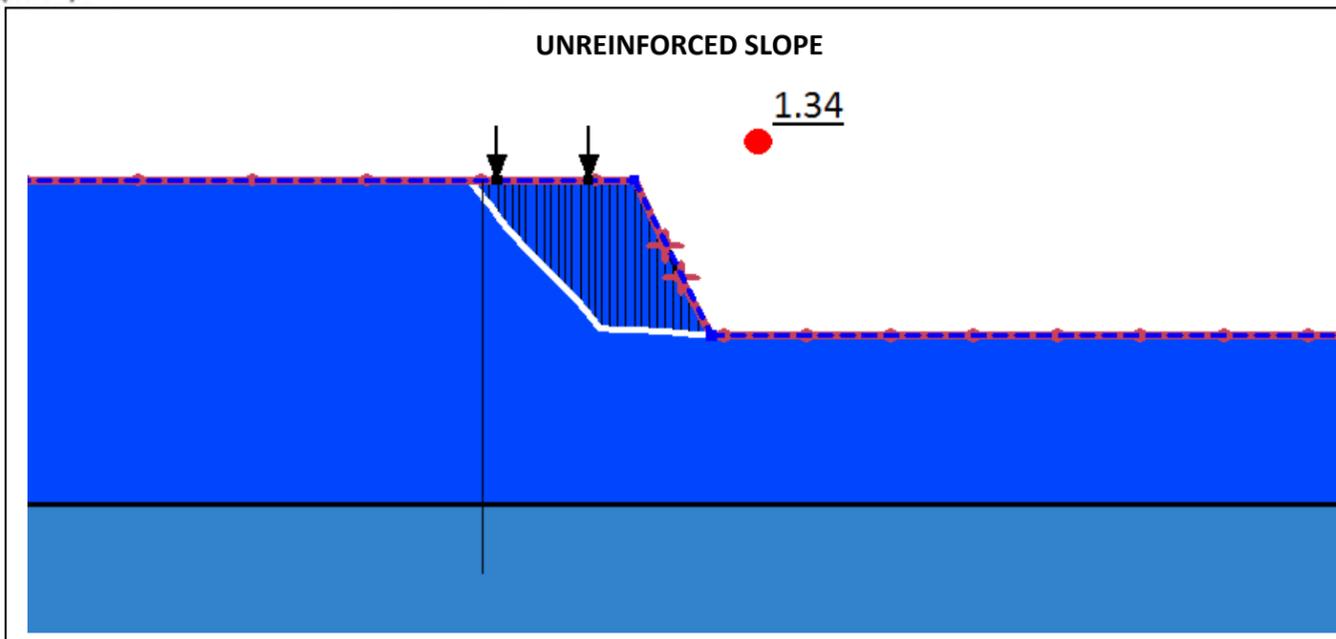
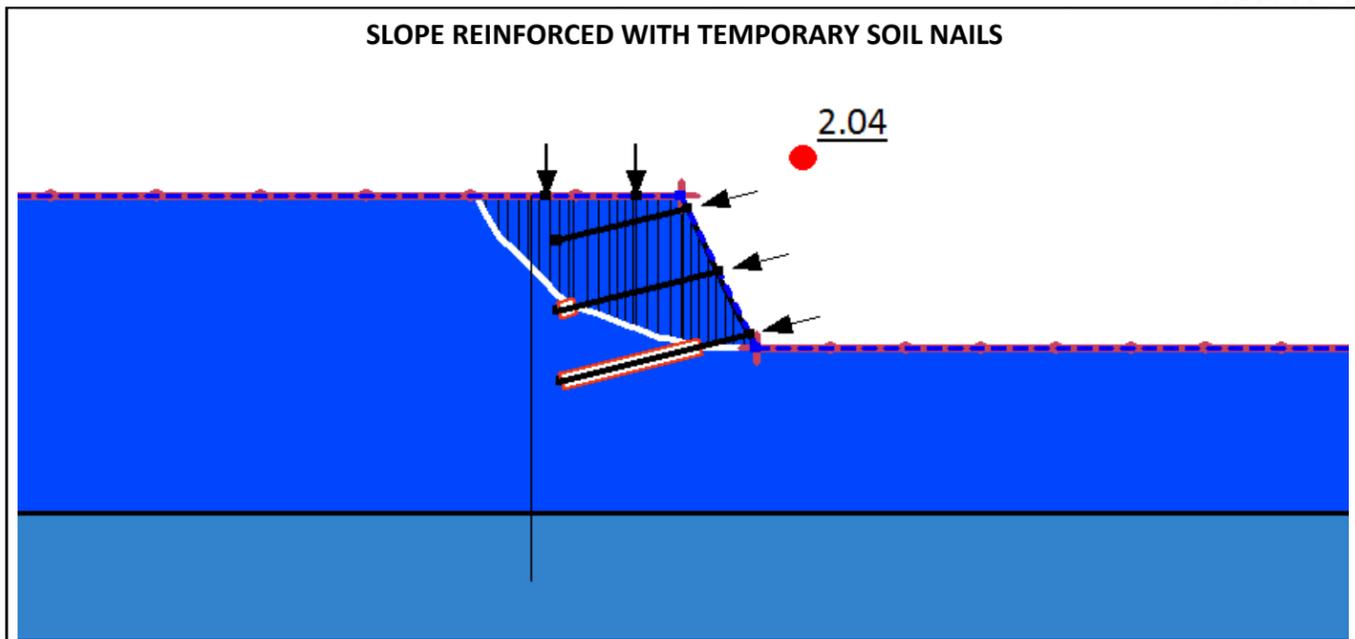
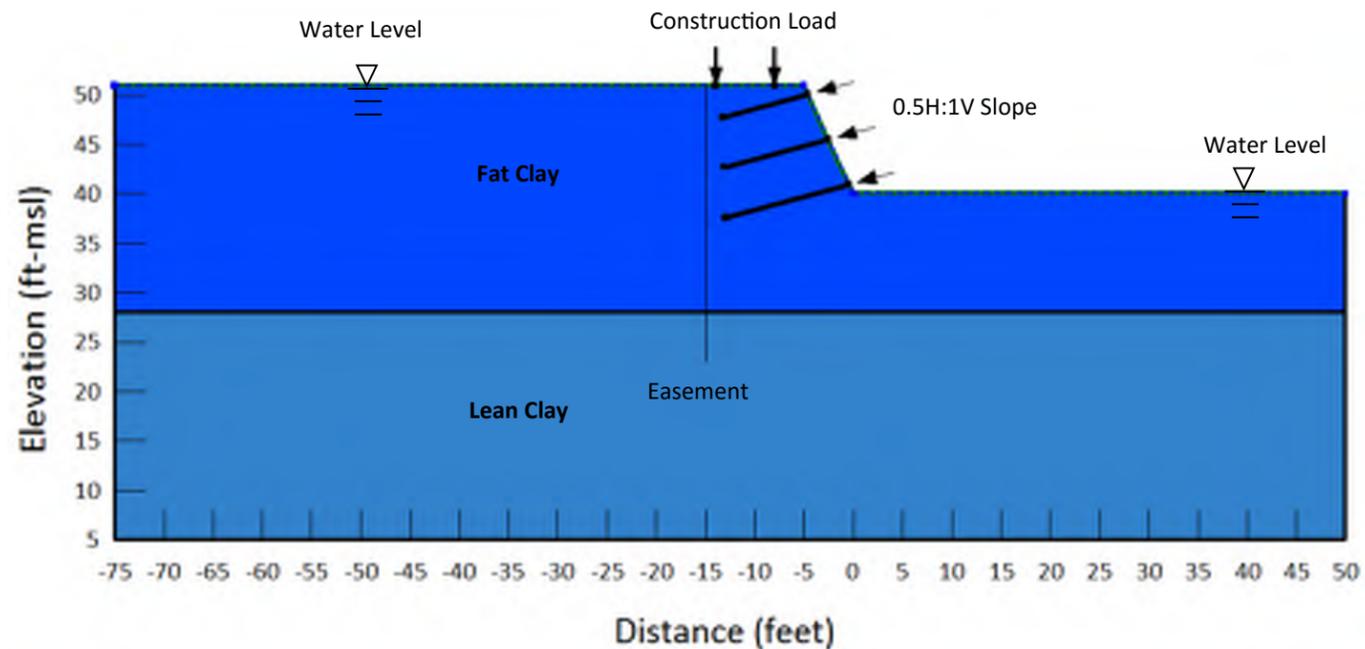
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ALTERNATIVE 1A, 2A and 2C LEFT SLOPES REINFORCED WITH TEMPORARY SOIL NAILS INCLUDING CONSTRUCTION LOAD ON FULLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

General Notes:

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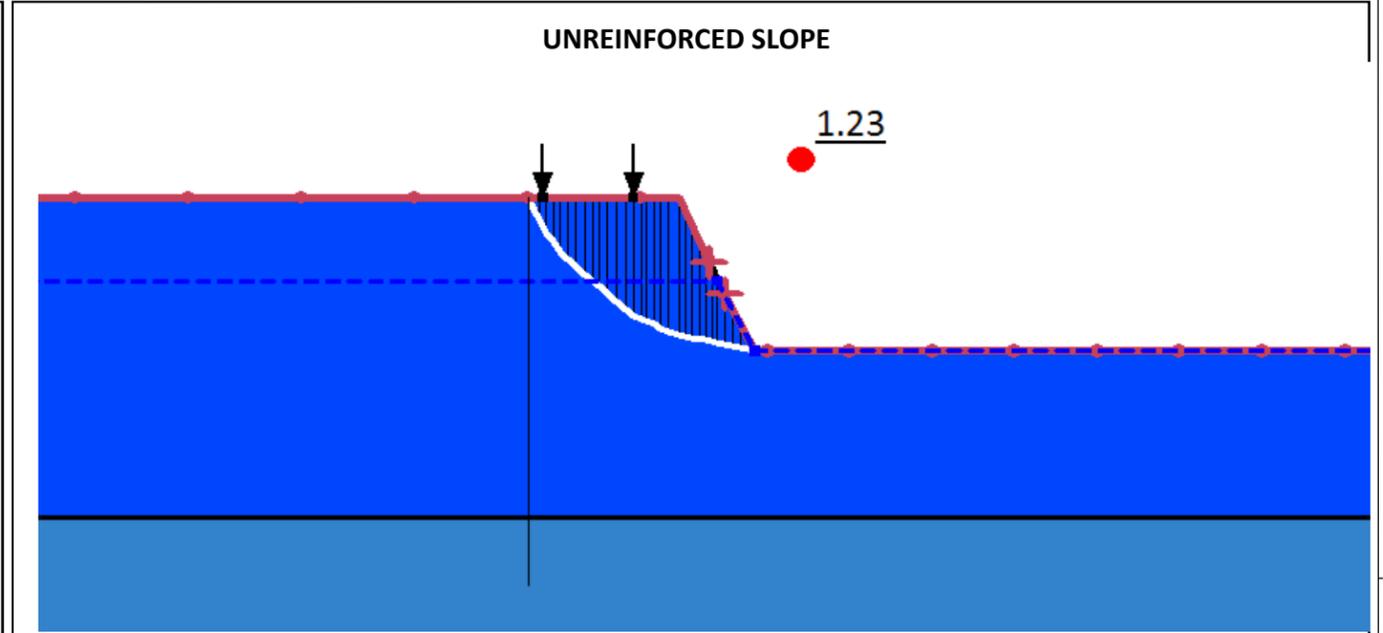
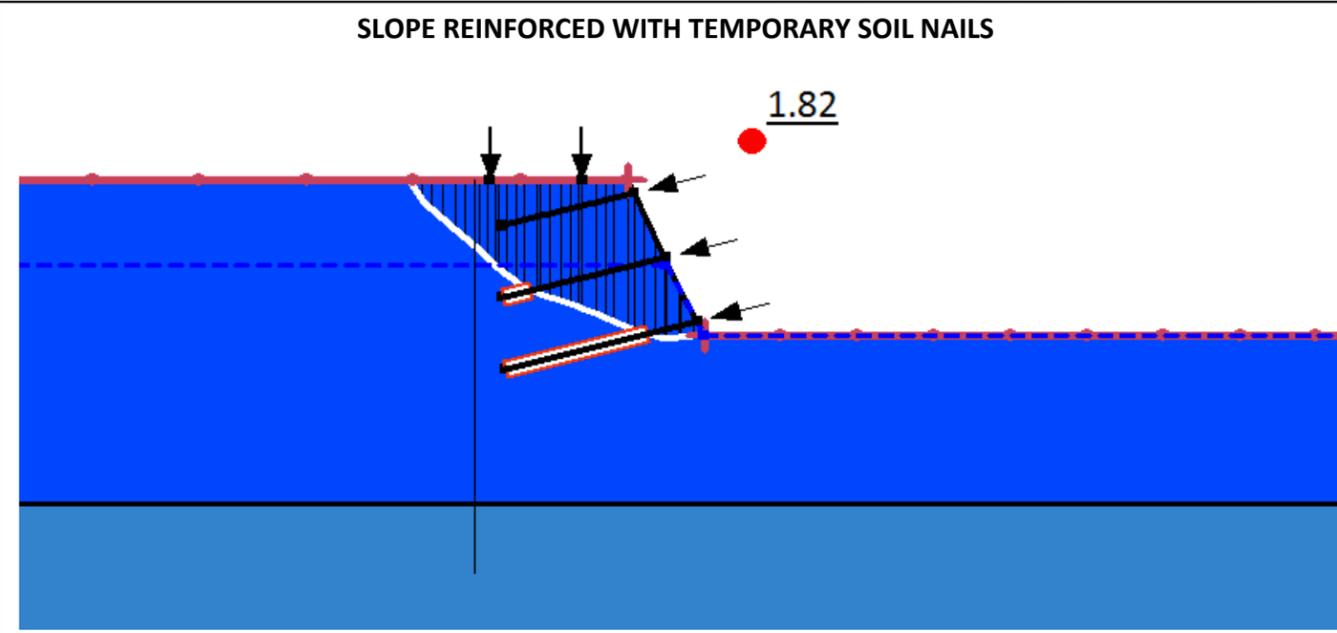
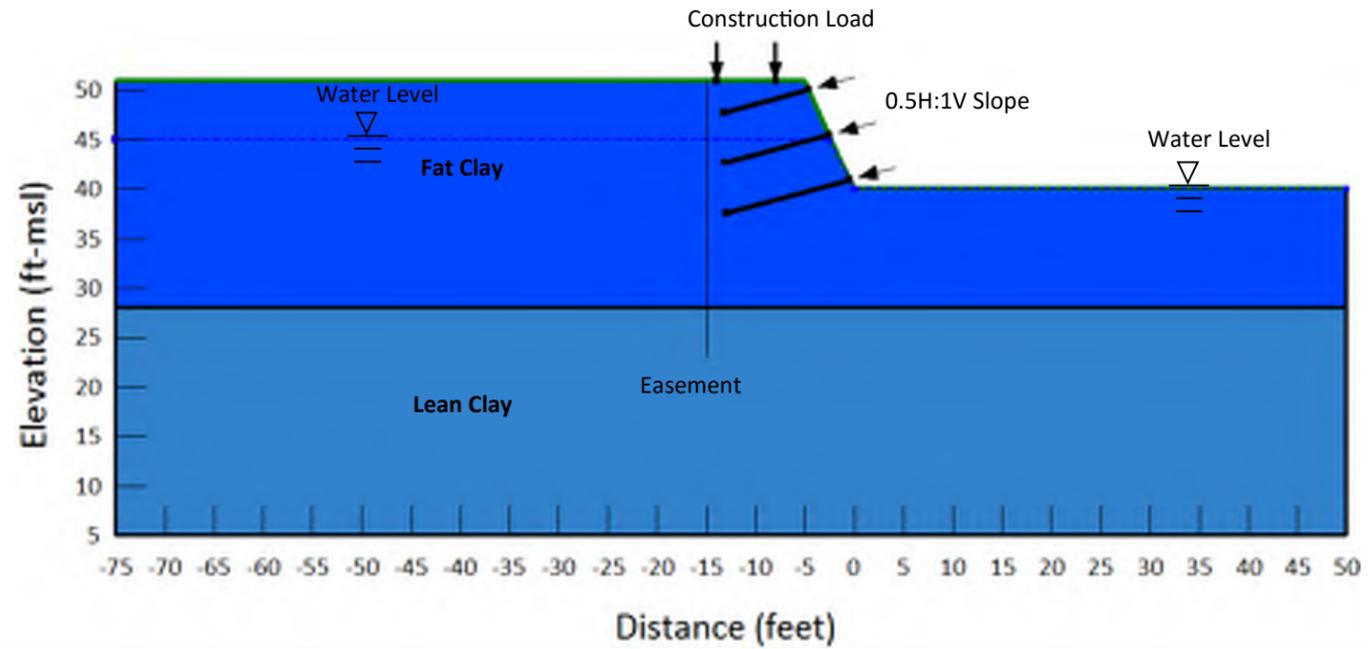
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
 Alternative 1A, 2A, 2C Left Slopes

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**HARRIS COUNTY FLOOD CONTROL DISTRICT**

9900 Northwest Freeway  
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ALTERNATIVE 1A, 2A and 2C LEFT SLOPES REINFORCED WITH TEMPORARY SOIL NAILS INCLUDING CONSTRUCTION LOAD ON PARTIALLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

**General Notes:**

1. All elevations are in NAVD88 feet mean sea level (feet-msl).
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FN PROJECT NO. HCF16148  
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 PREPARED BY Stability Analysis  
 HG

POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL

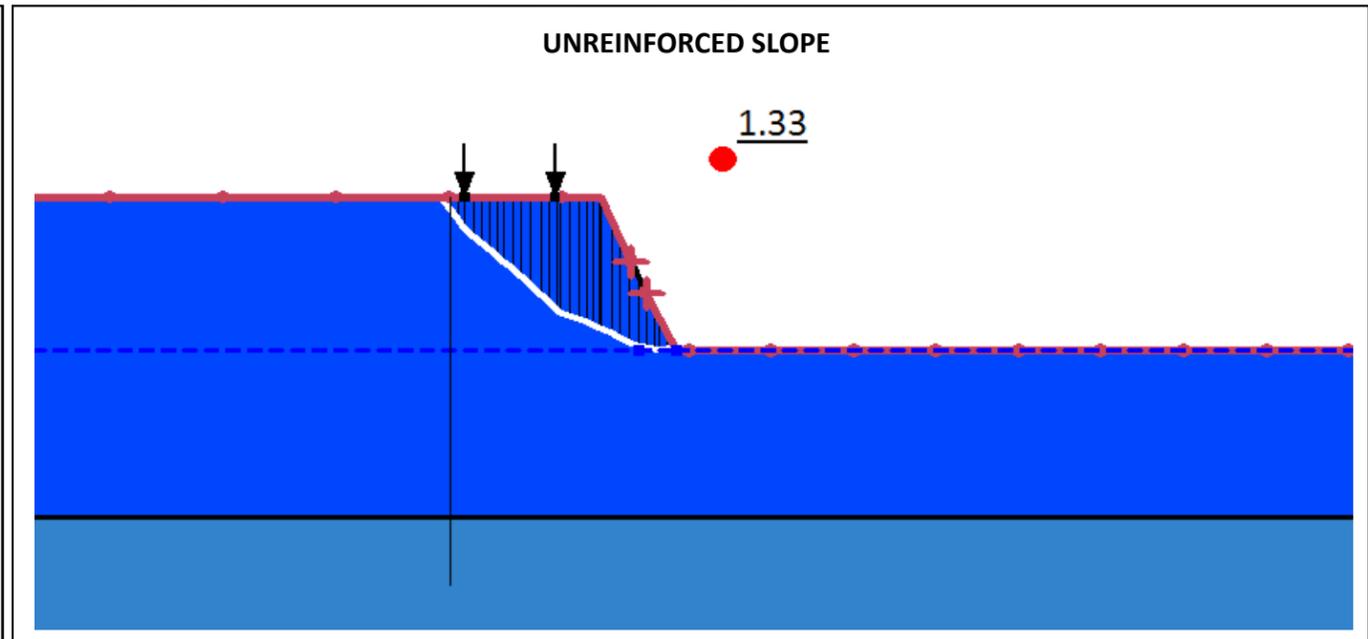
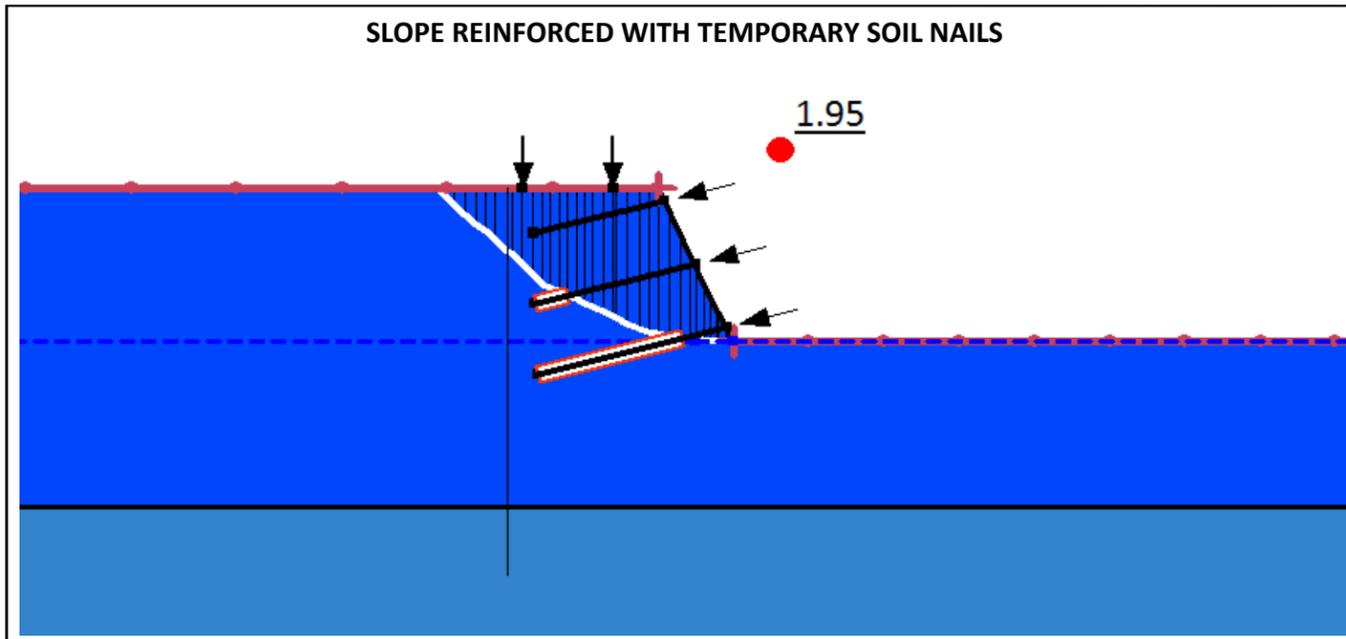
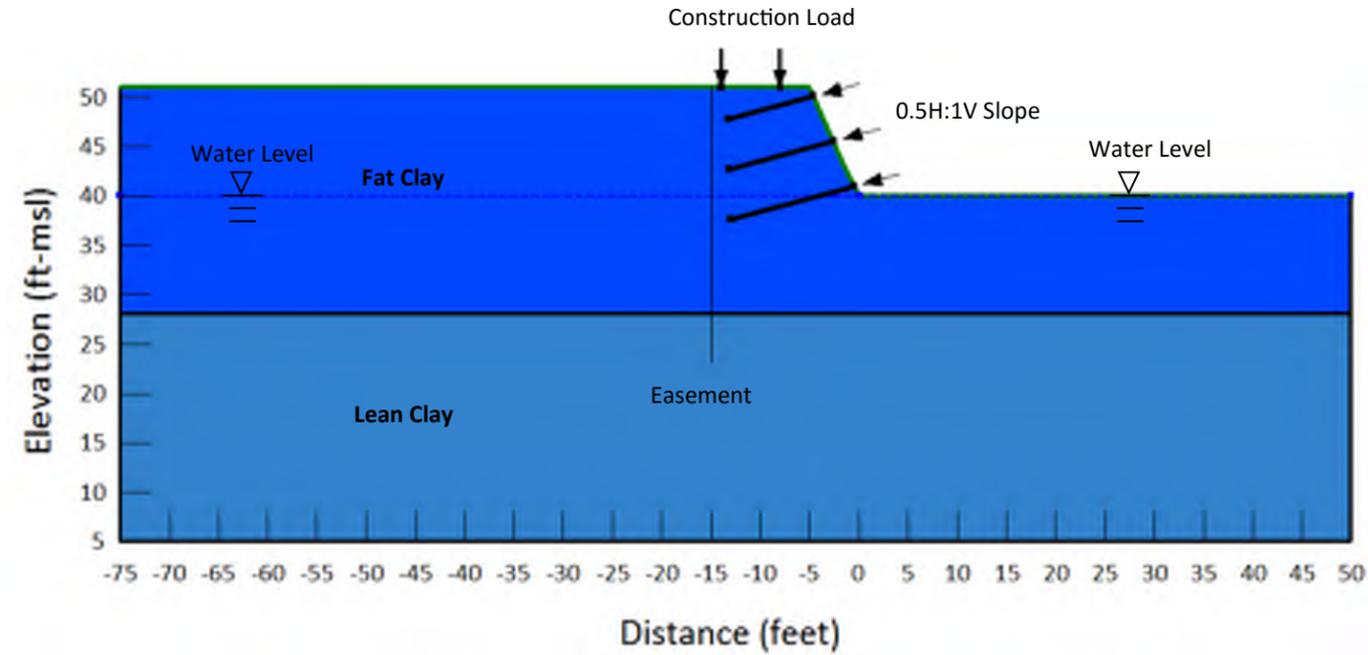
**Slope Stability Analysis**  
**Alternative 1A, 2A, 2C Left Slopes**

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ALTERNATIVE 1A, 2A and 2C LEFT SLOPES REINFORCED WITH TEMPORARY SOIL NAILS INCLUDING CONSTRUCTION LOAD WITH WATER AT CHANNEL BASE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL

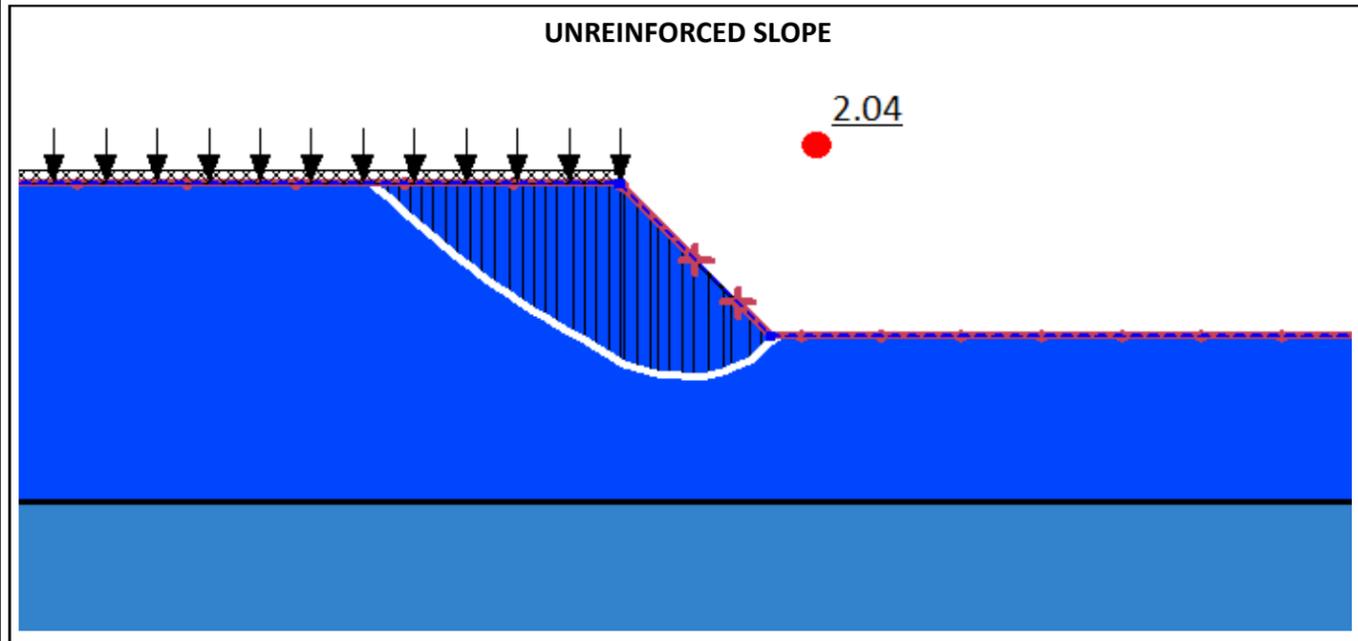
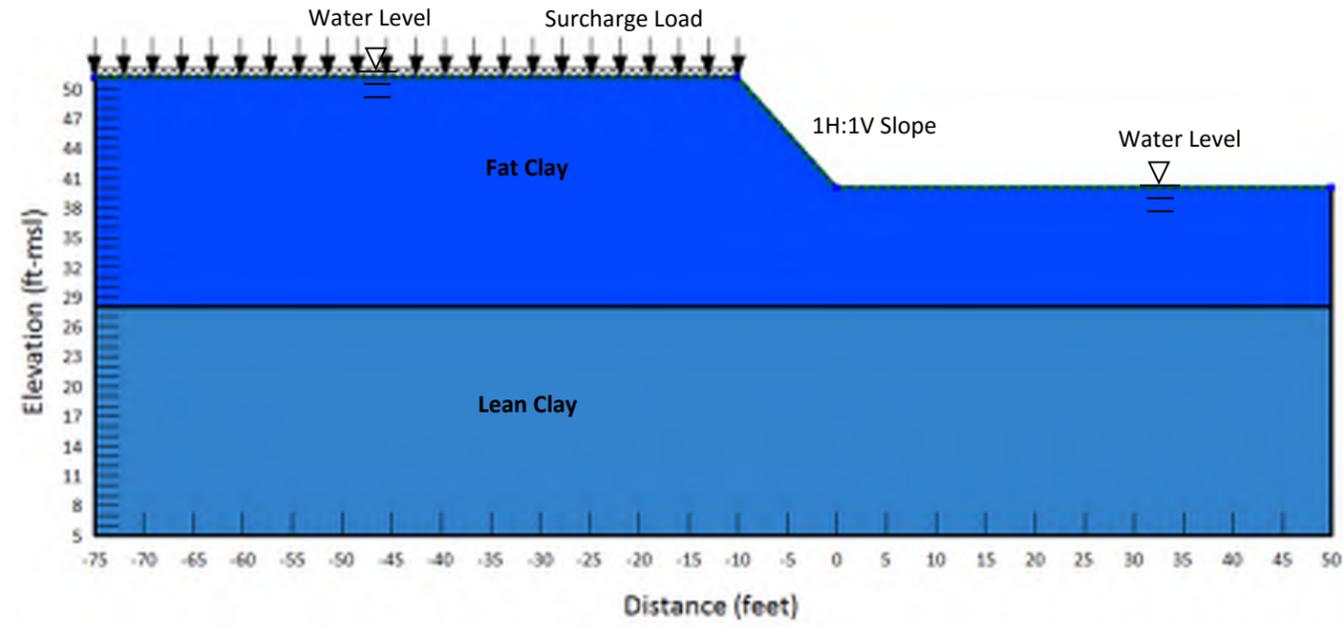
Slope Stability Analysis  
 Alternative 1A, 2A, 2C Left Slopes

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ALTERNATIVE 1A, 2A RIGHT SLOPES UNREINFORCED, INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)

General Notes:

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FILE NAME	Stability Analysis
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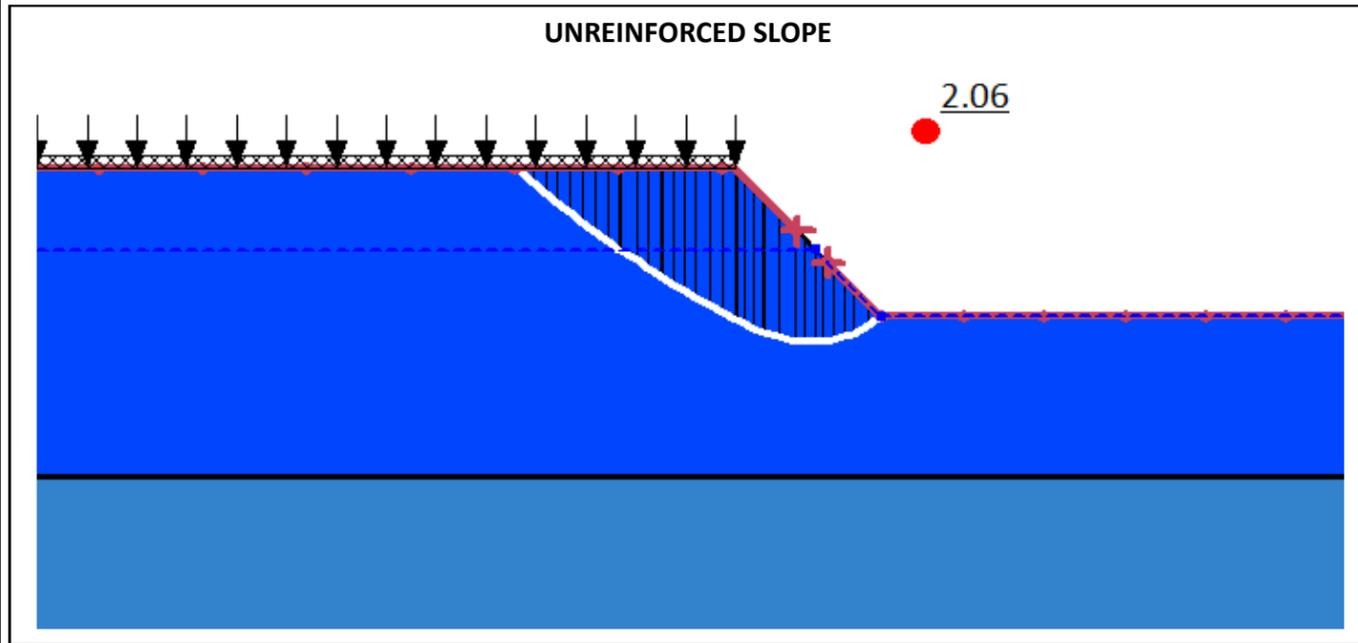
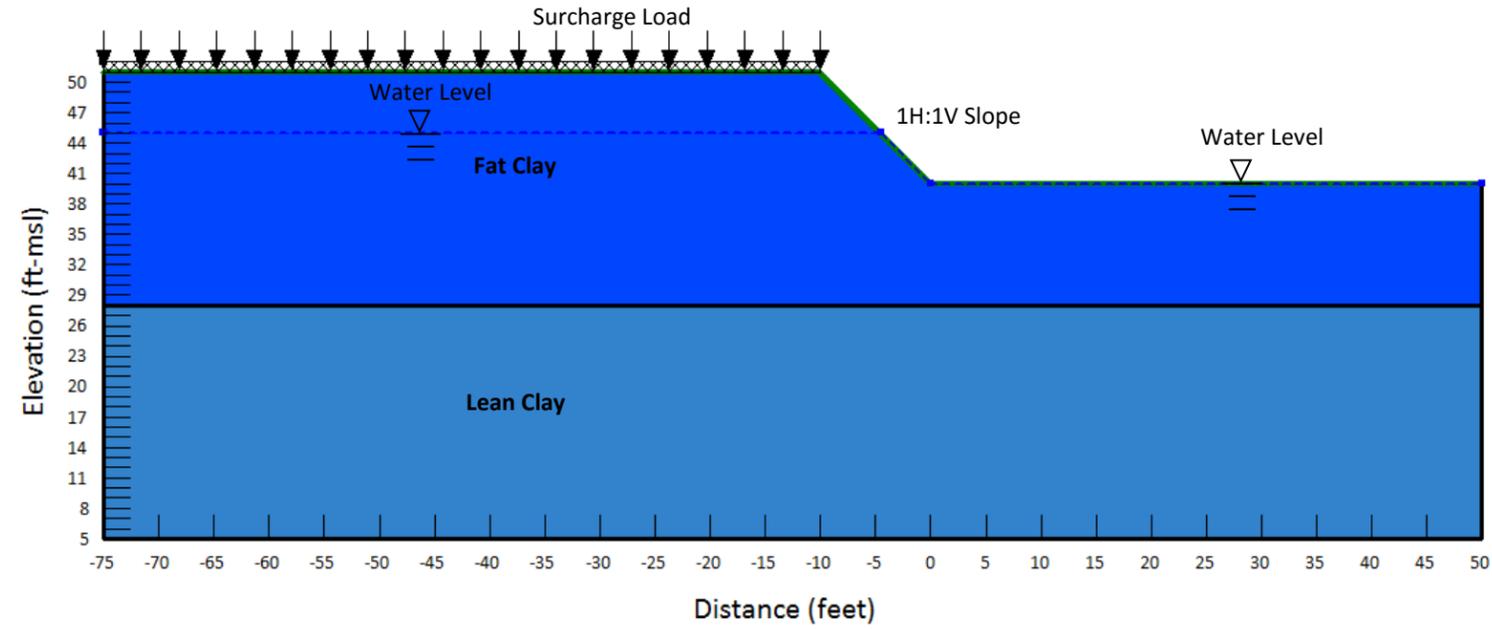
POOR FARM DITCH IMPROVEMENTS  
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**Slope Stability Analysis**  
**Alternative 1A, 2A Right Slopes**

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ALTERNATIVE 1A, 2A RIGHT SLOPES UNREINFORCED, INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)

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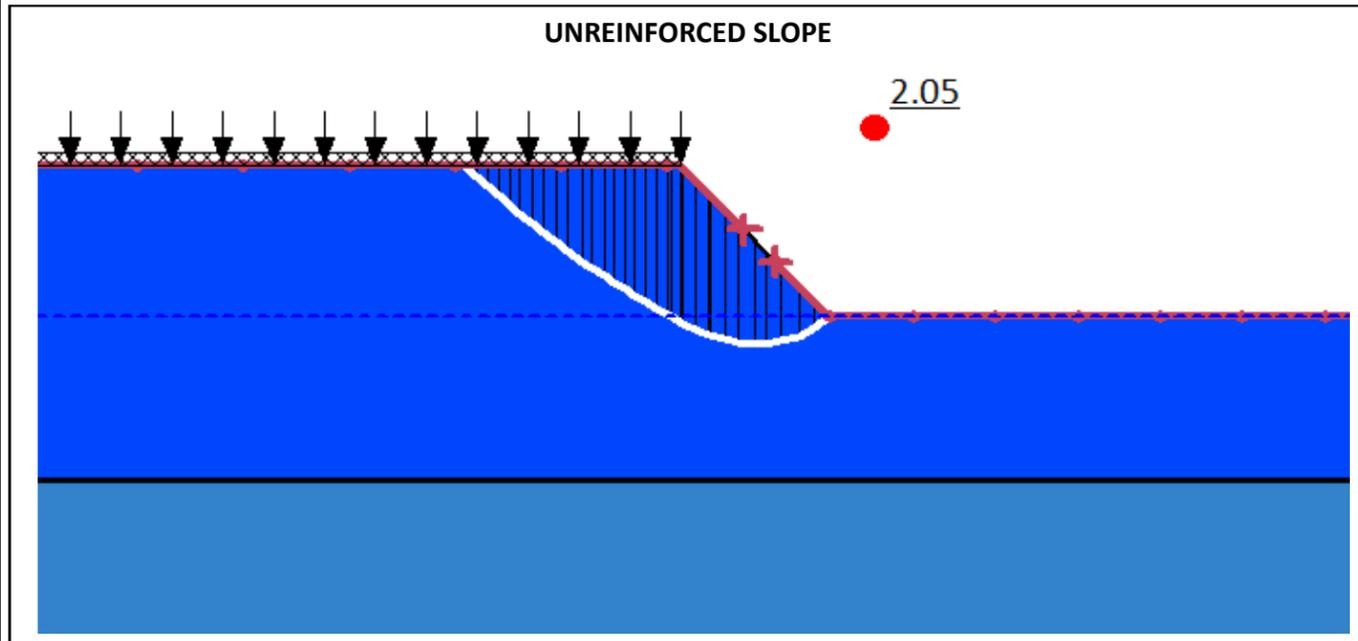
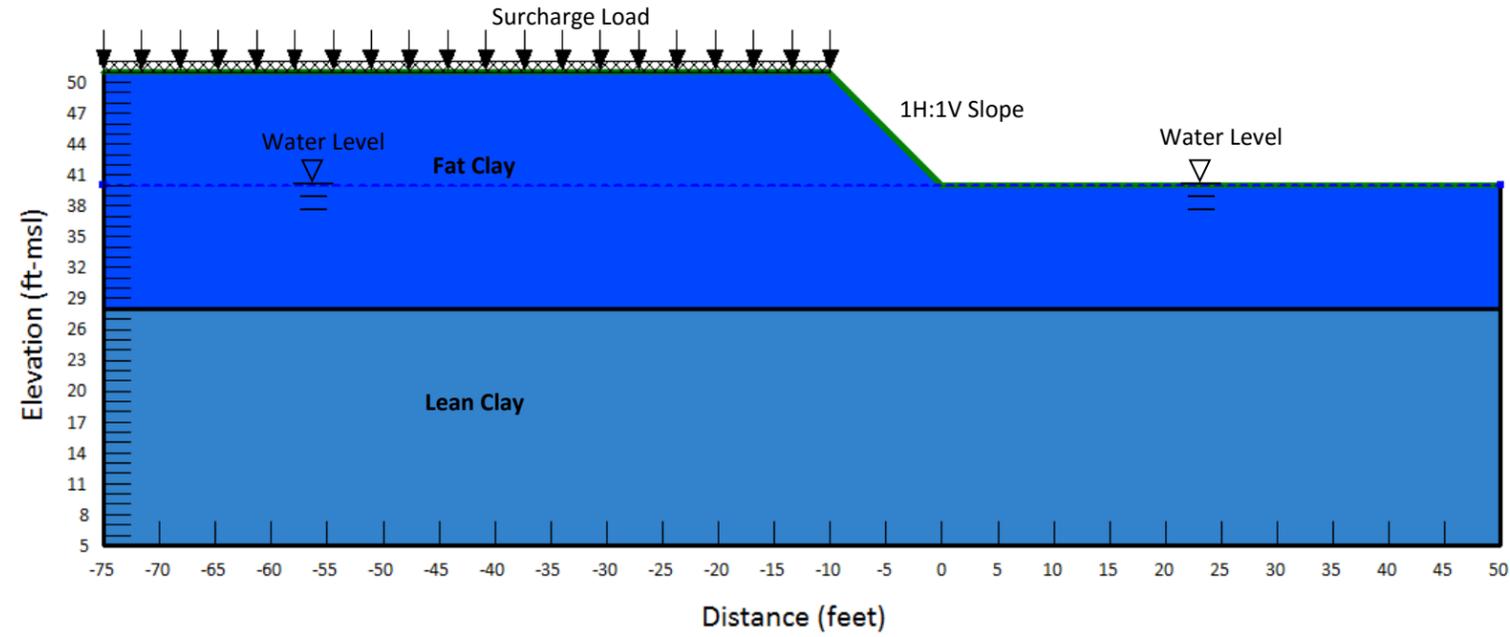
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**Slope Stability Analysis**  
**Alternative 1A, 2A Right Slopes**

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ALTERNATIVE 1A, 2A RIGHT SLOPES UNREINFORCED, INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)

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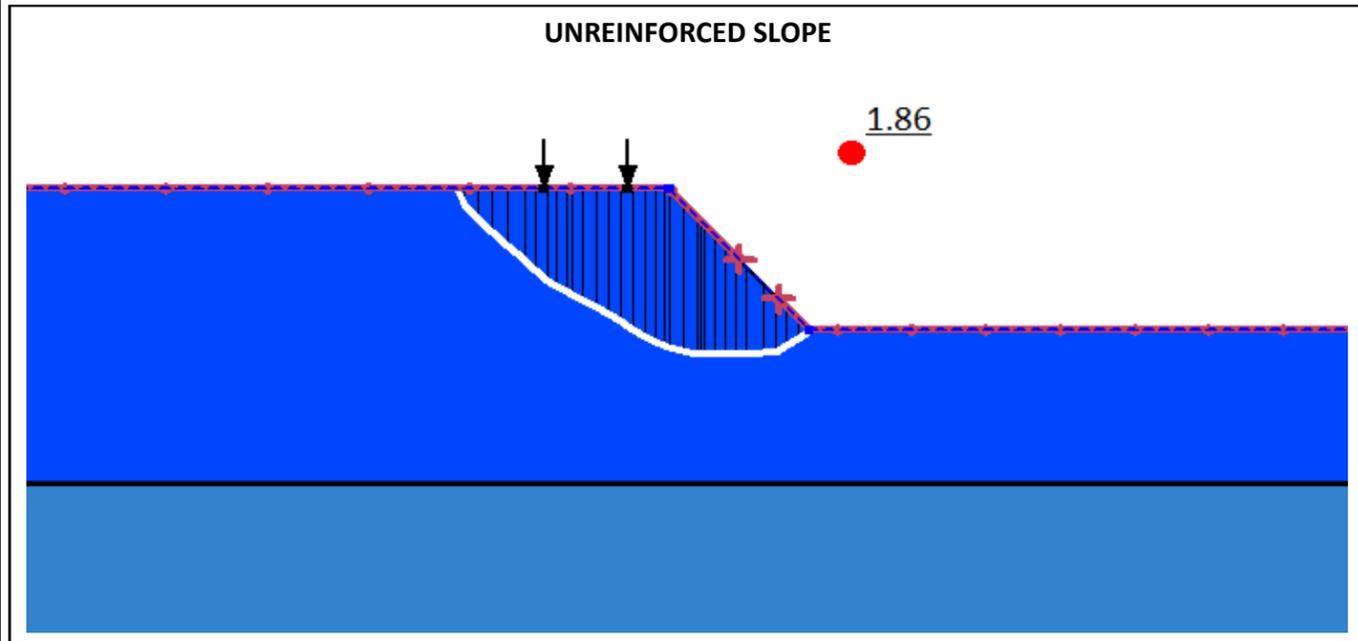
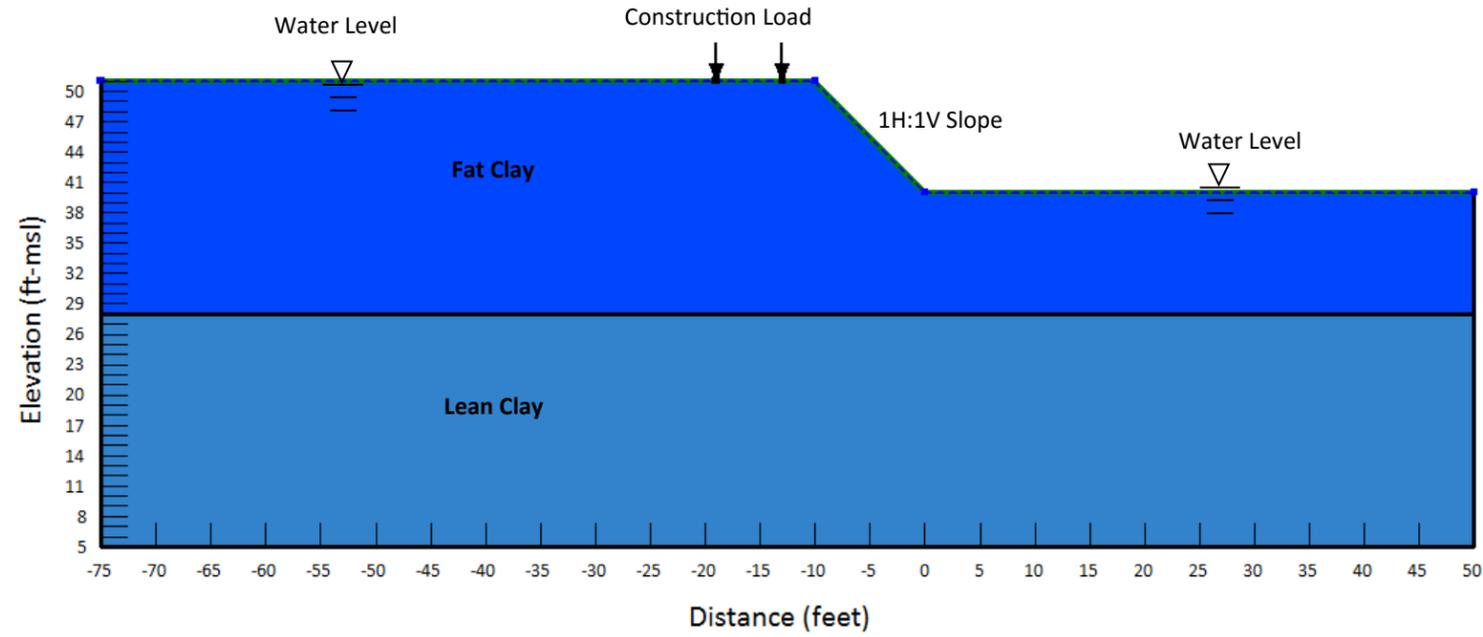
POOR FARM DITCH IMPROVEMENTS  
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**Slope Stability Analysis**  
**Alternative 1A, 2A Right Slopes**

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**ALTERNATIVE 1A, 2A RIGHT SLOPES UNREINFORCED, INCLUDING CONSTRUCTION LOAD ON FULLY SATURATED SLOPE**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)

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	HG

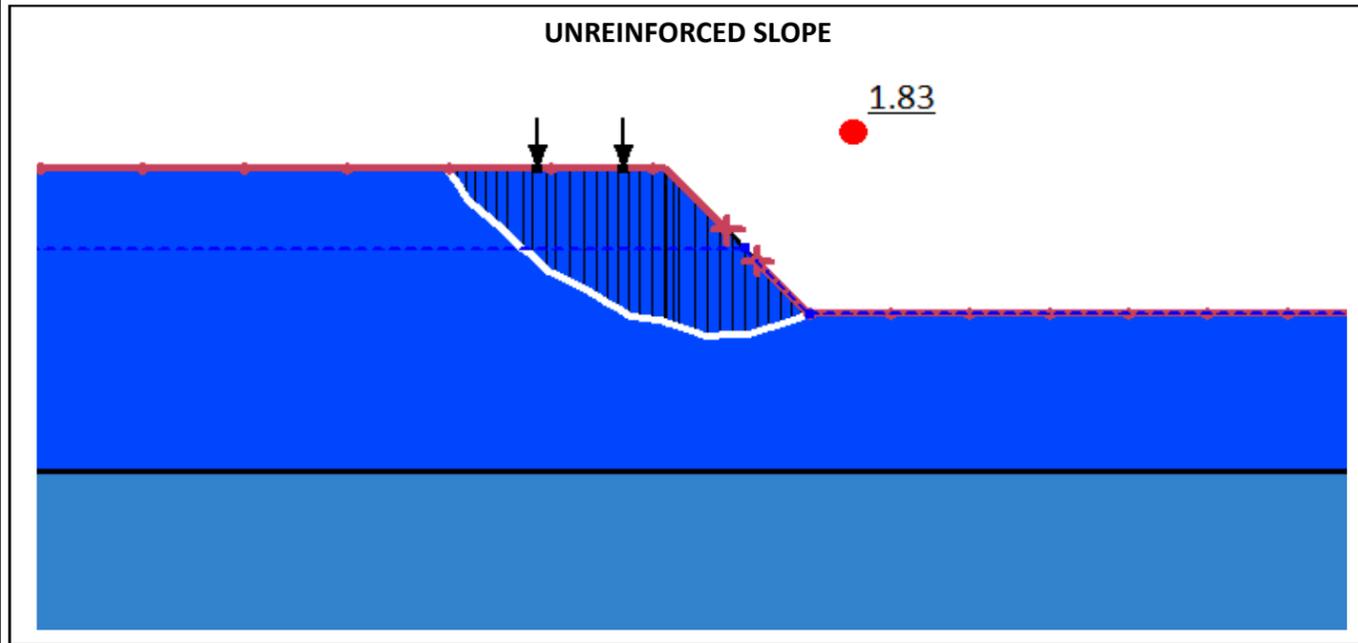
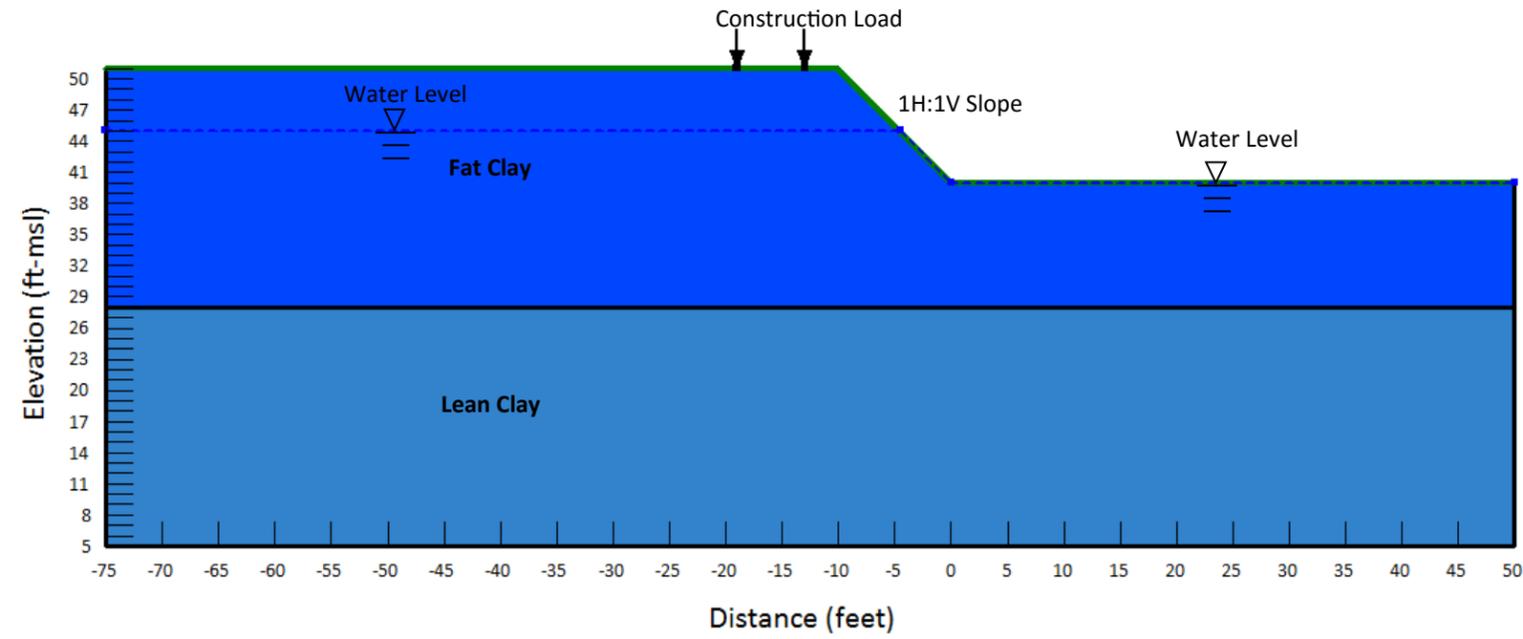
POOR FARM DITCH IMPROVEMENTS  
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**Slope Stability Analysis**  
**Alternative 1A, 2A Right Slopes**

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**HARRIS COUNTY FLOOD CONTROL DISTRICT**

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ALTERNATIVE 1A, 2A RIGHT SLOPES UNREINFORCED, INCLUDING CONSTRUCTION LOAD ON PARTIALLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
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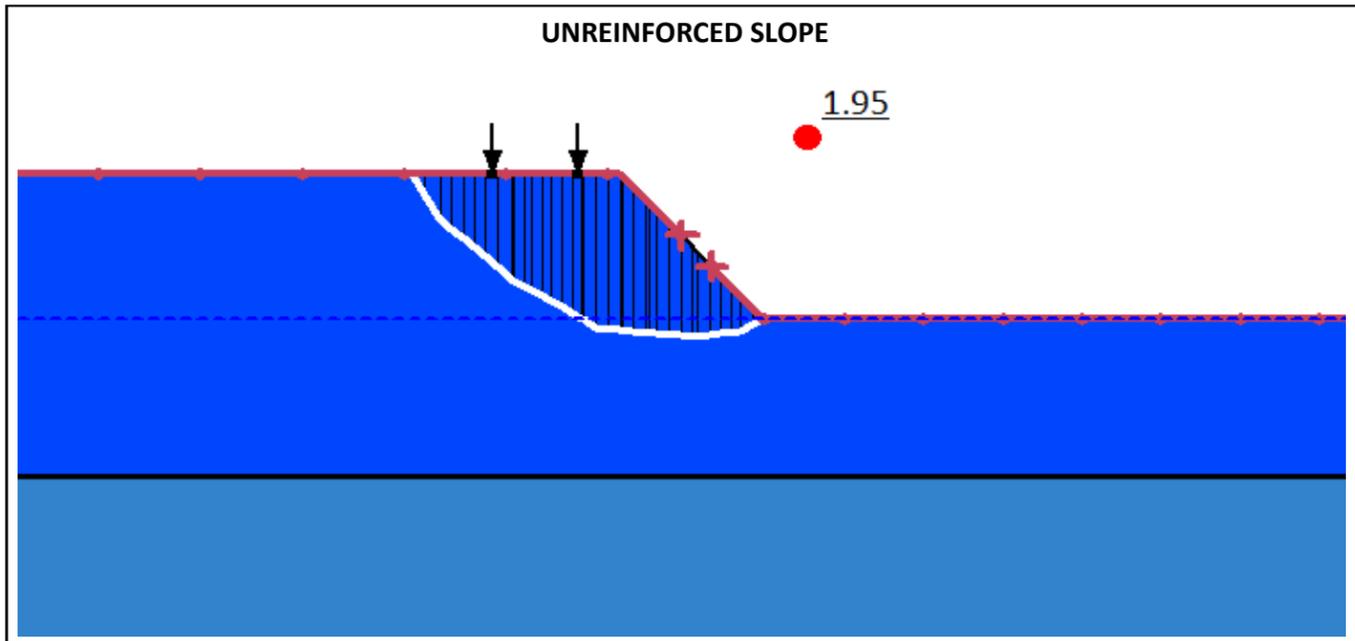
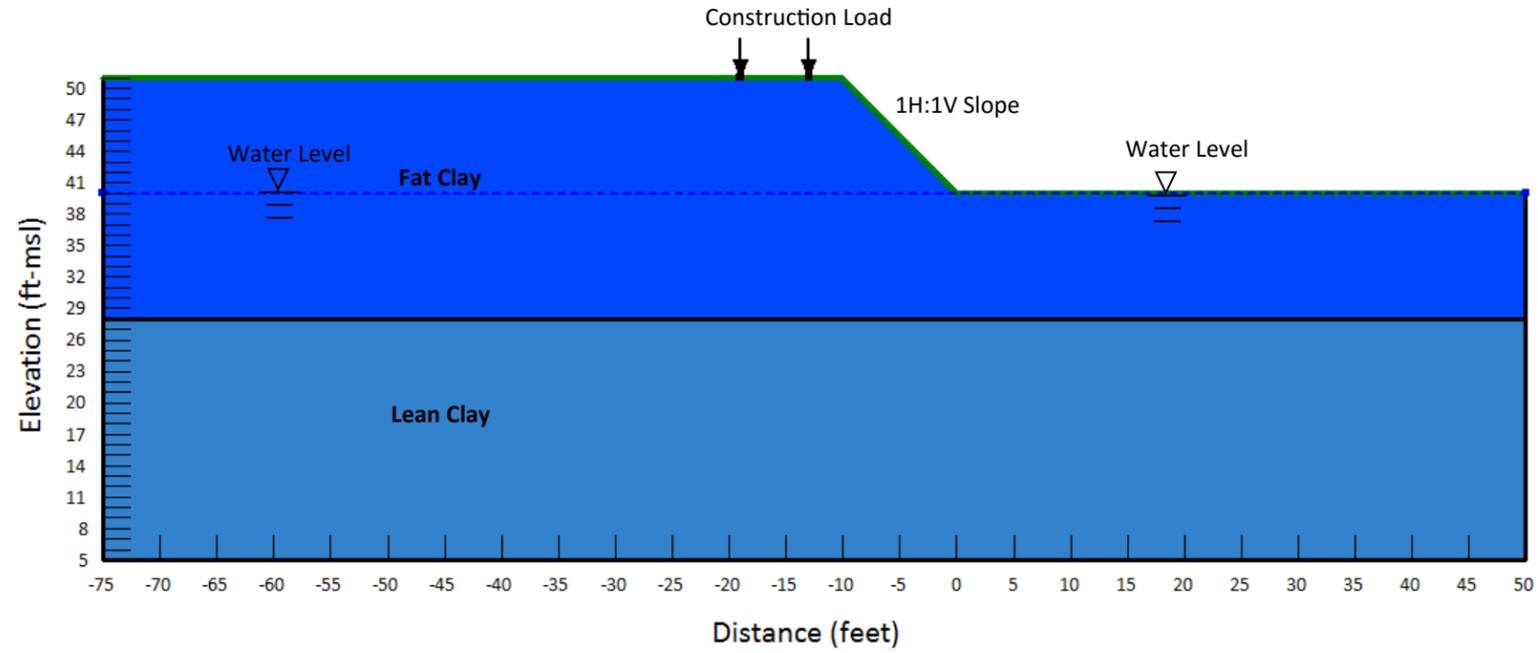
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 1A, 2A Right Slopes**

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**FLOOD CONTROL DISTRICT**

9900 Northwest Freeway  
 Houston, Texas 77092

ALTERNATIVE 1A, 2A RIGHT SLOPES UNREINFORCED, INCLUDING CONSTRUCTION LOAD WITH WATER AT CHANNEL BASE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)

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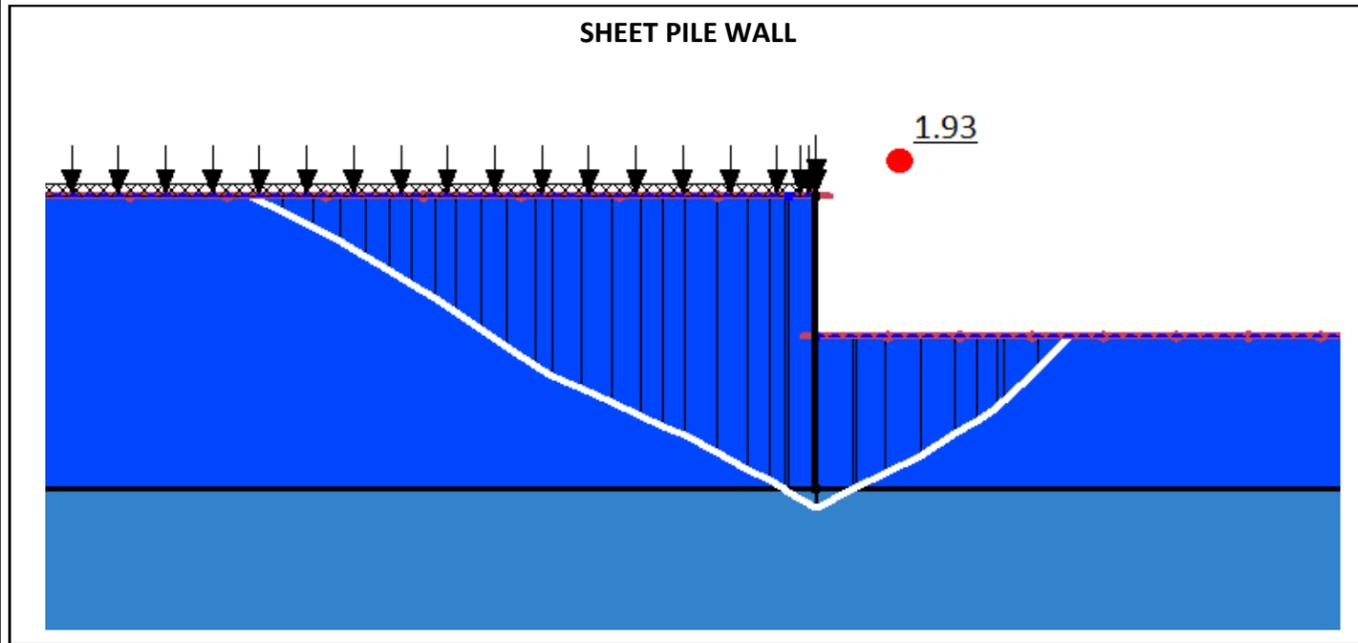
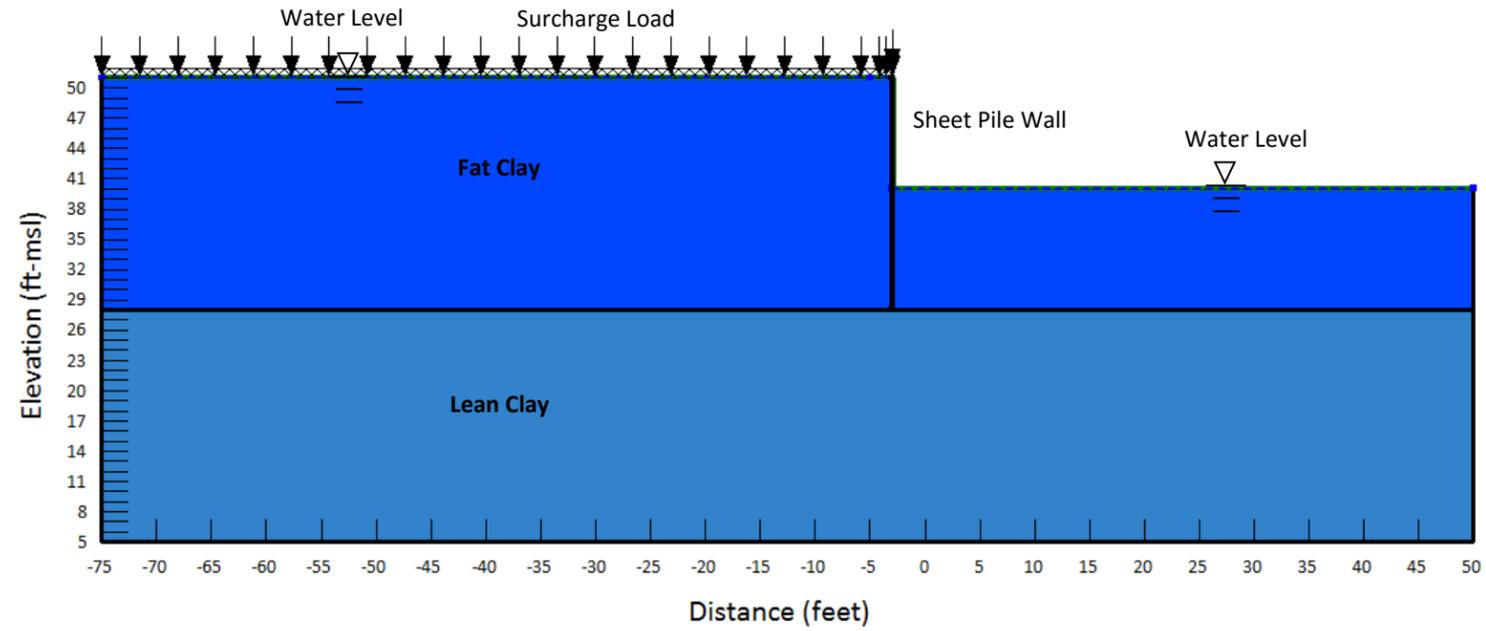
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 1A, 2A Right Slopes**

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ALTERNATIVE 1B, 2B, and 2C RIGHT: SHEET PILE WALL, INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Sheet Pile Wall

General Notes:

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FILE NAME	Stability Analysis
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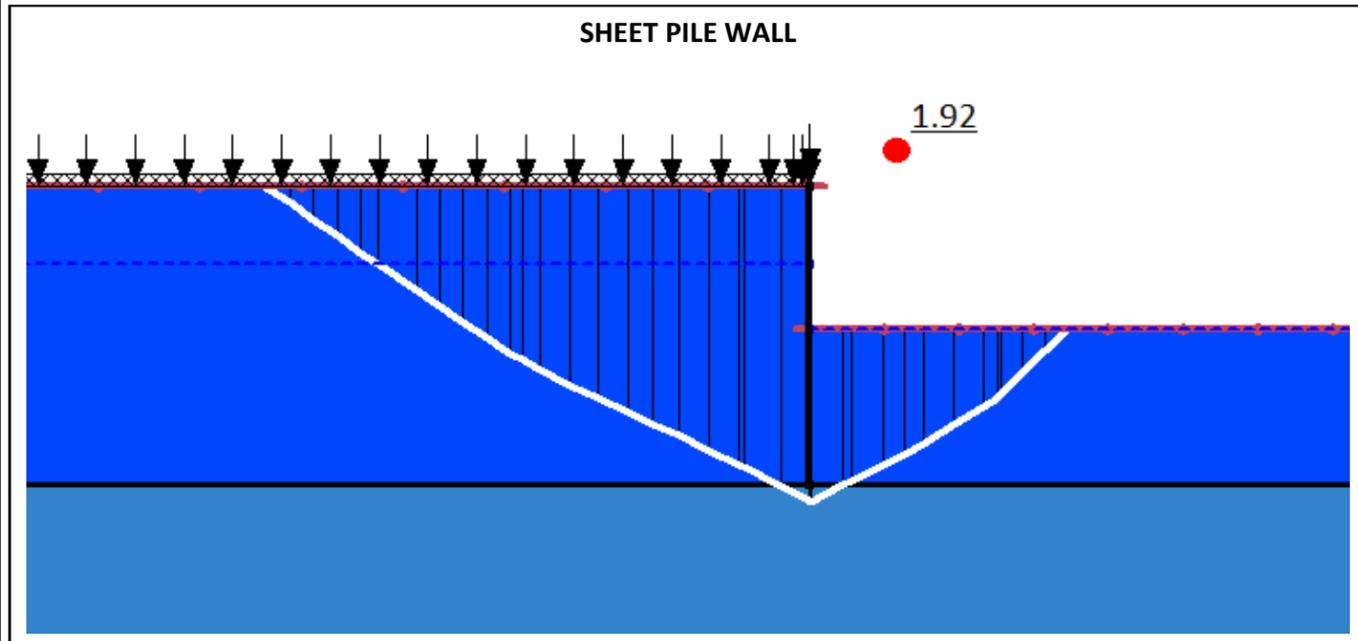
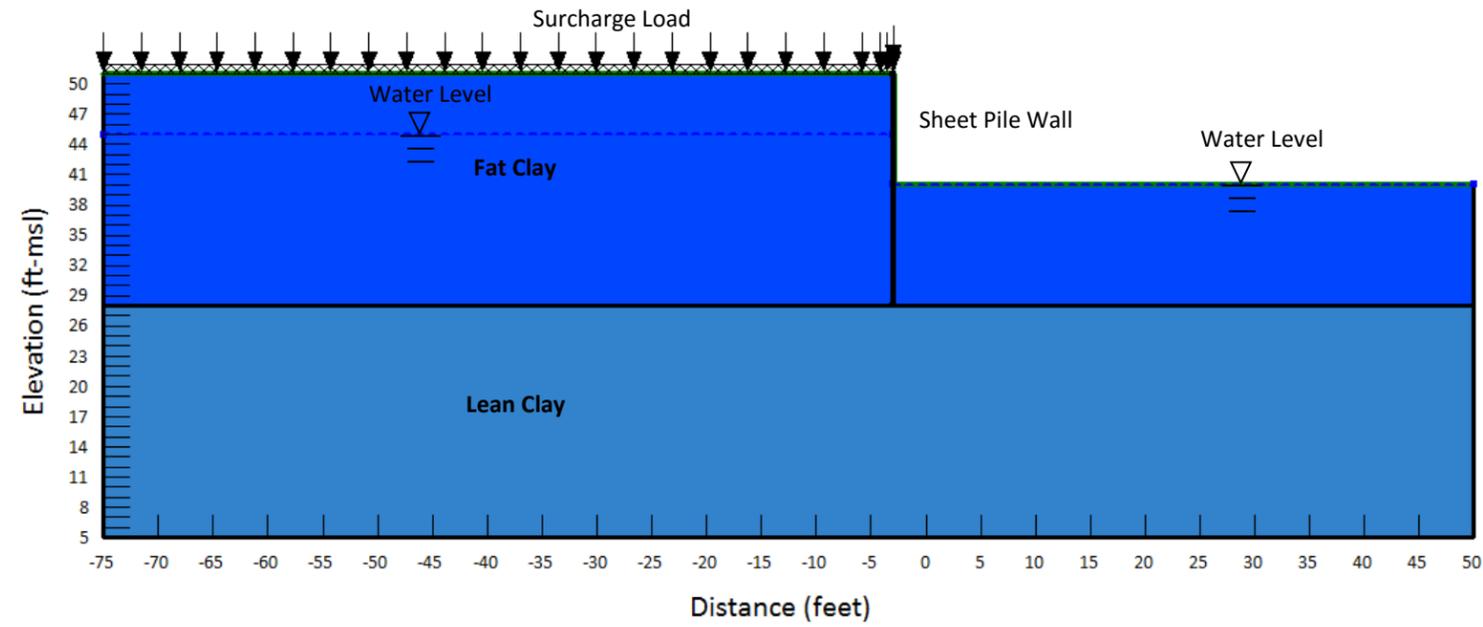
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**Slope Stability Analysis**  
**Alternative 1B, 2B and 2C Right**

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**FLOOD CONTROL DISTRICT**

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ALTERNATIVE 1B, 2B and 2C RIGHT: SHEET PILE WALL, INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Sheet Pile Wall

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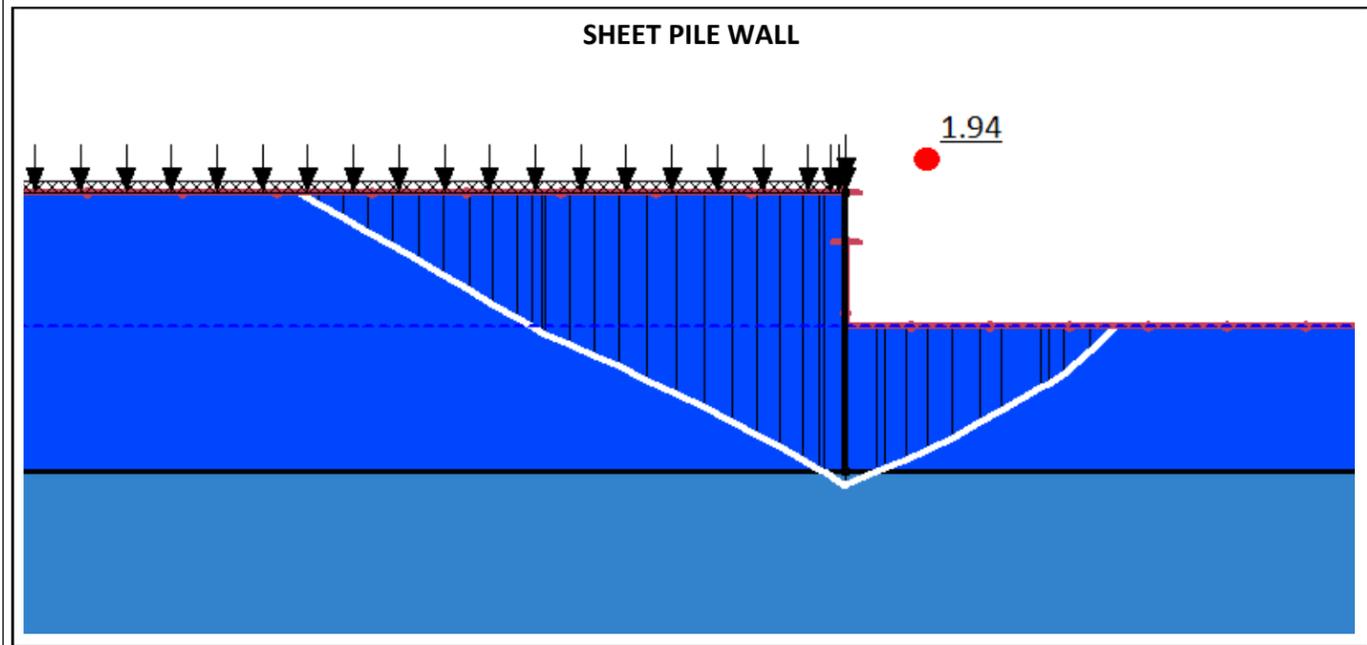
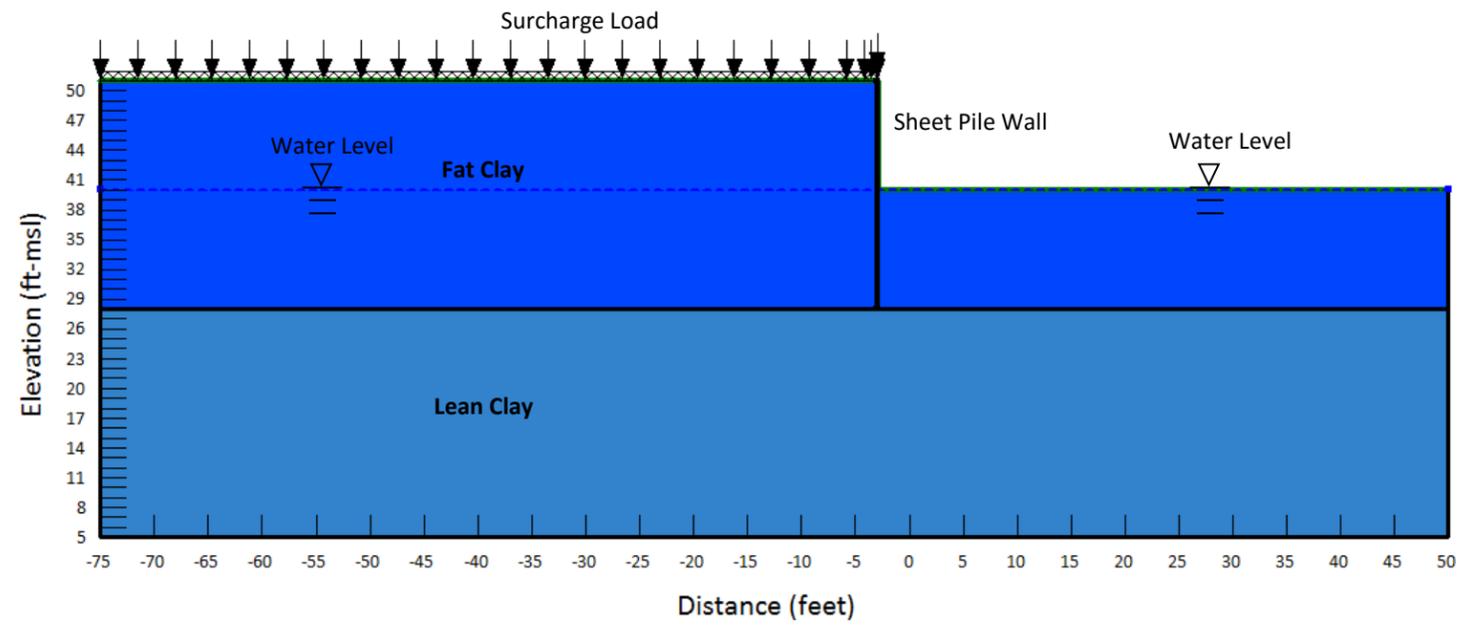
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**Slope Stability Analysis**  
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ALTERNATIVE 1B, 2B and 2C RIGHT: SHEET PILE WALL, INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
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	2,000 lbs Point Load (Construction Load)
	Sheet Pile Wall

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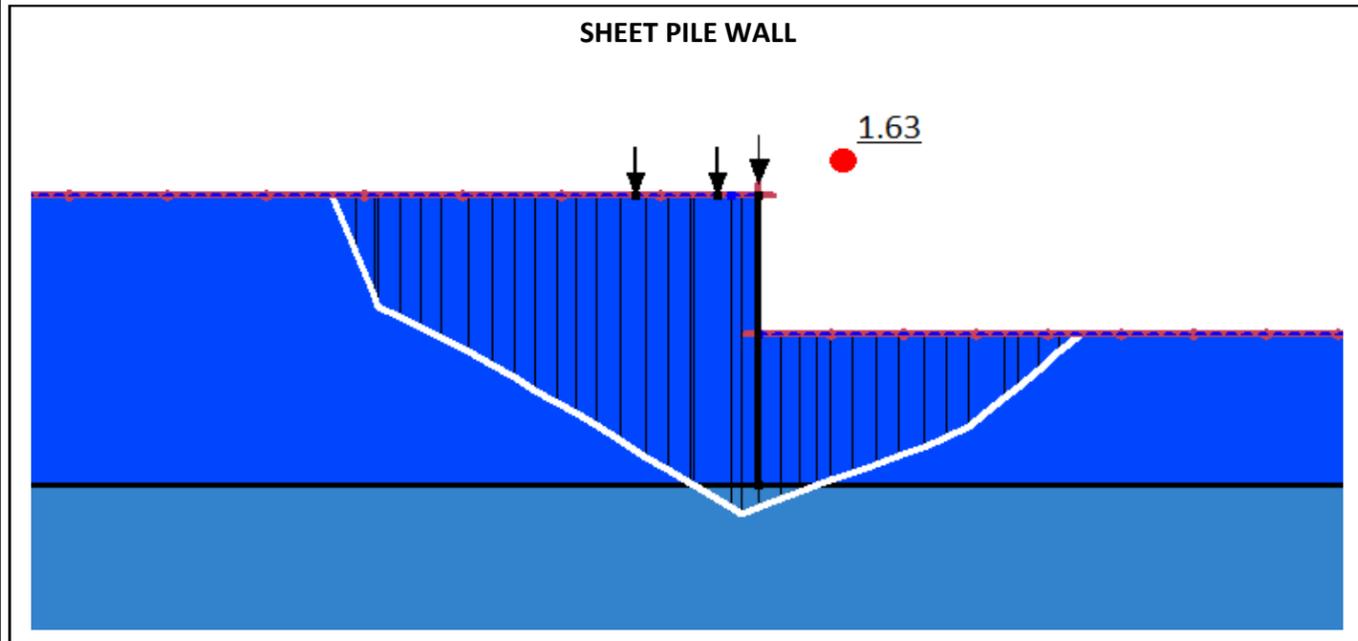
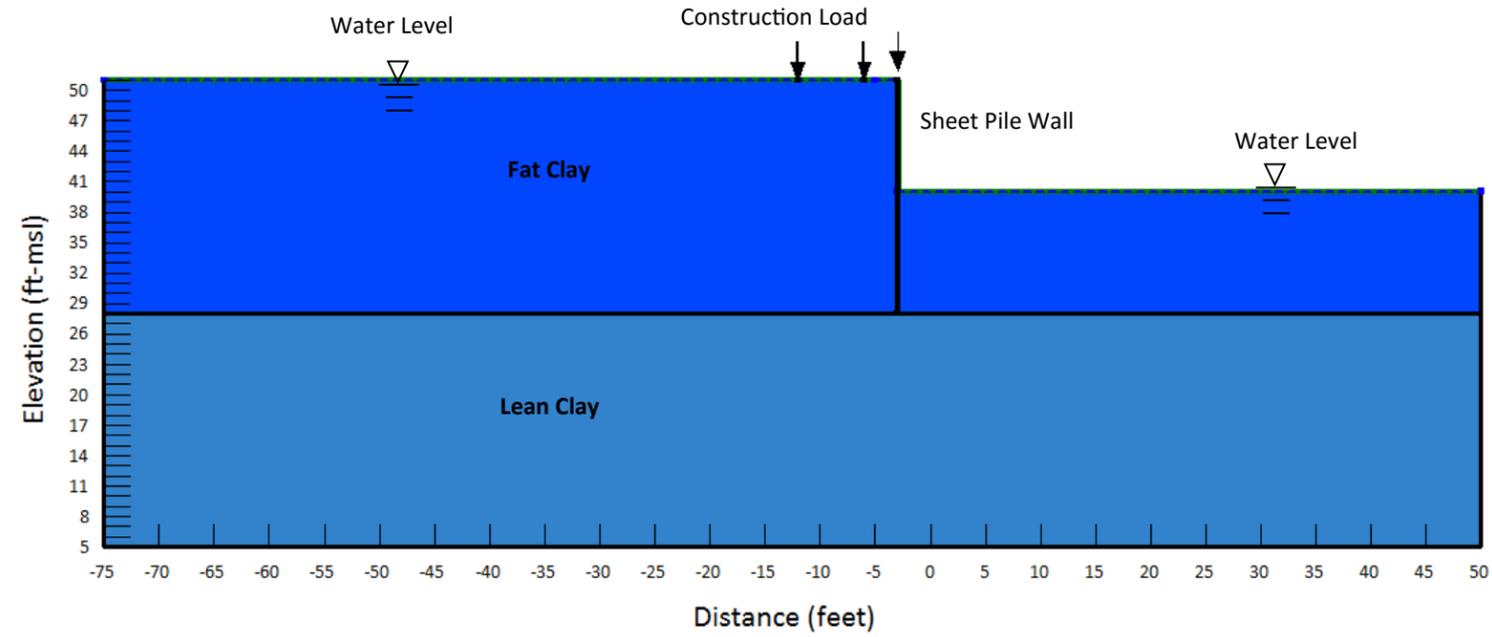
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**HARRIS COUNTY FLOOD CONTROL DISTRICT**  
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ALTERNATIVE 1B, 2B and 2C RIGHT: SHEET PILE WALL, INCLUDING CONSTRUCTION LOAD ON FULLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Sheet Pile Wall

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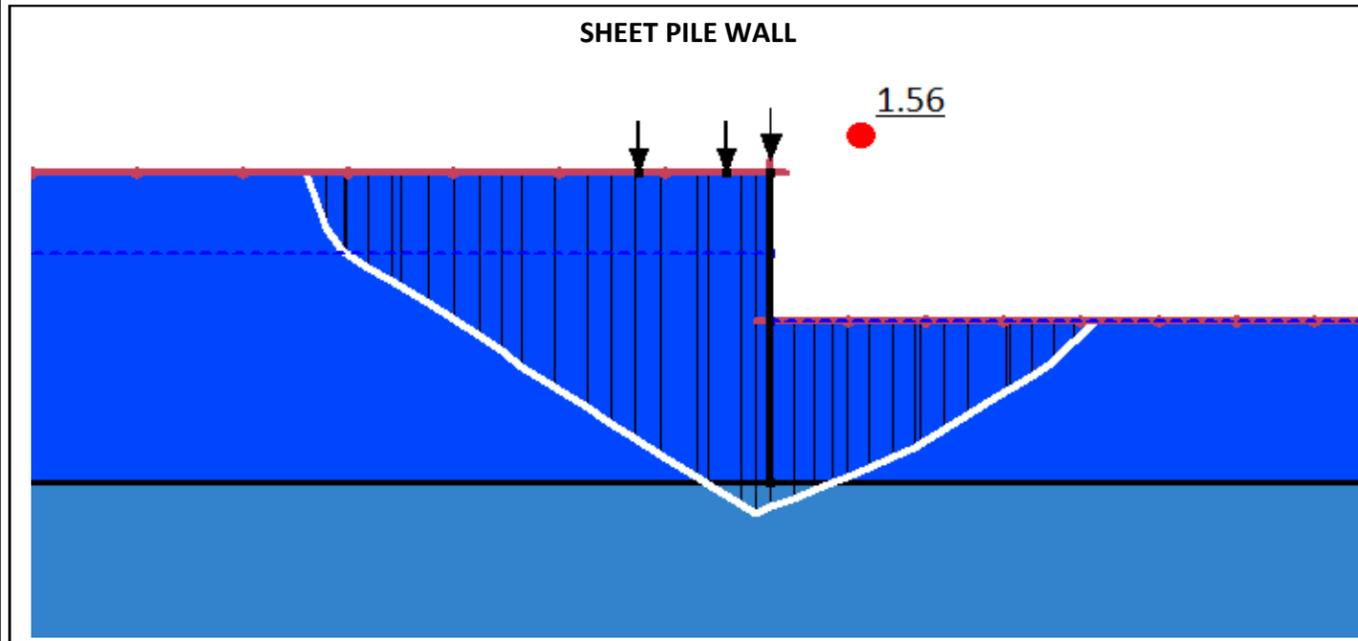
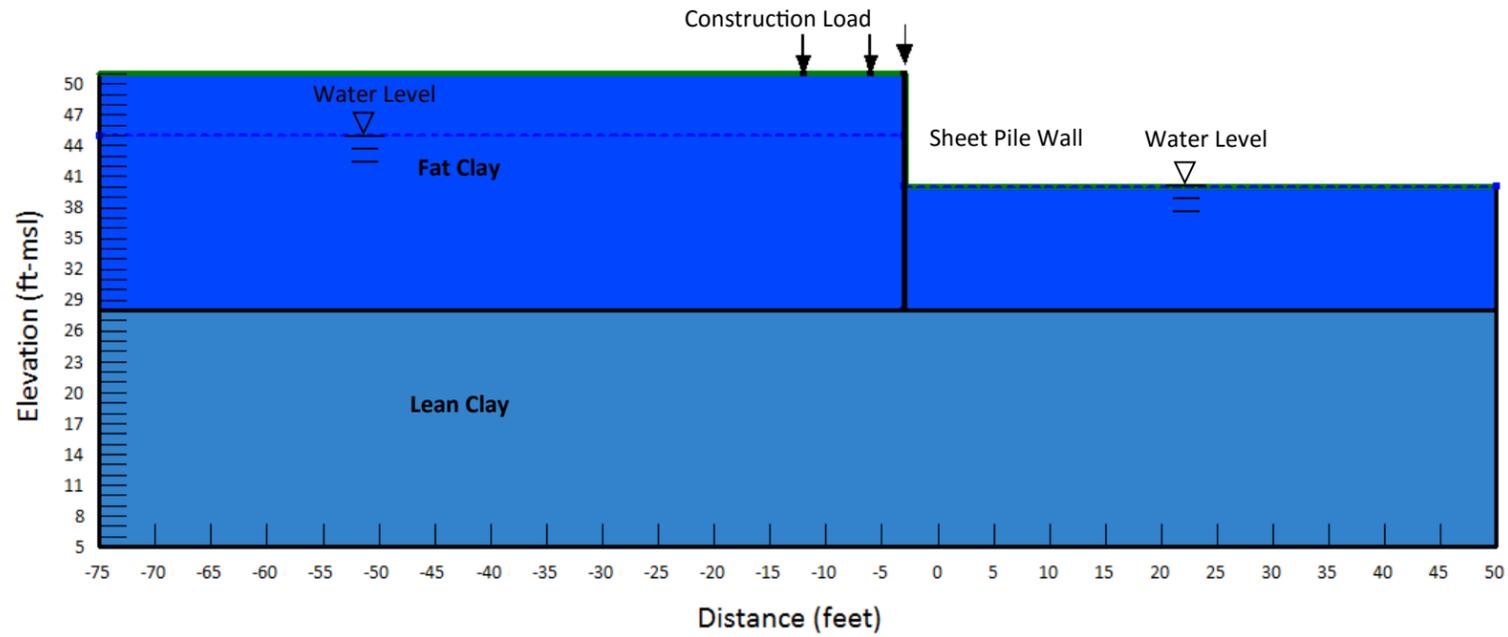
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ALTERNATIVE 1B, 2B and 2C RIGHT: SHEET PILE WALL, INCLUDING CONSTRUCTION LOAD ON PARTIALLY SATURATED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Sheet Pile Wall

**General Notes:**

1. All elevations are in NAVD88 feet mean sea level (feet-msl).
2. Foundation stratigraphy is approximate and presented for illustrative purposes only.

FN PROJECT NO. HCF16148  
 DATE CREATED 1/27/2017  
 DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central  
 FILE NAME  
 PREPARED BY Stability Analysis  
 HG

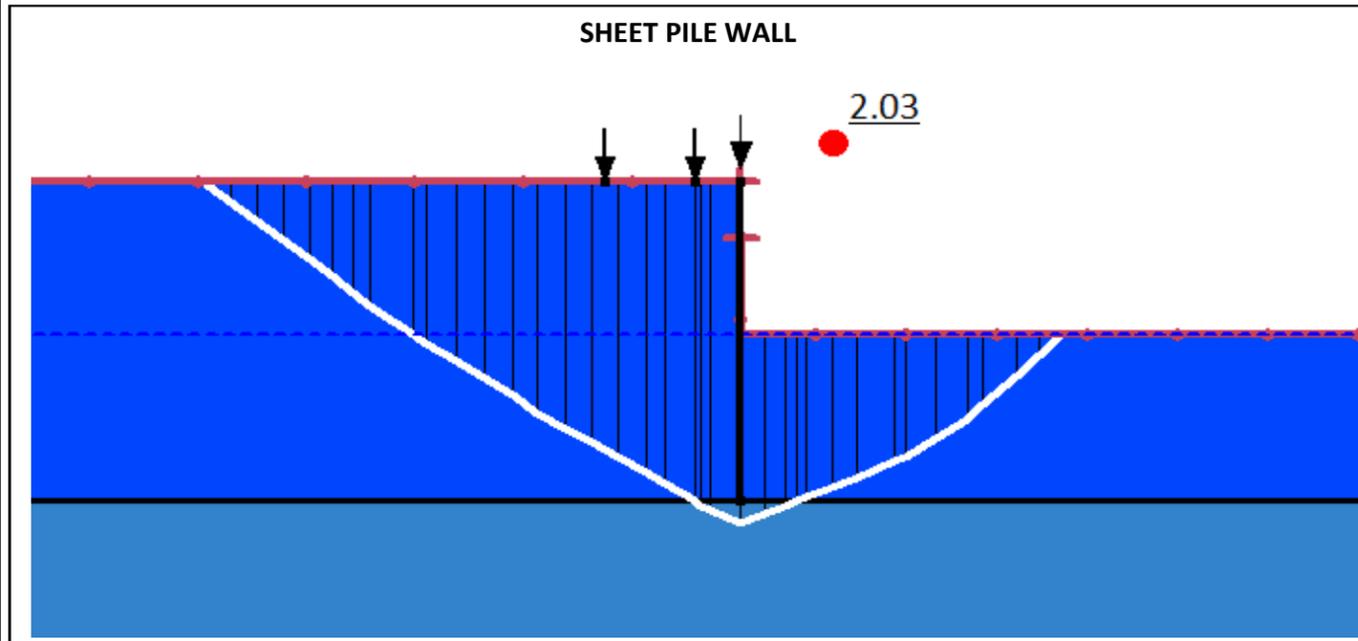
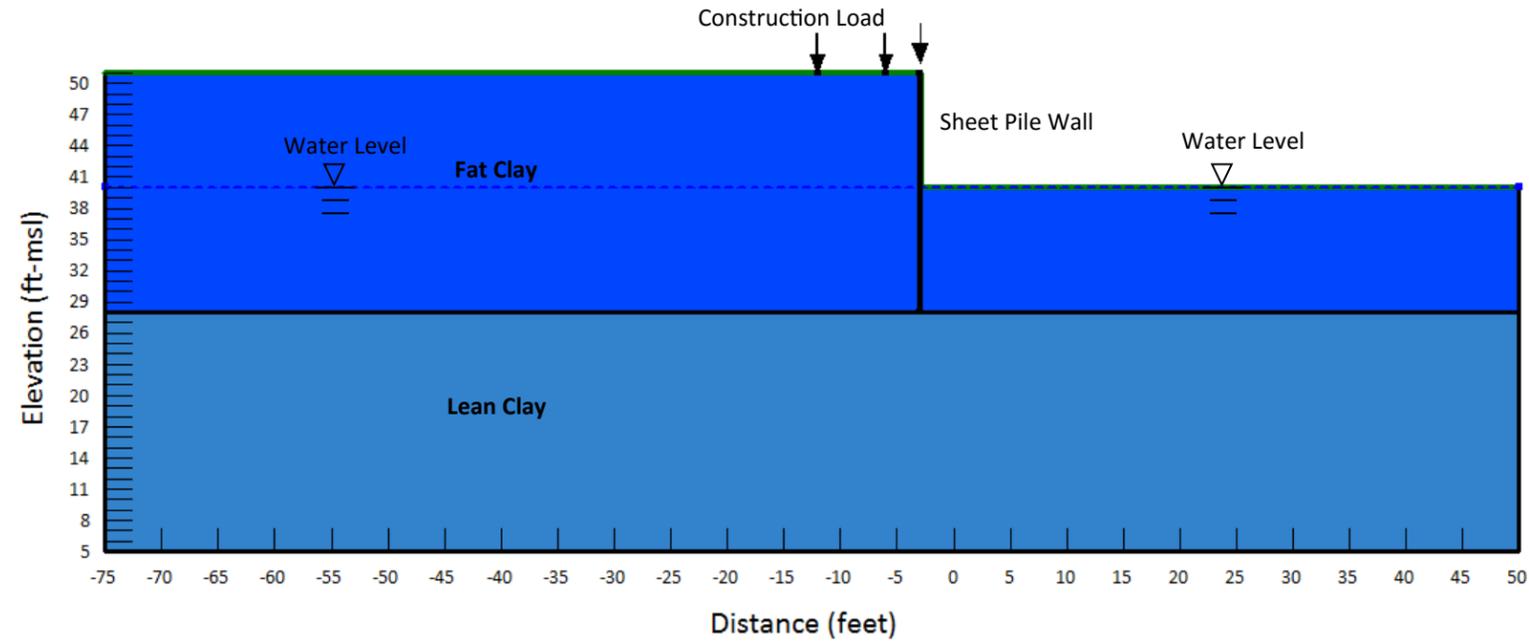
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 1B, 2B and 2C Right**

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ALTERNATIVE 1B, 2B and 2C RIGHT: SHEET PILE WALL, INCLUDING CONSTRUCTION LOAD WITH WATER AT CHANNEL BASE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Sheet Pile Wall

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DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Stability Analysis
PREPARED BY	HG

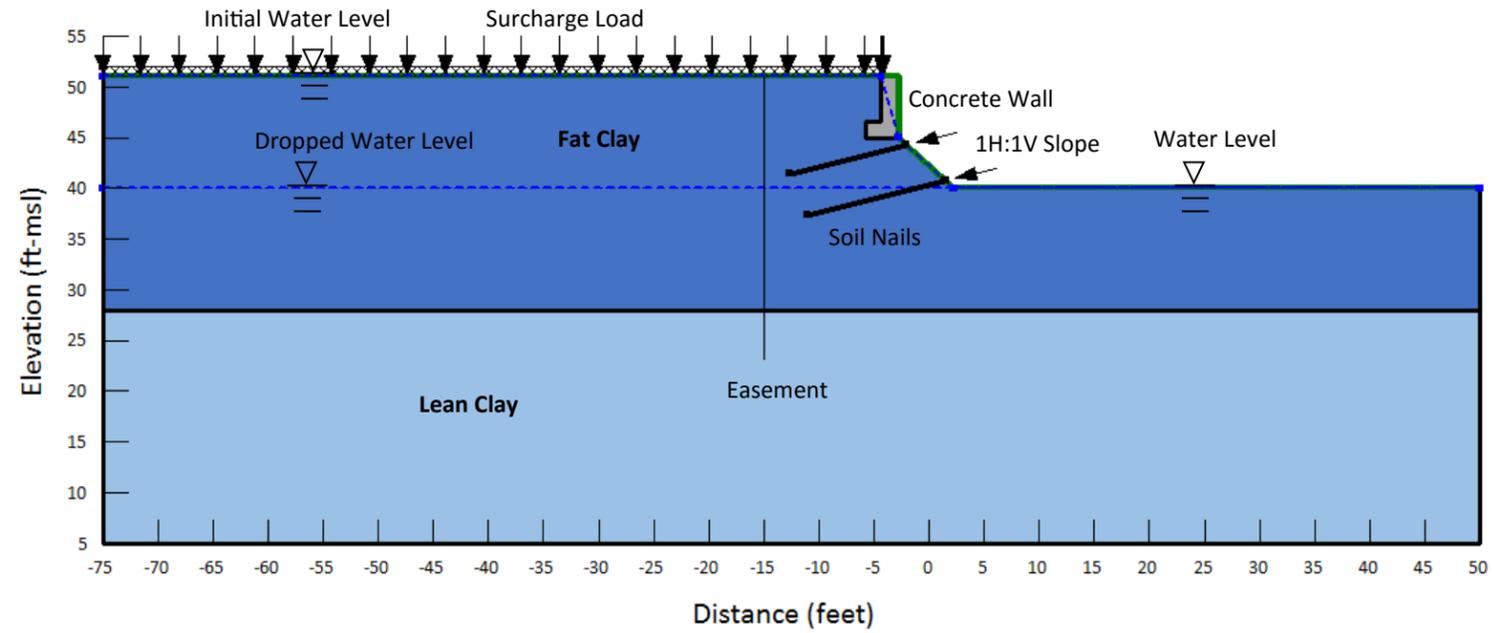
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 1B, 2B and 2C Right**

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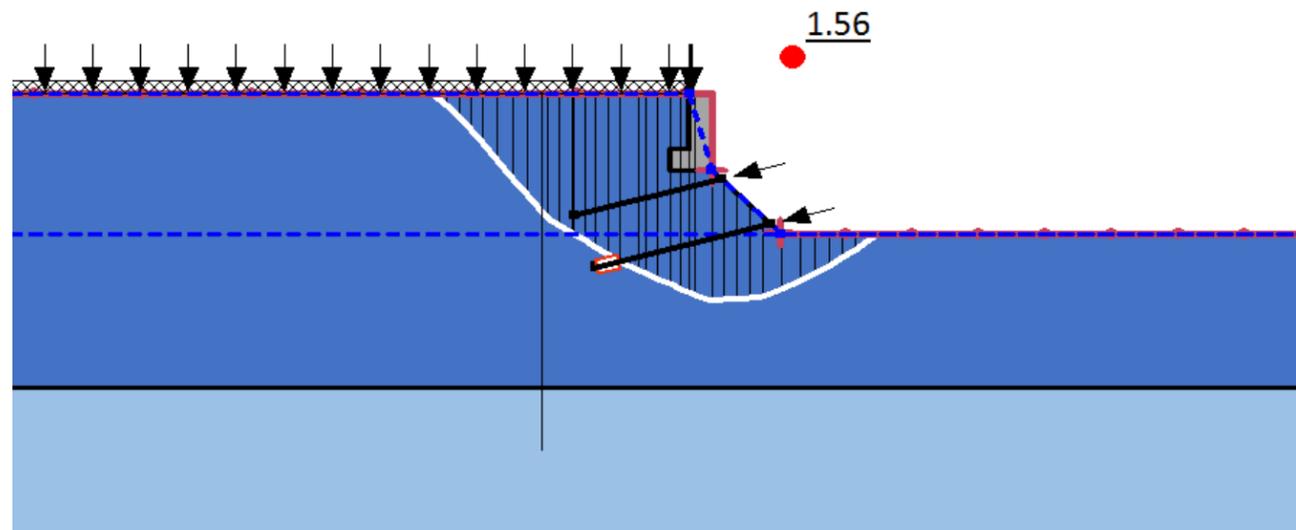
**HARRIS COUNTY**  
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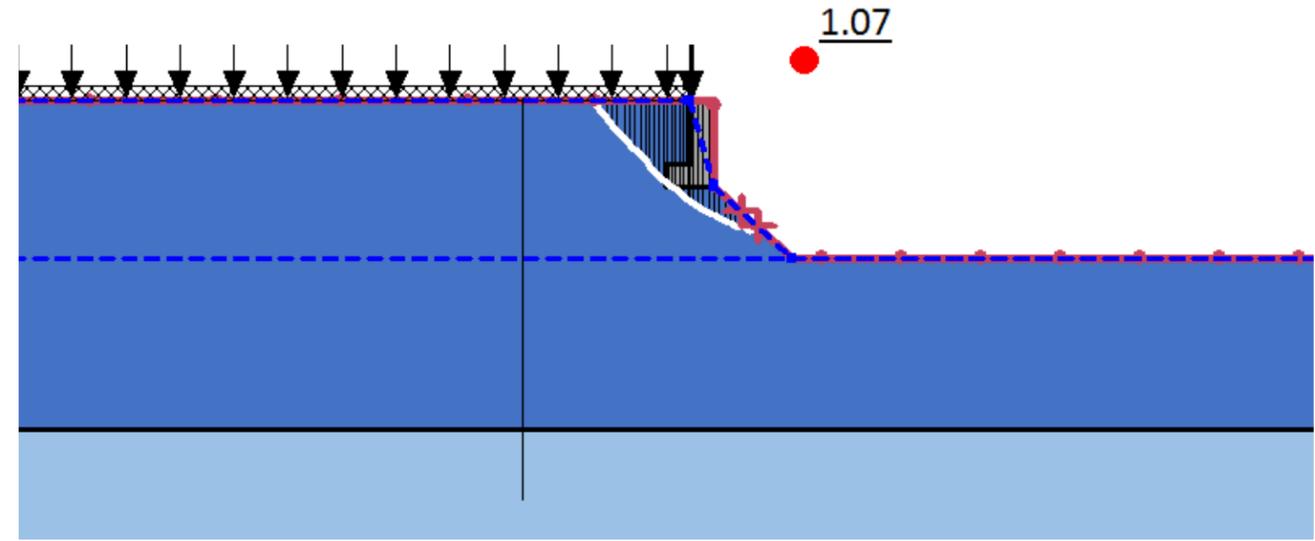
**ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD, RAPID DRAWDOWN**



**REINFORCED WITH PERMANENT SOIL NAILS**



**UNREINFORCED WITH PERMANENT SOIL NAILS**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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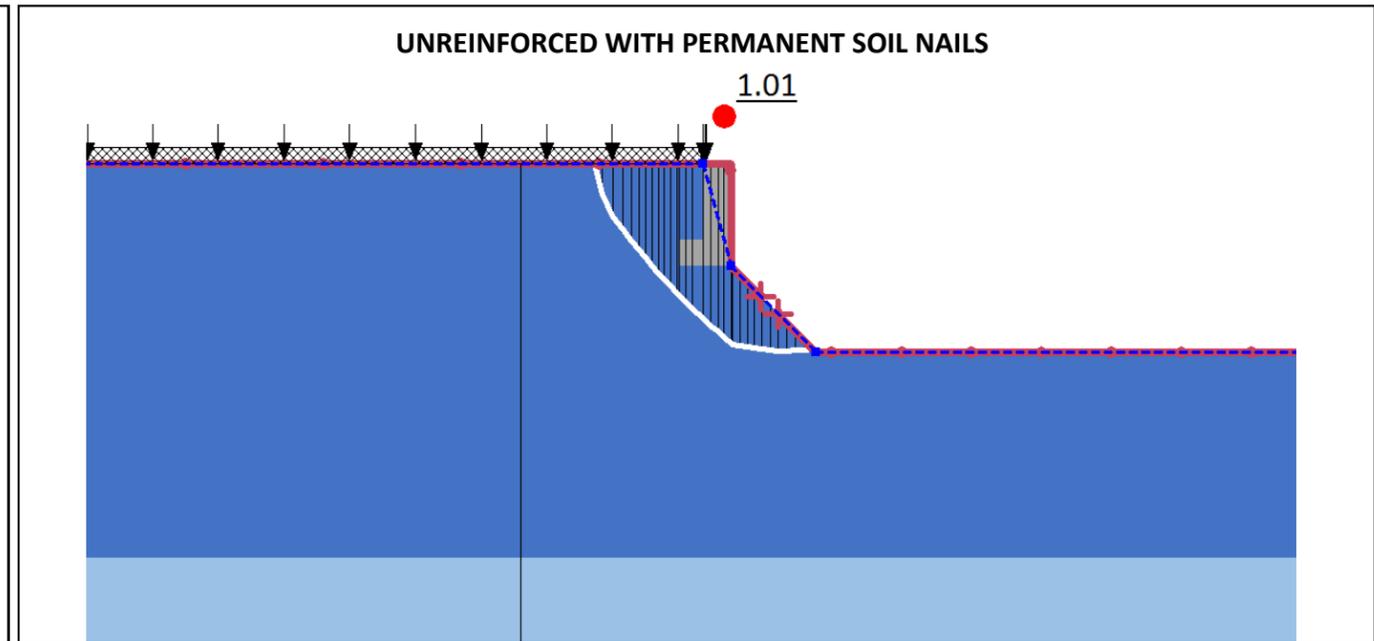
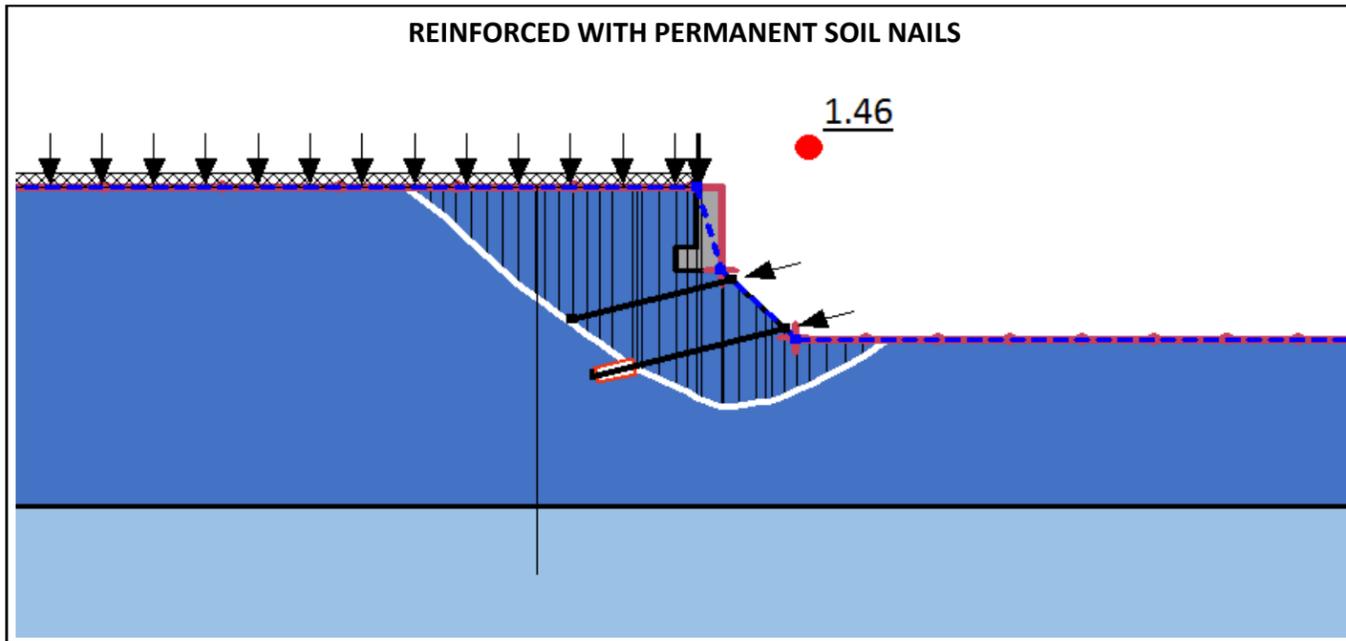
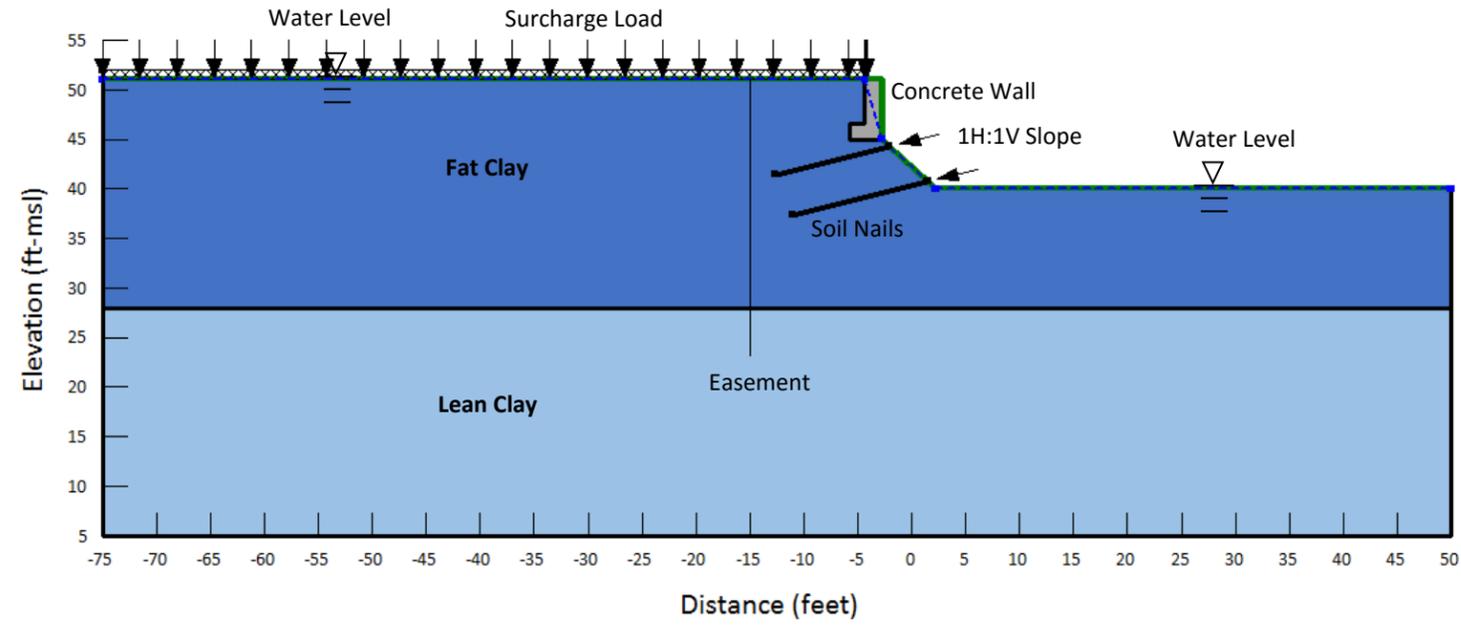
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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**ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE, EFFECTIVE STRENGTH**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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FILE NAME	Stability Analysis
PREPARED BY	HG

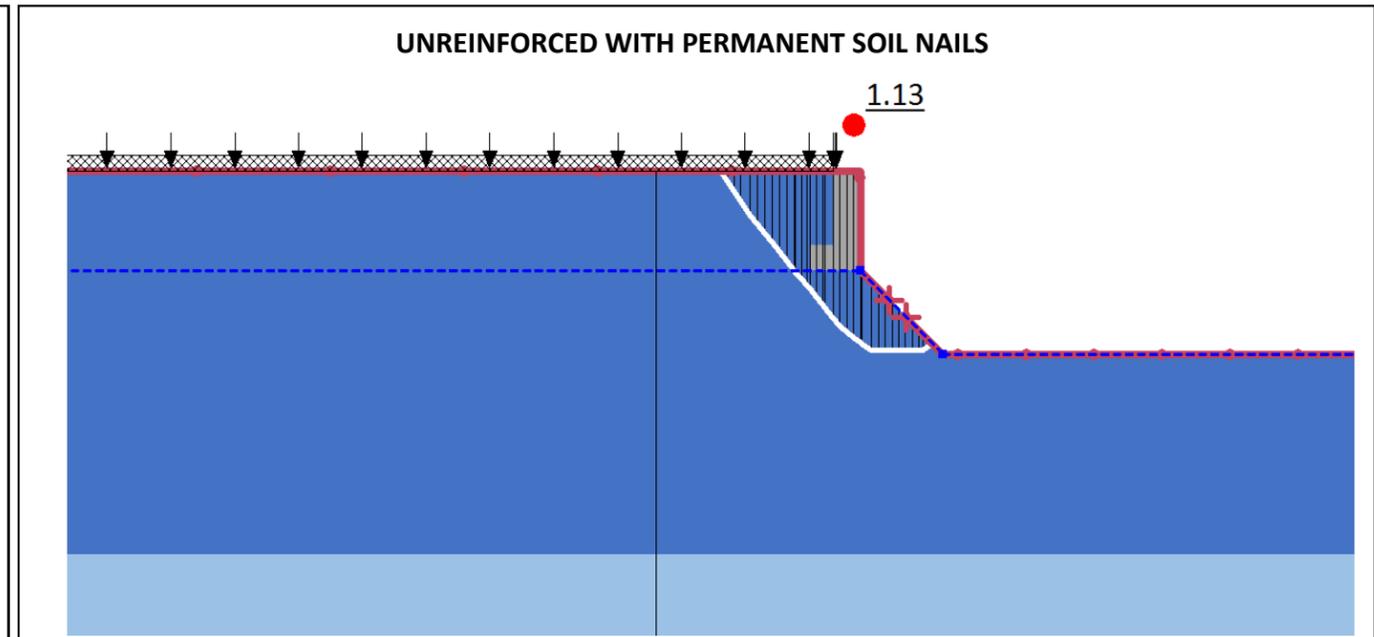
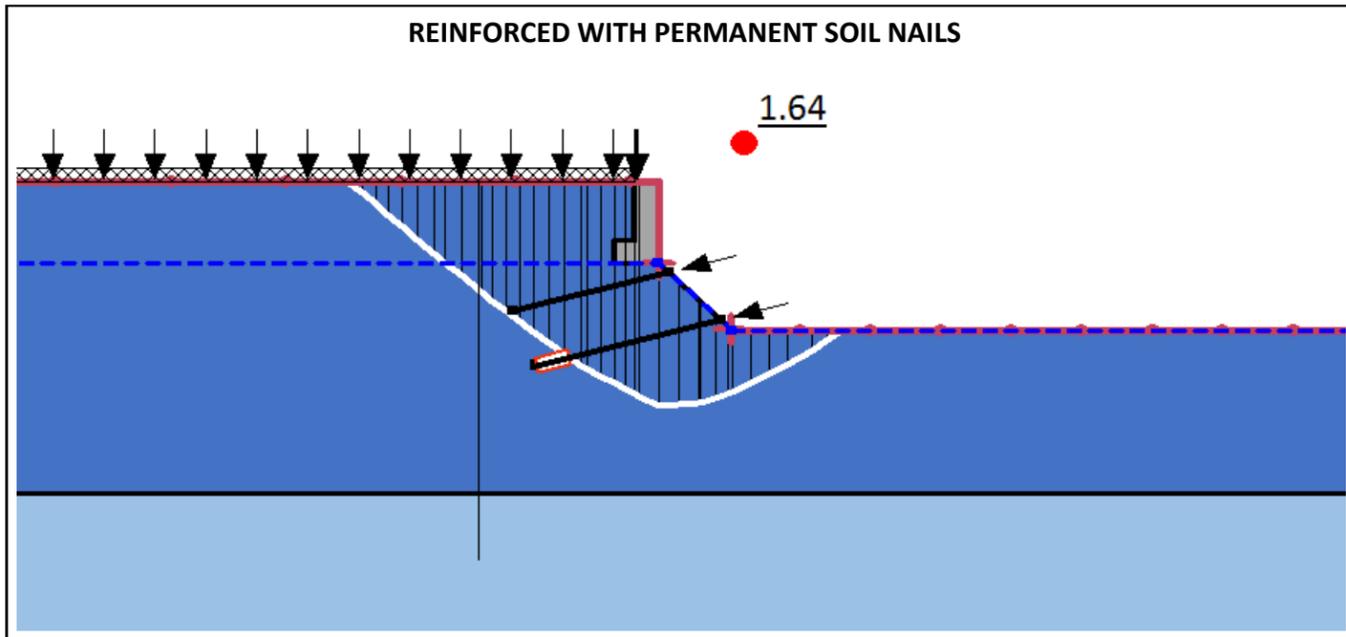
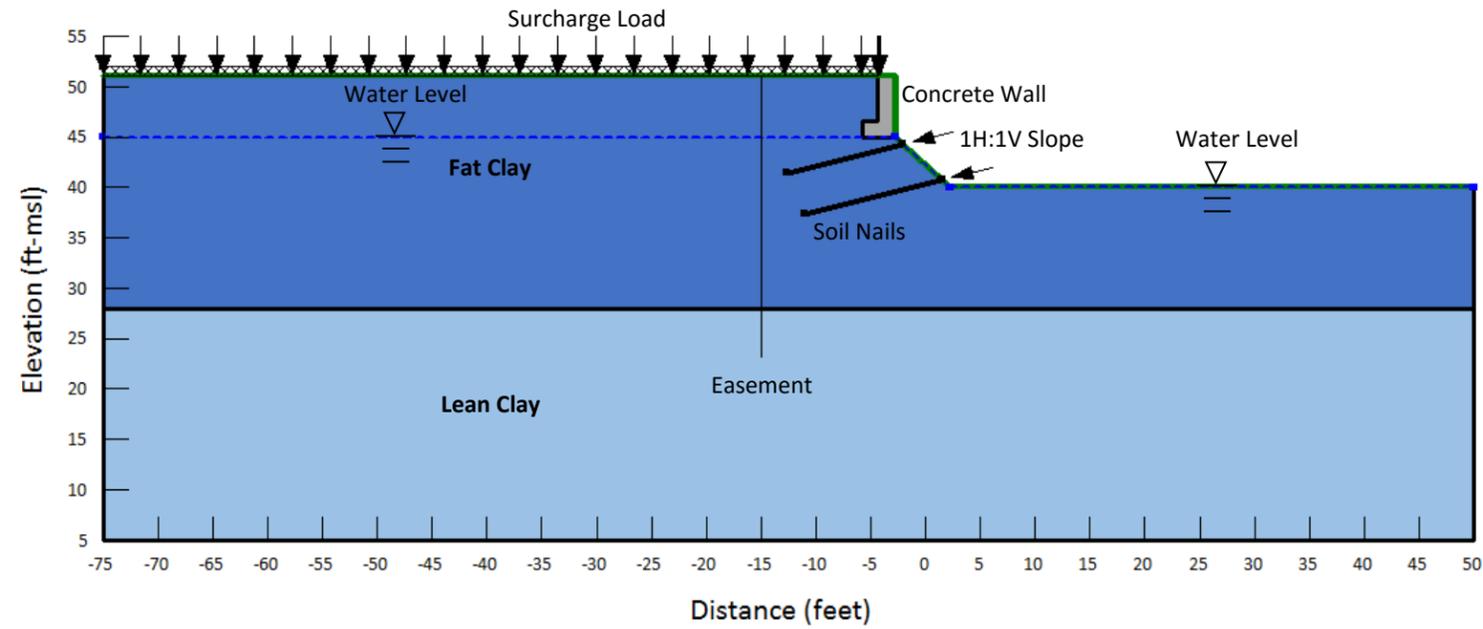
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE, EFFECTIVE STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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PREPARED BY	HG

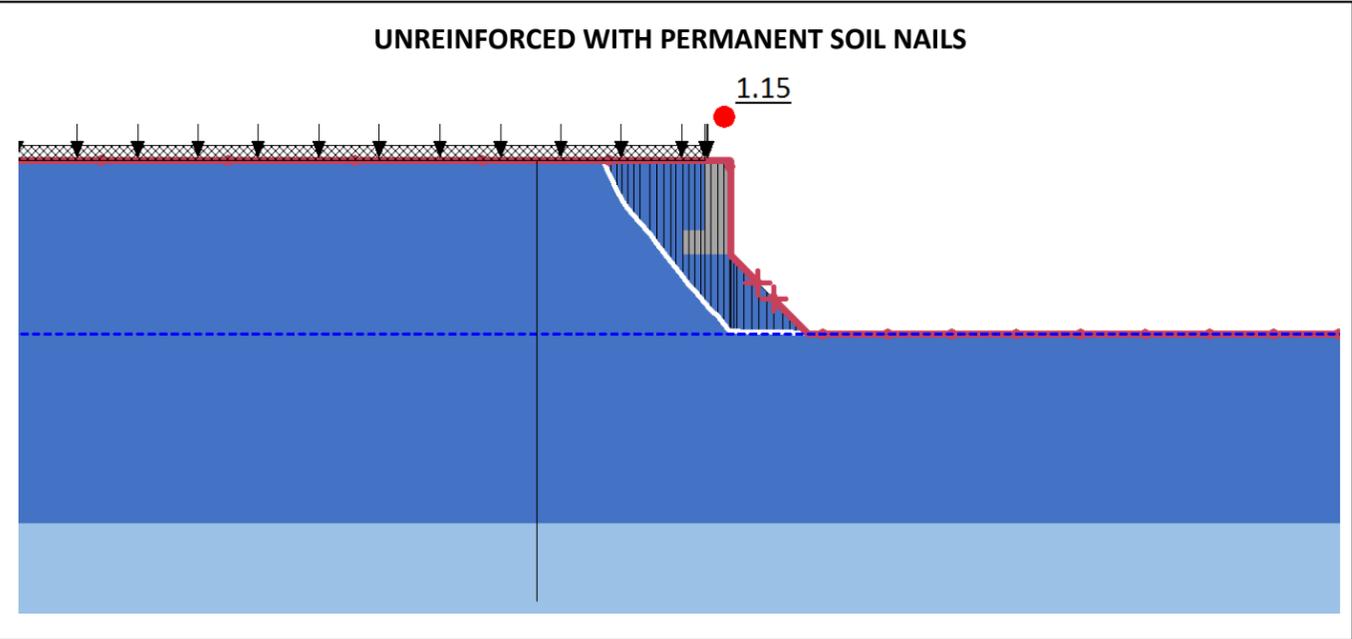
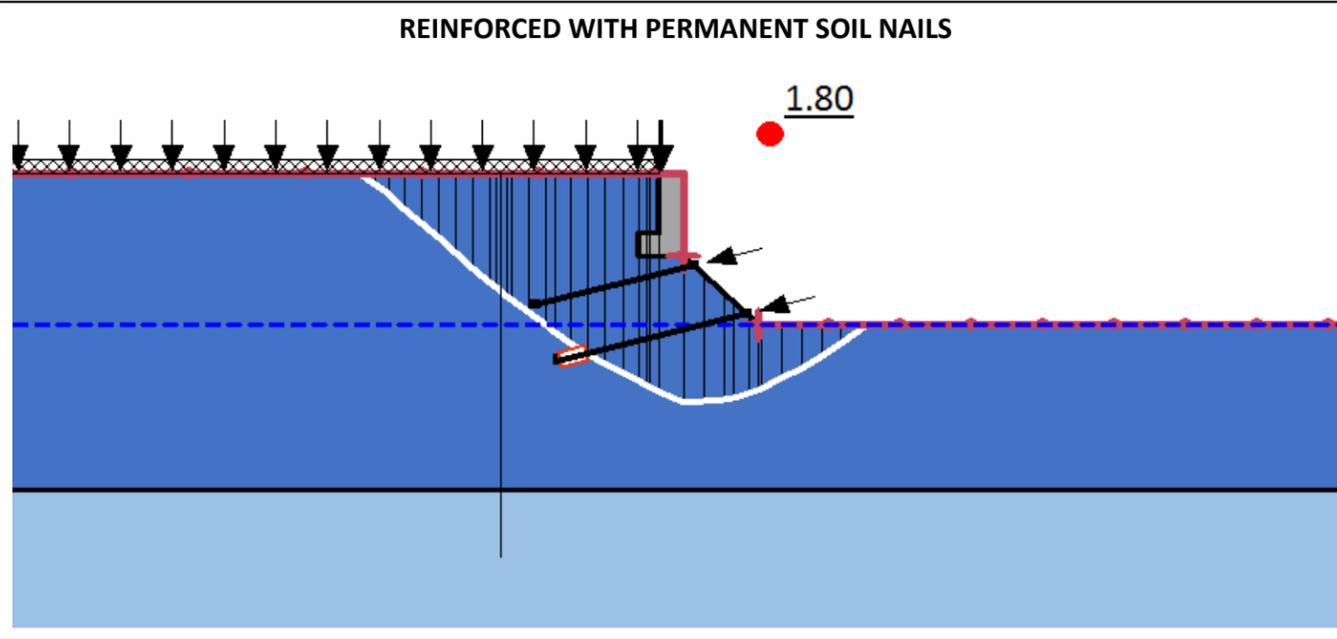
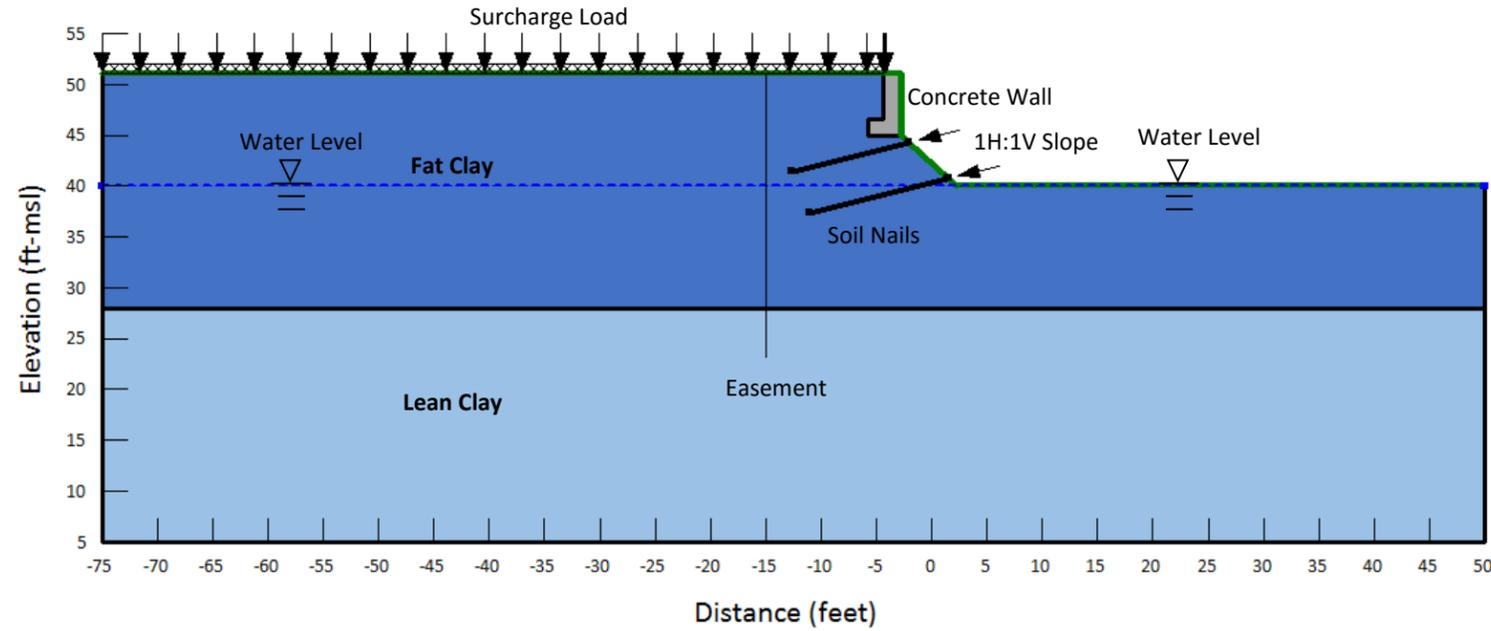
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE, EFFECTIVE STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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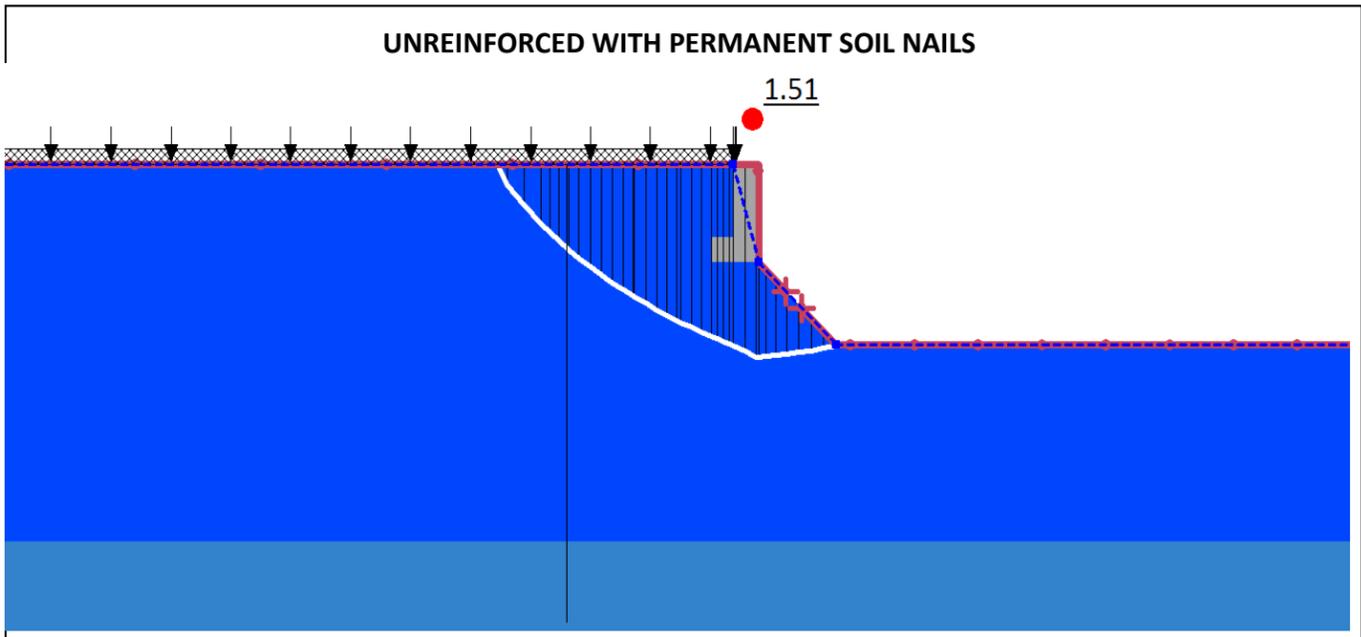
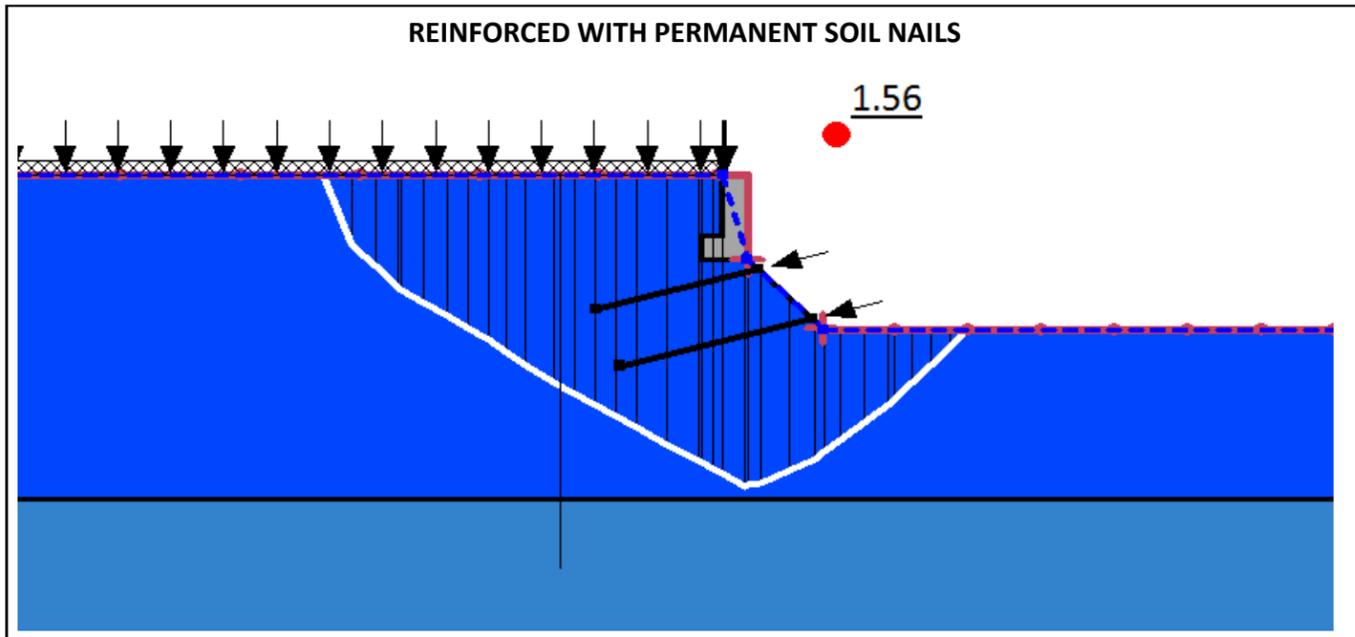
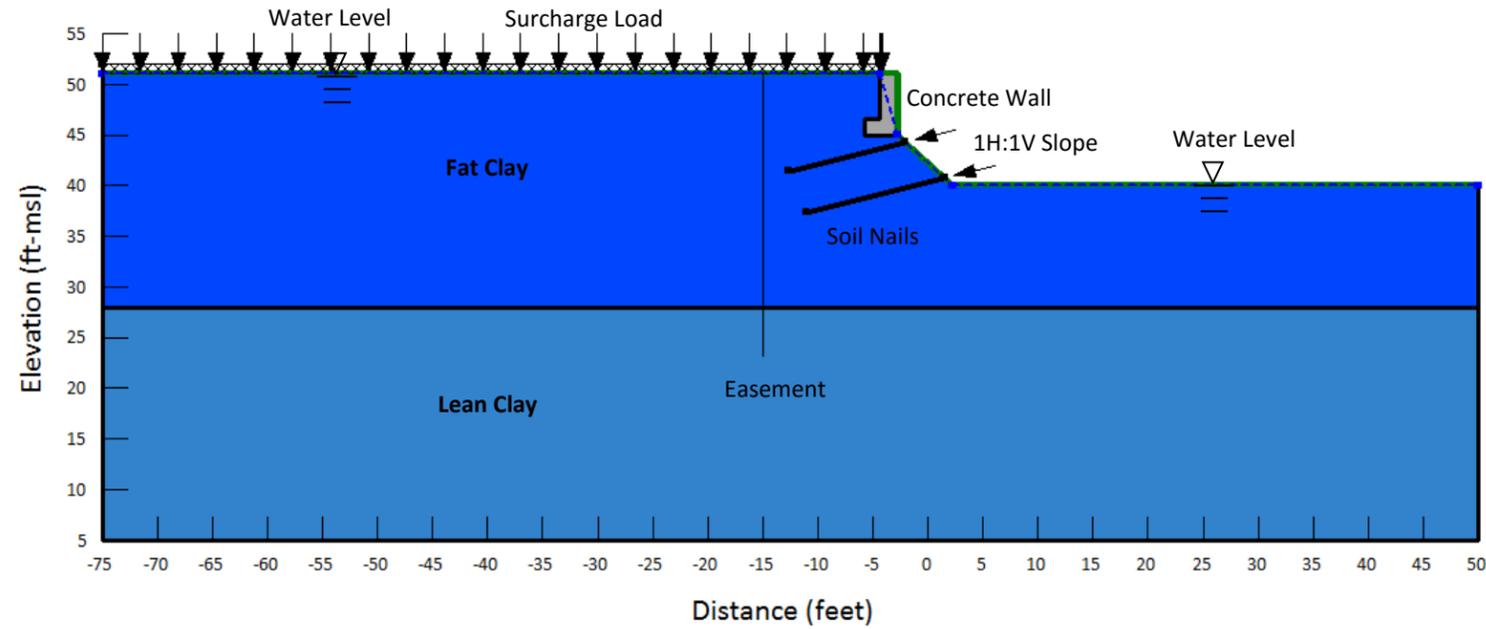
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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PAGE  
**22**

**ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE, TOTAL STRENGTH**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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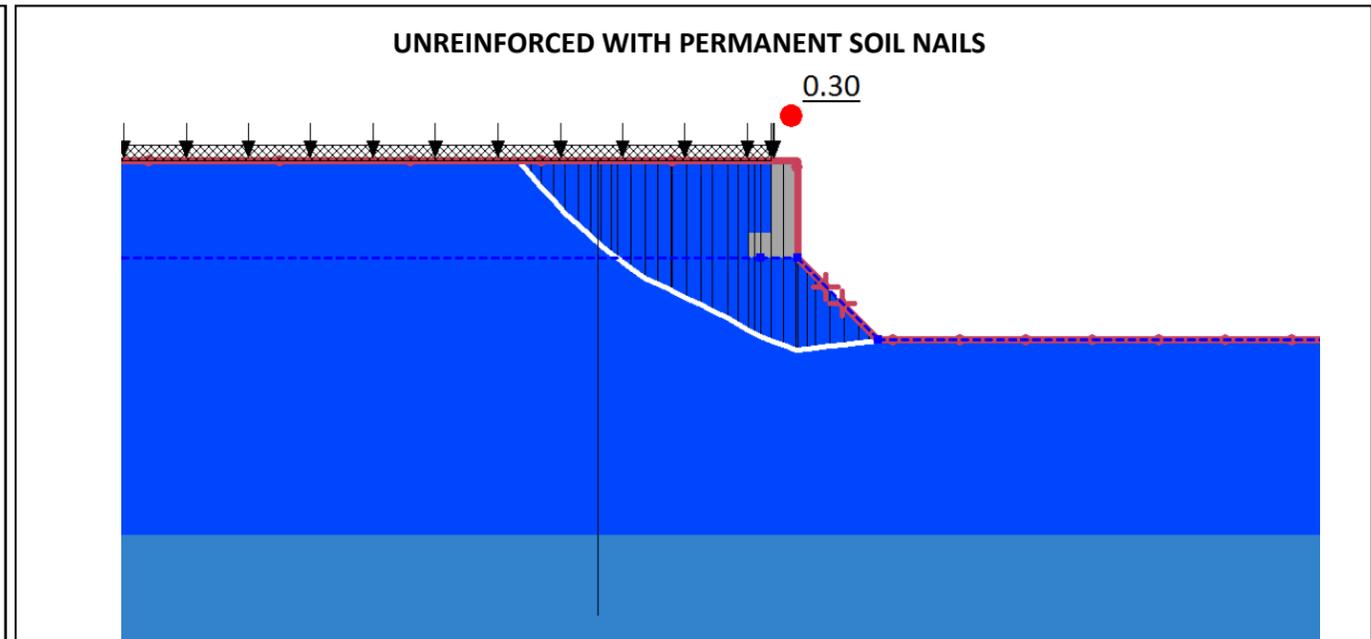
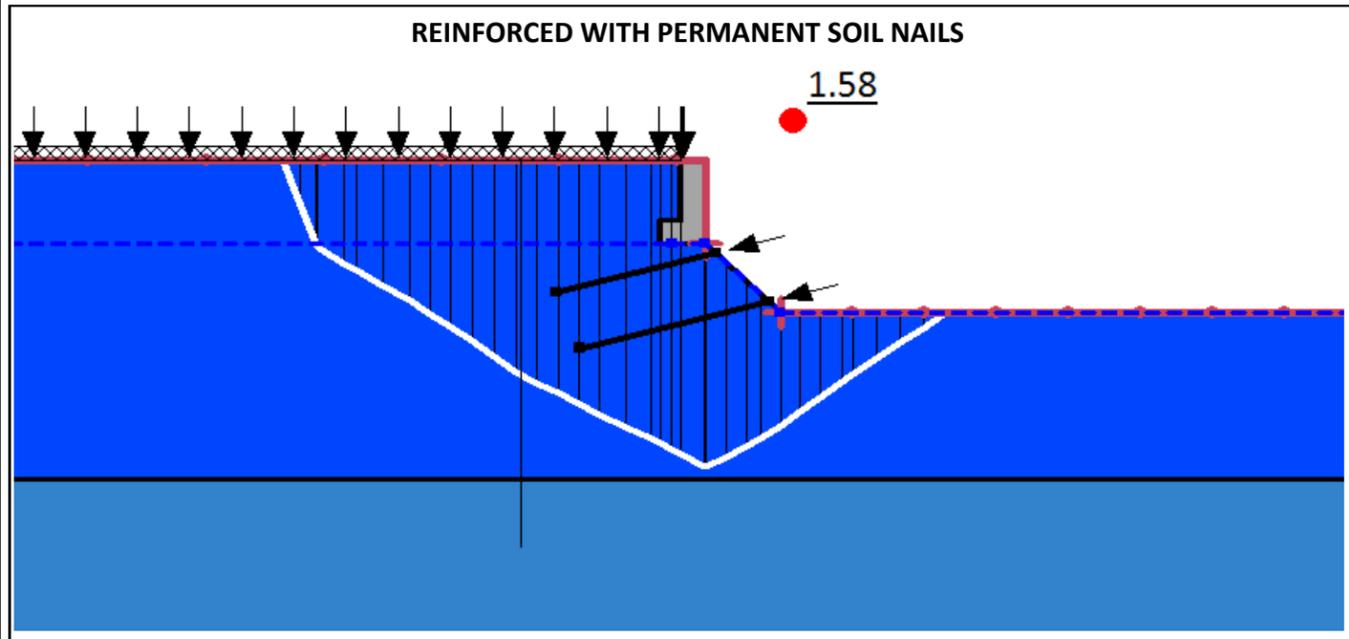
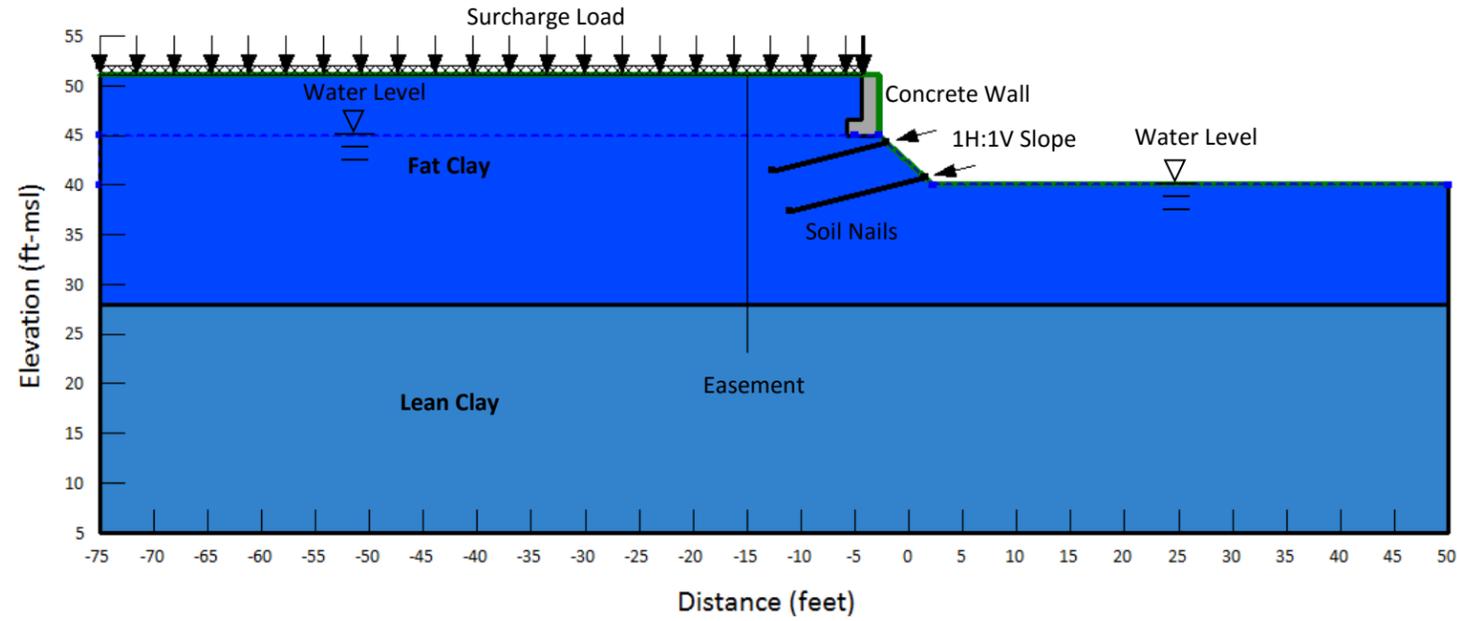
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE, TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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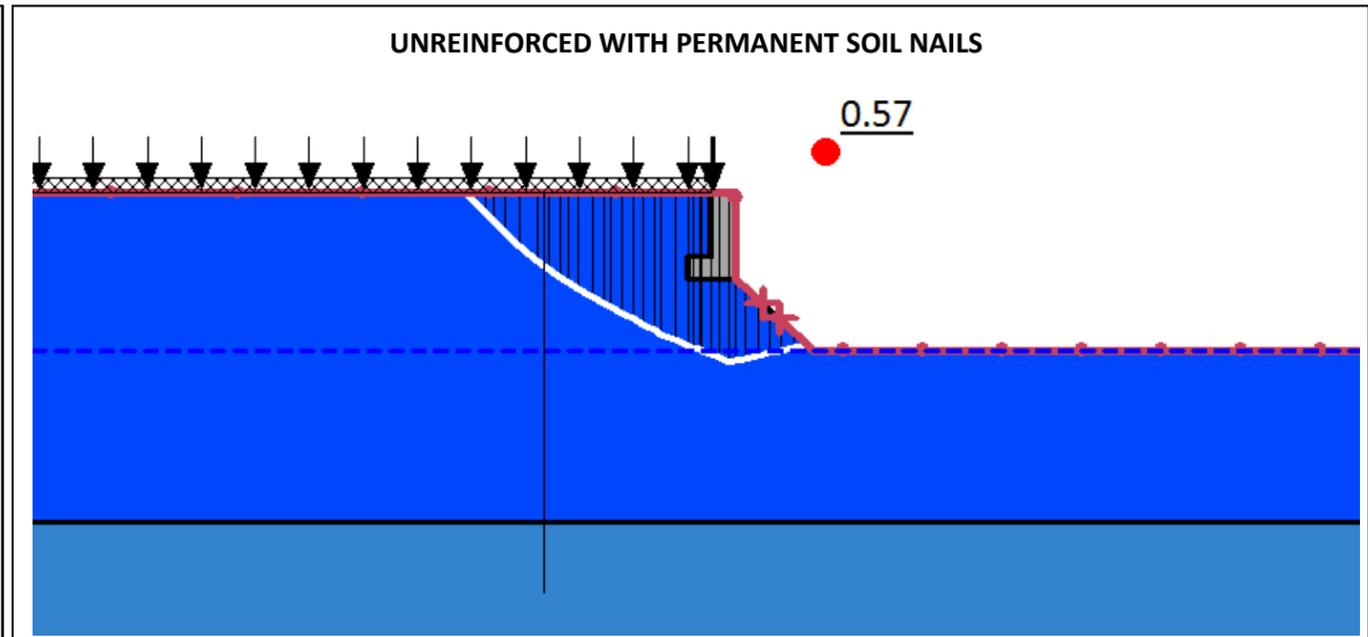
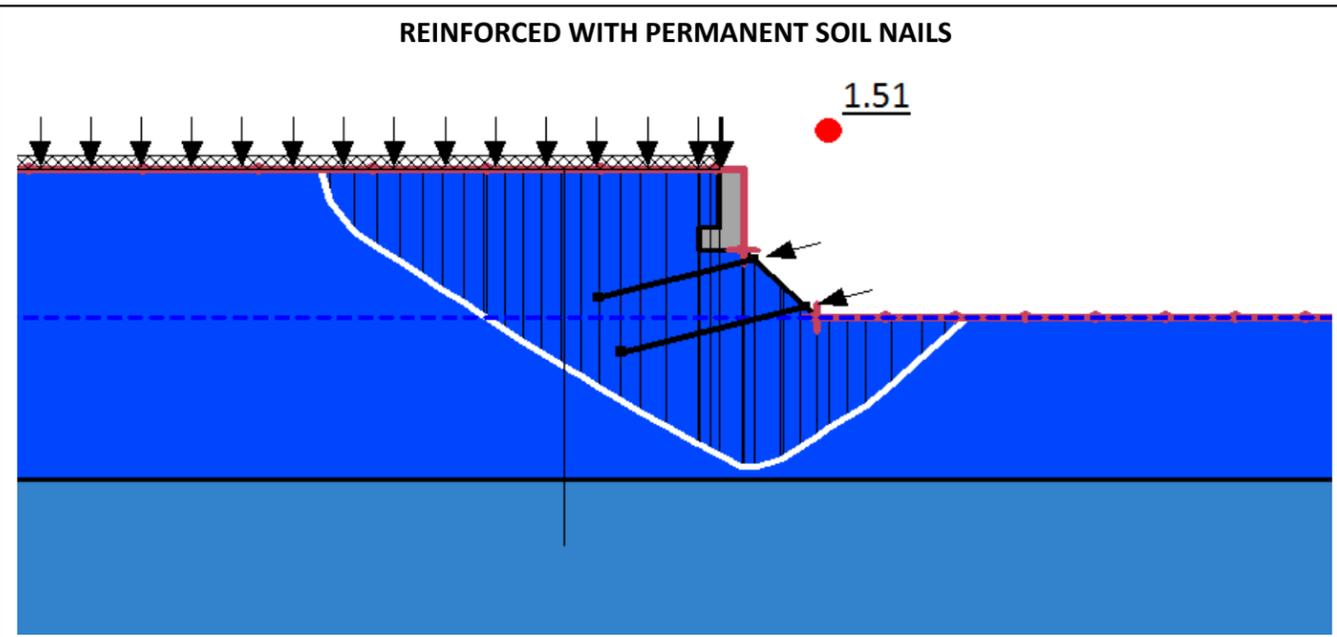
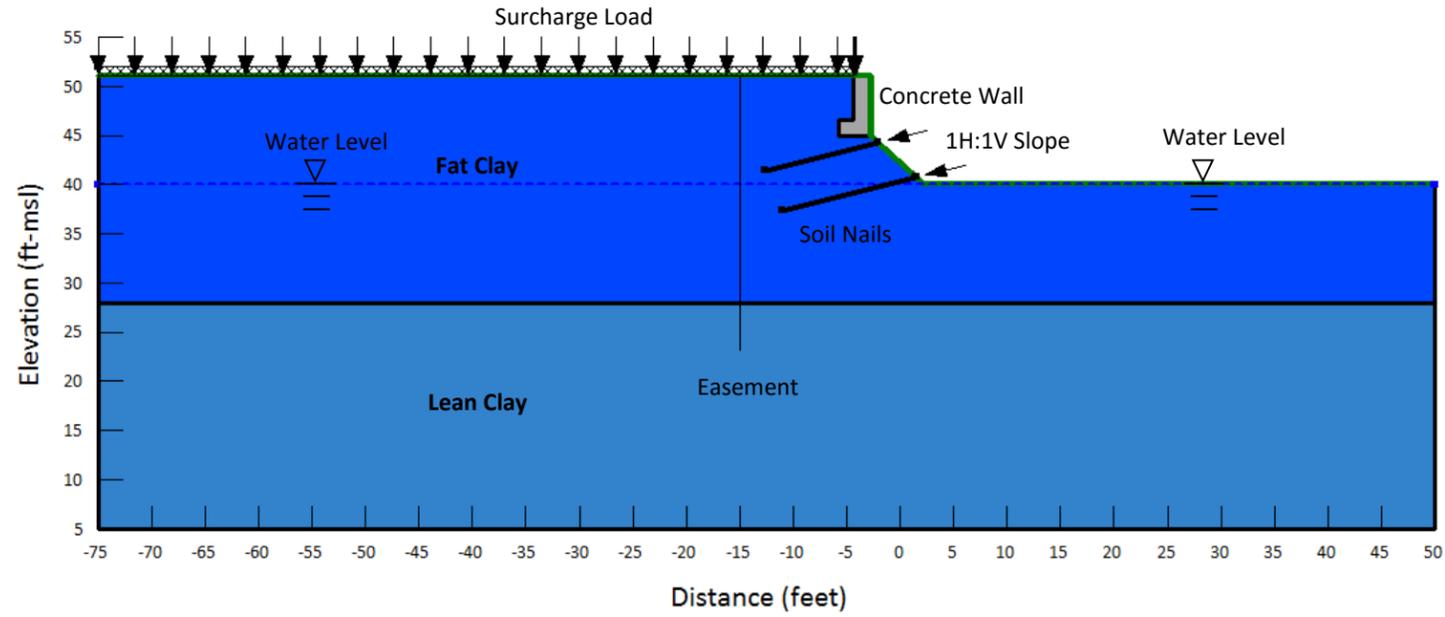
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
 Slope Stability Analysis  
 Alternative 3A Left Slope

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ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE, TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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FILE NAME	Stability Analysis
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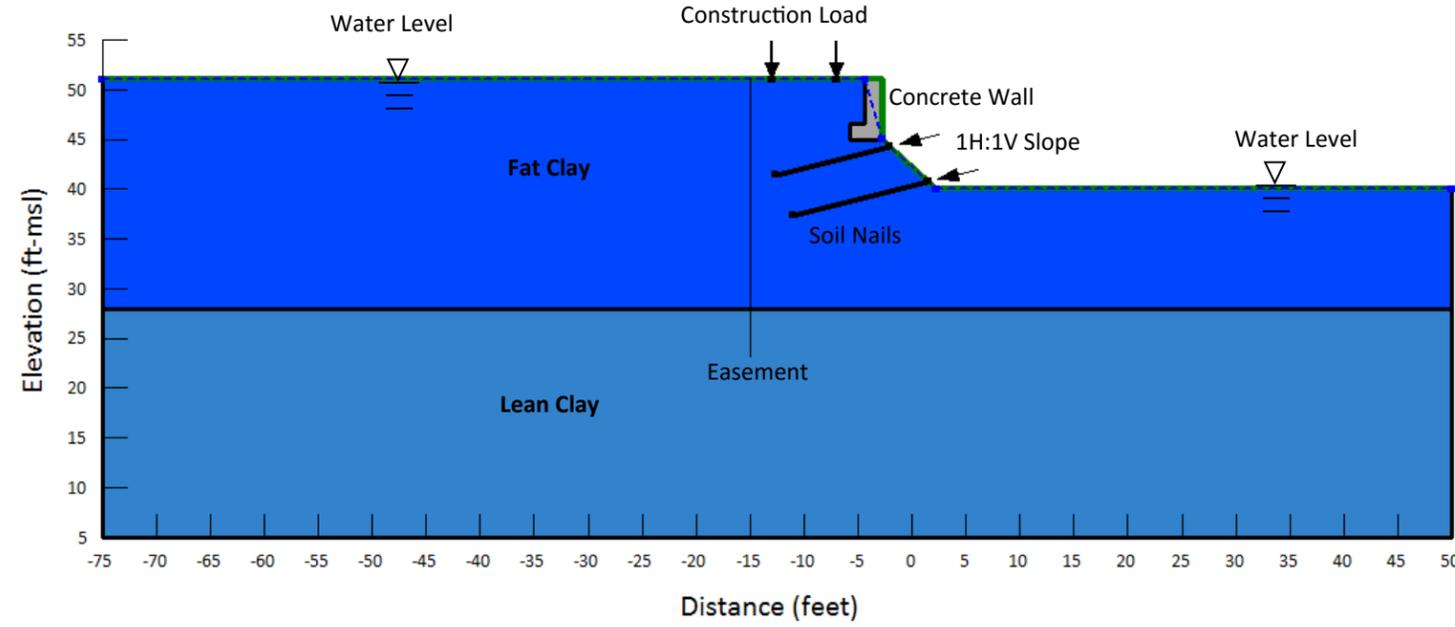
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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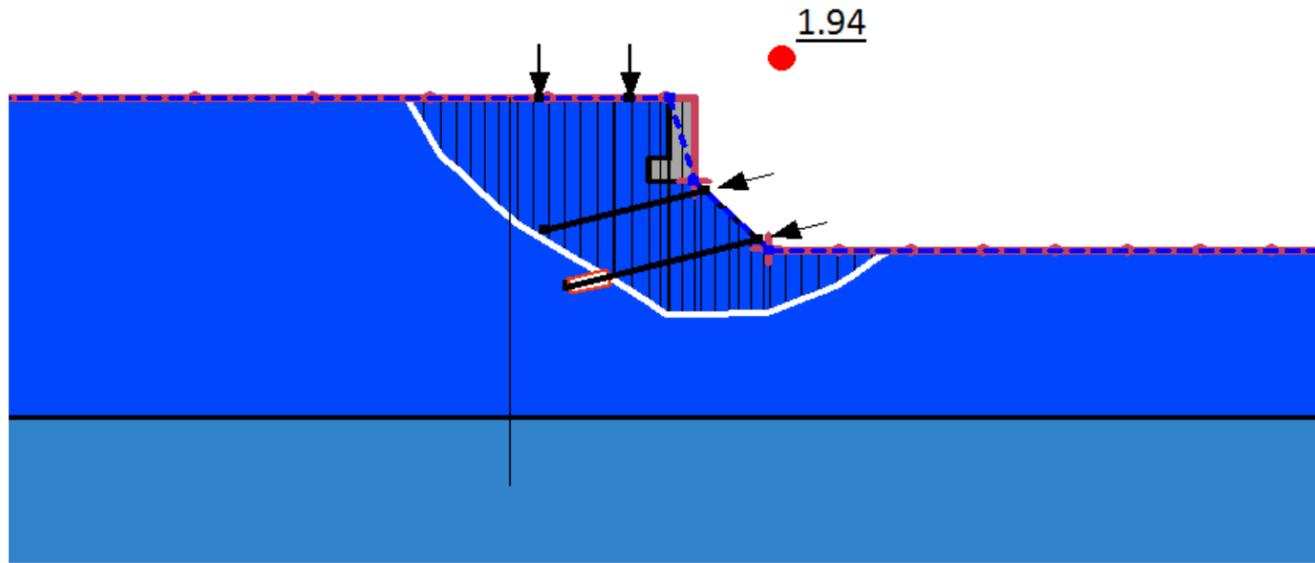


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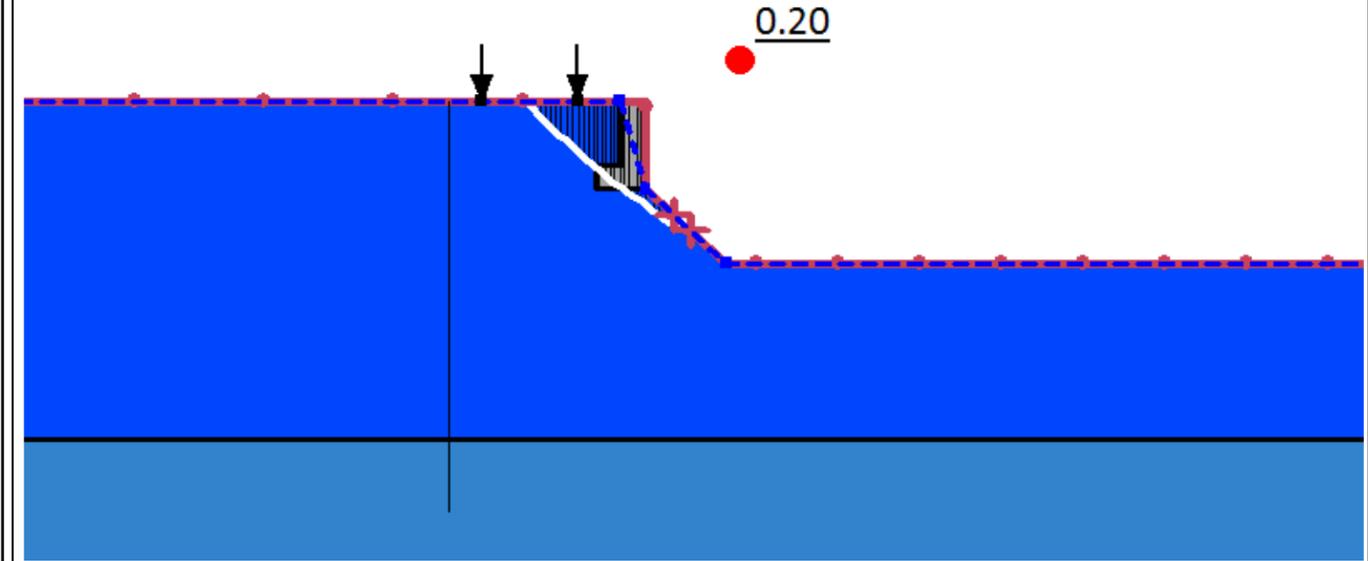
**ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD ON FULLY SATURATED SLOPE, TOTAL STRENGTH**



**REINFORCED WITH PERMANENT SOIL NAILS**



**UNREINFORCED WITH PERMANENT SOIL NAILS**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
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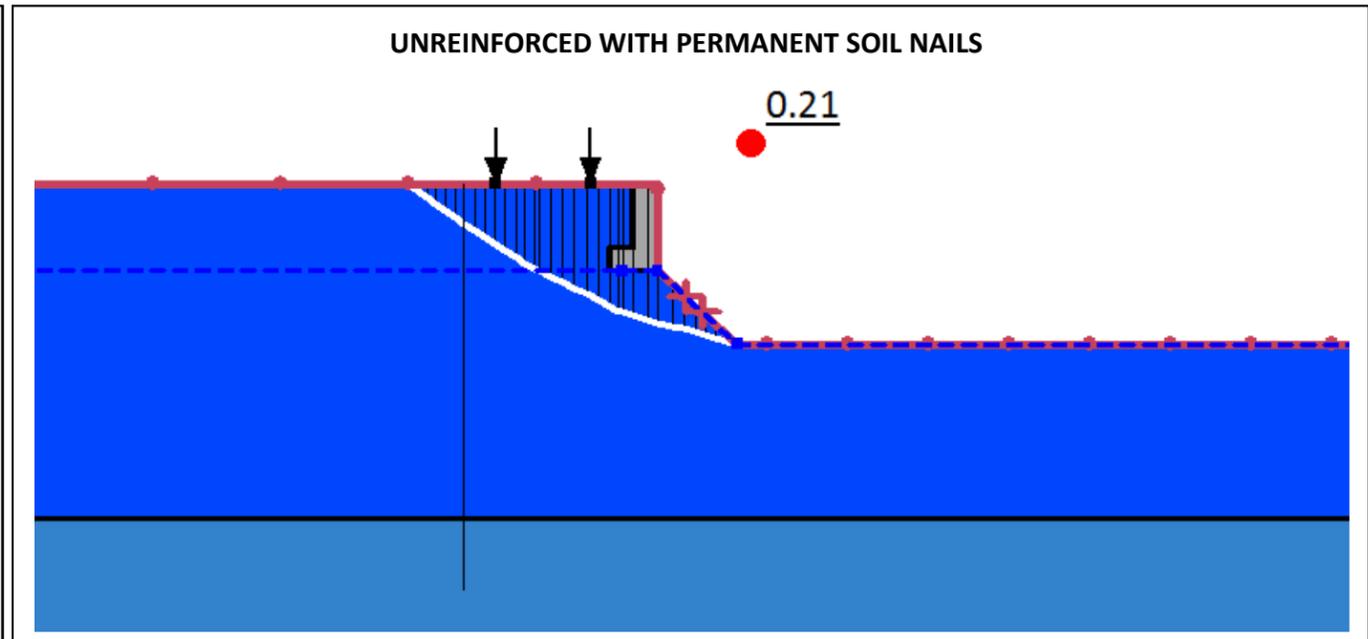
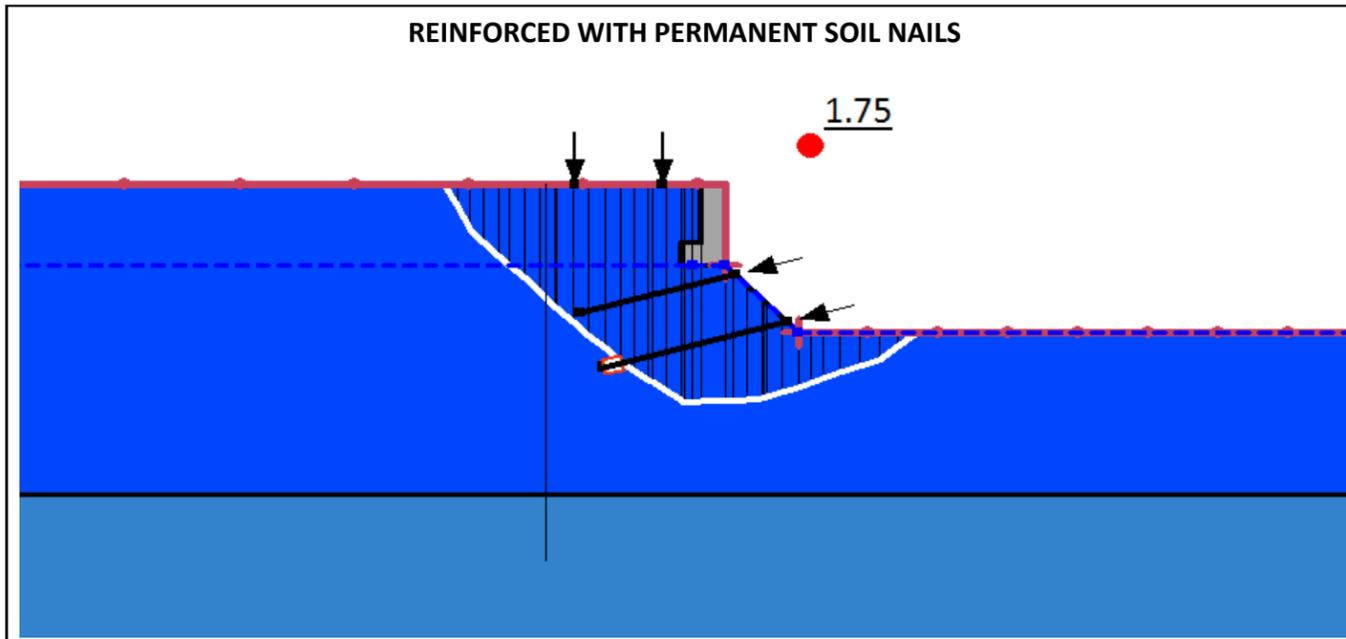
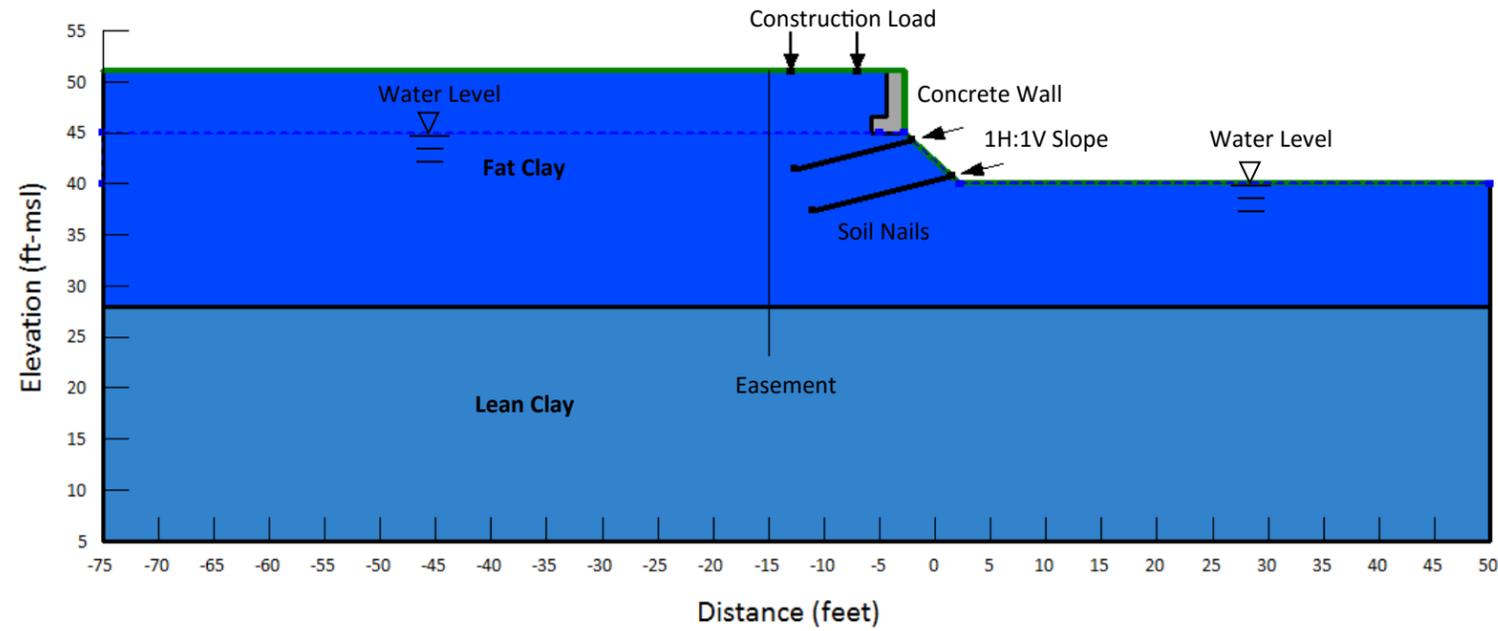
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3A Left Slope**

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ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD ON PARTIALLY SATURATED SLOPE ,TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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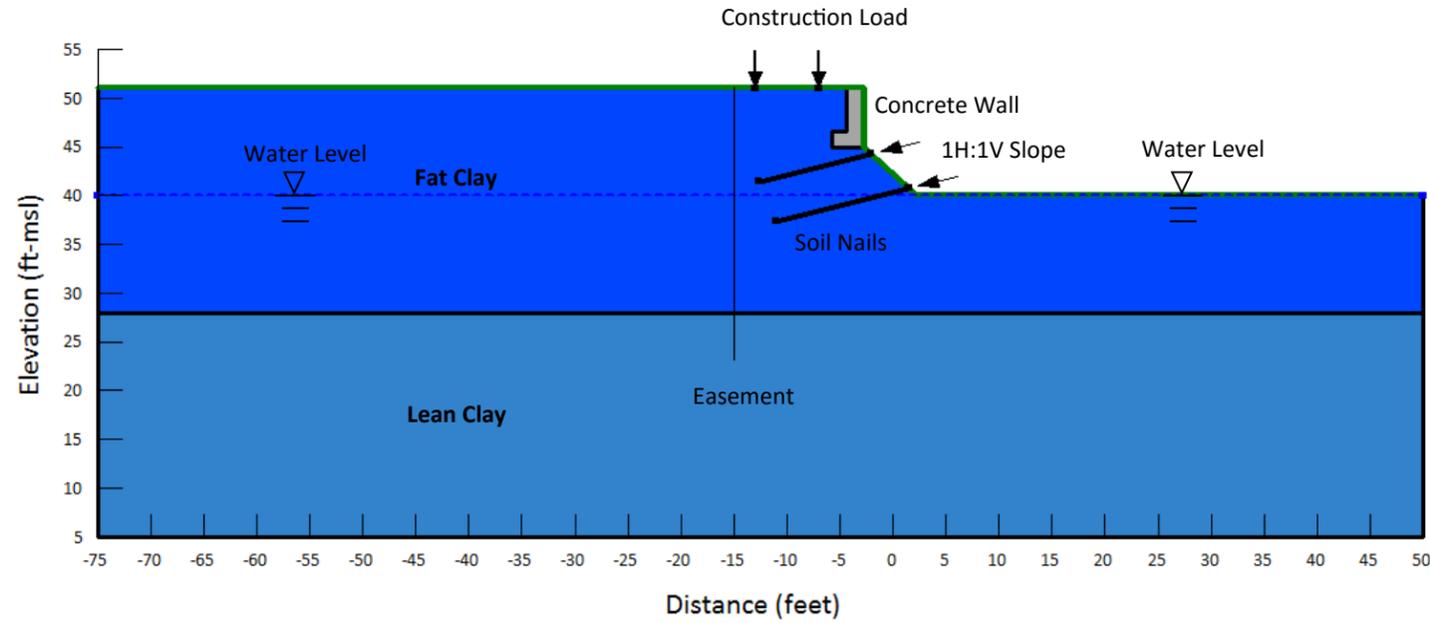
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
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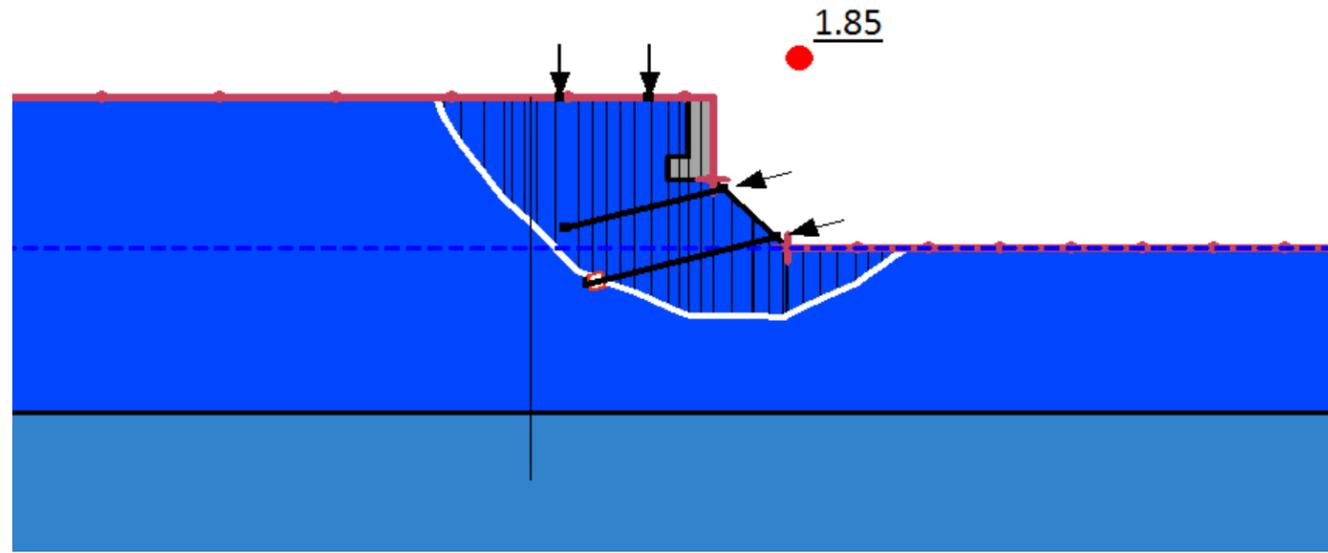


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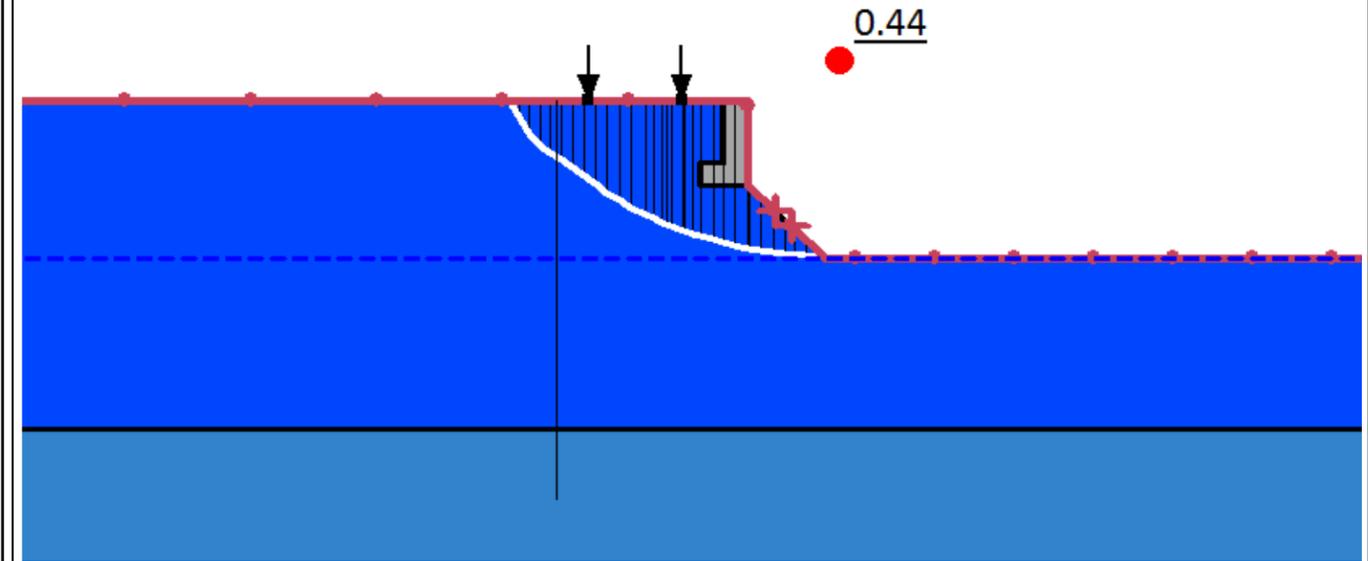
ALTERNATIVE 3A LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD WITH WATER AT CHANNEL BASE, TOTAL STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED WITH TEMPORARY SOIL NAILS



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

General Notes:

1. All elevations are in NAVD88 feet mean sea level (feet-msl).
2. Foundation stratigraphy is approximate and presented for illustrative purposes only.

FN PROJECT NO. HCF16148  
 DATE CREATED 1/27/2017  
 DATUM & COORDINATE SYSTEM NAD83 State Plane (feet) Texas South Central  
 FILE NAME  
 PREPARED BY Stability Analysis  
 HG

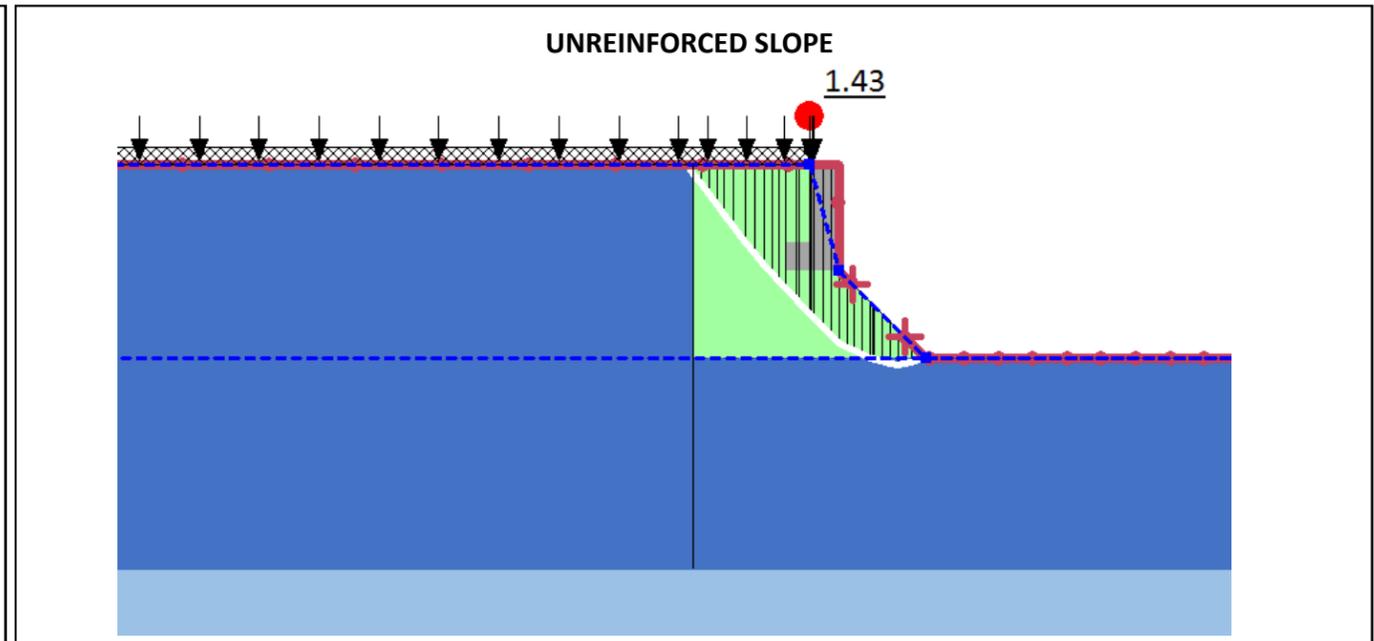
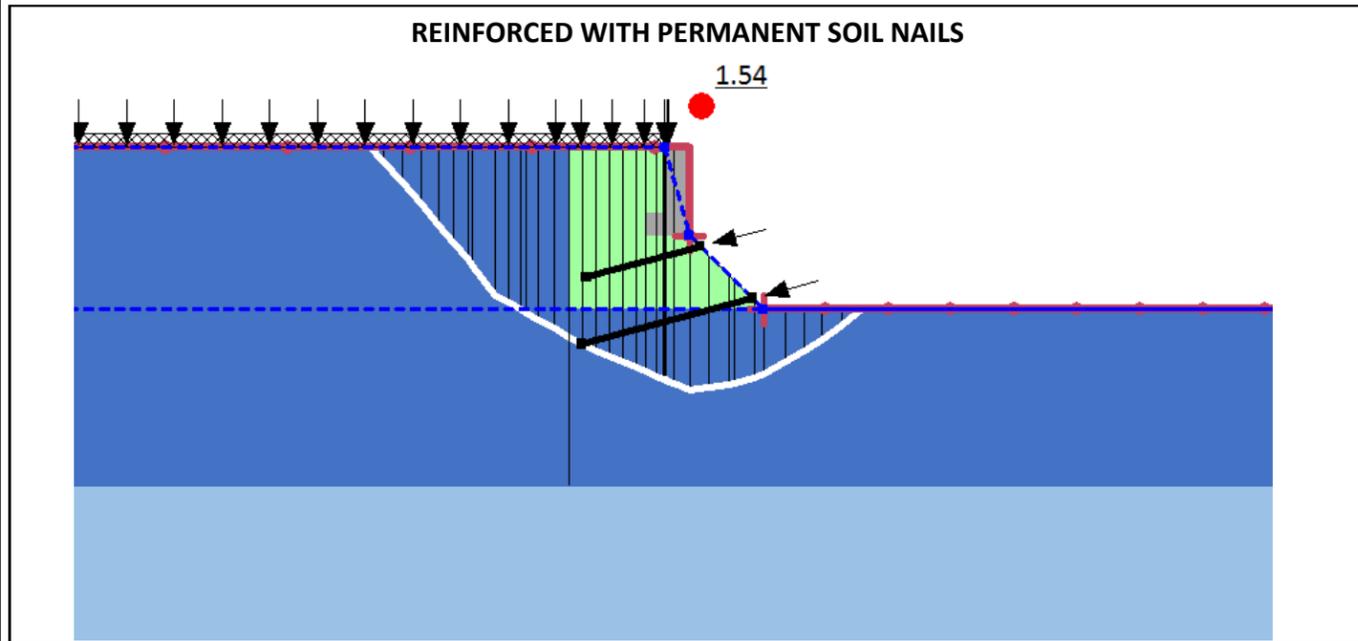
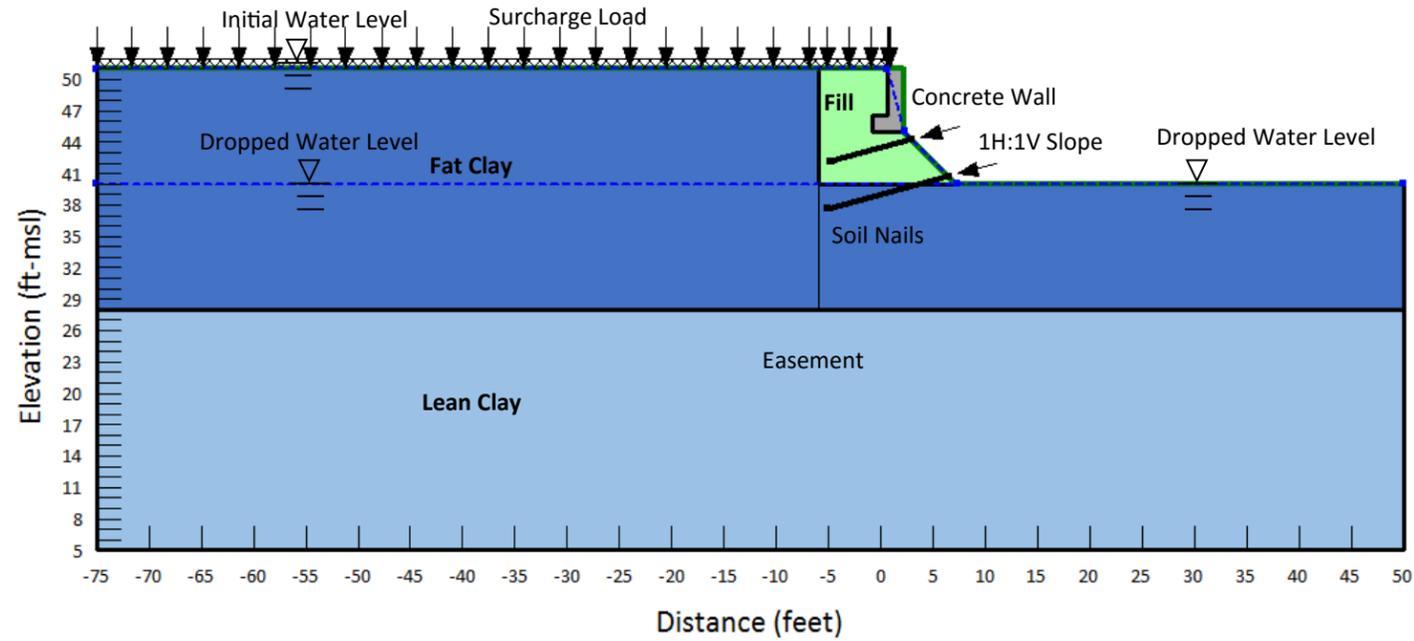
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
 Slope Stability Analysis  
 Alternative 3A Left Slope

**FREESE NICHOLS**  
 FREESE AND NICHOLS, INC.  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
 P: (713) 600-6800  
 F: (713) 600-6801



9900 Northwest Freeway  
 Houston, Texas 77092

**ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD, RAPID DRAWDOWN**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

**General Notes:**

1. All elevations are in NAVD88 feet mean sea level (feet-msl).
2. Foundation stratigraphy is approximate and presented for illustrative purposes only.

FN PROJECT NO.	HCF16148
DATE CREATED	1/27/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas South Central
FILE NAME	Stability Analysis
PREPARED BY	HG

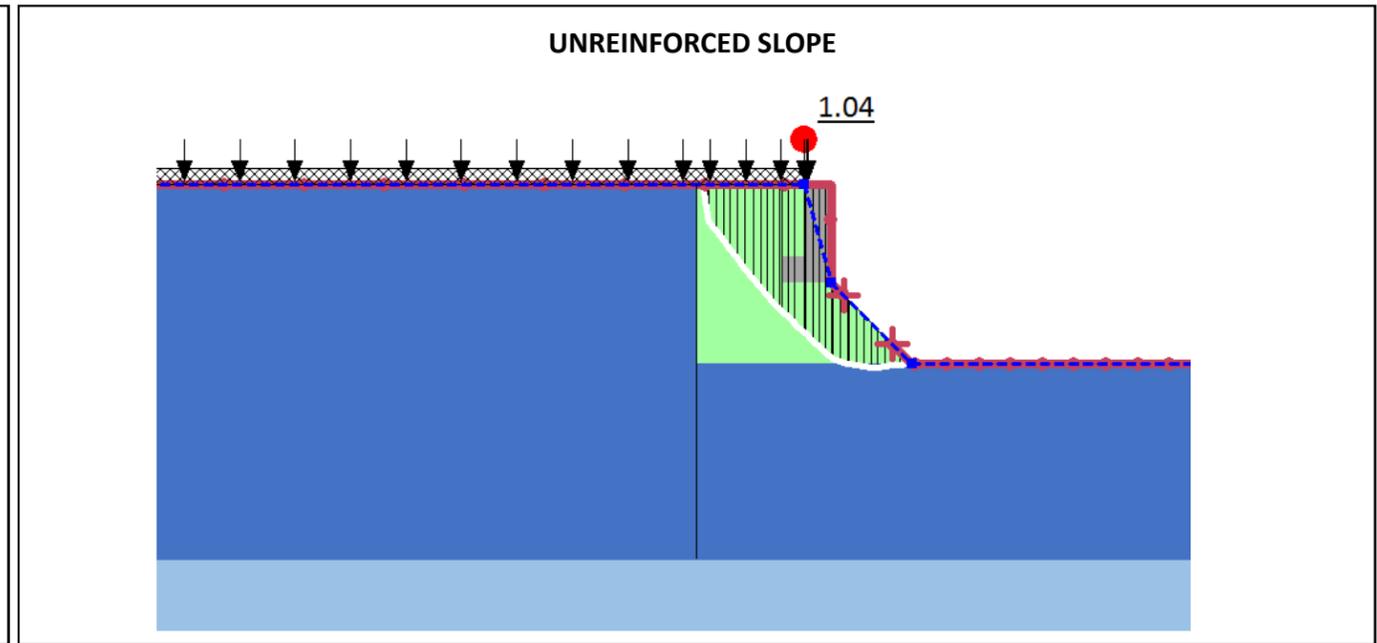
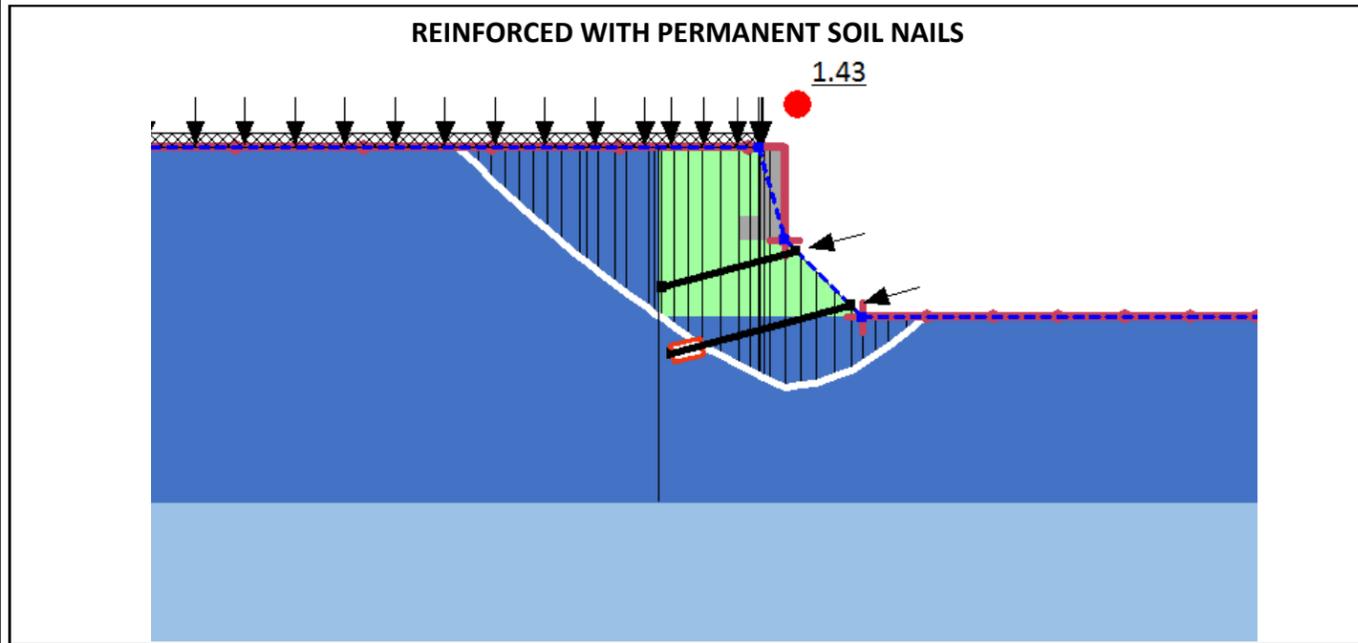
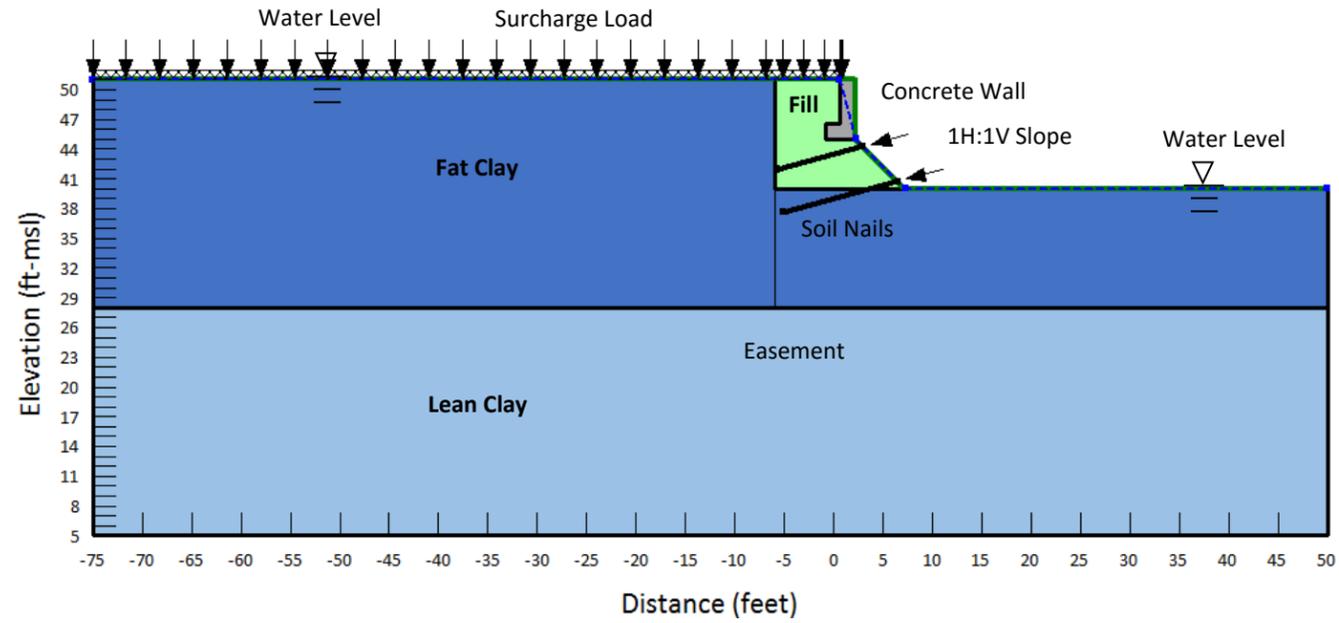
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

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ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE, EFFECTIVE STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

General Notes:

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FILE NAME	Stability Analysis
PREPARED BY	HG

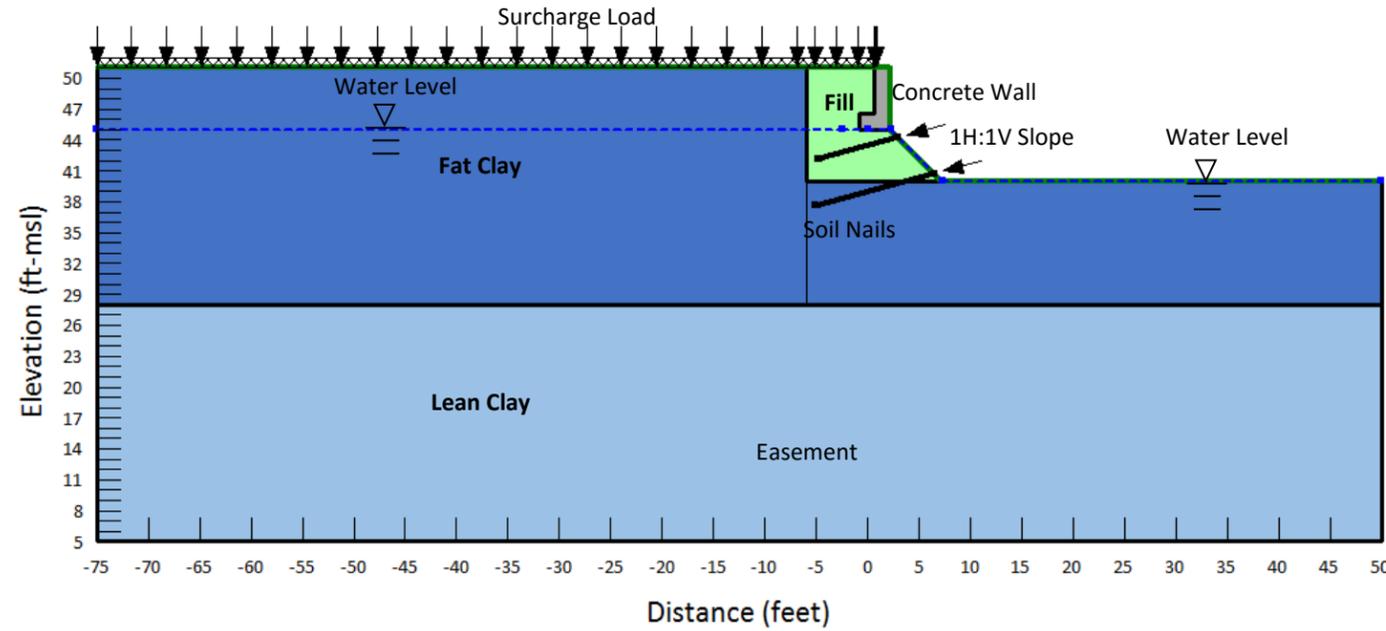
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

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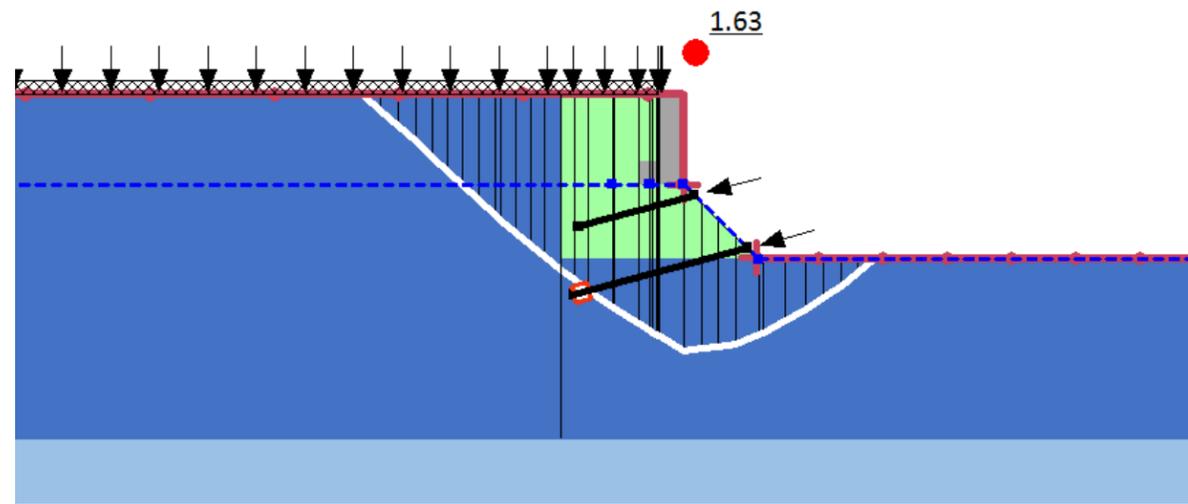


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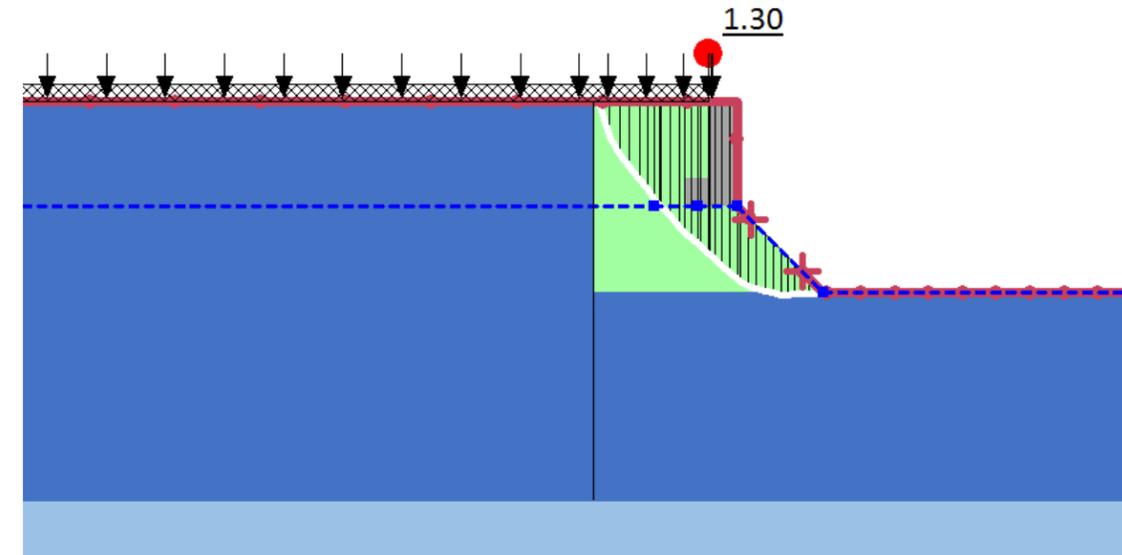
ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE, EFFECTIVE STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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FILE NAME	Stability Analysis
PREPARED BY	HG

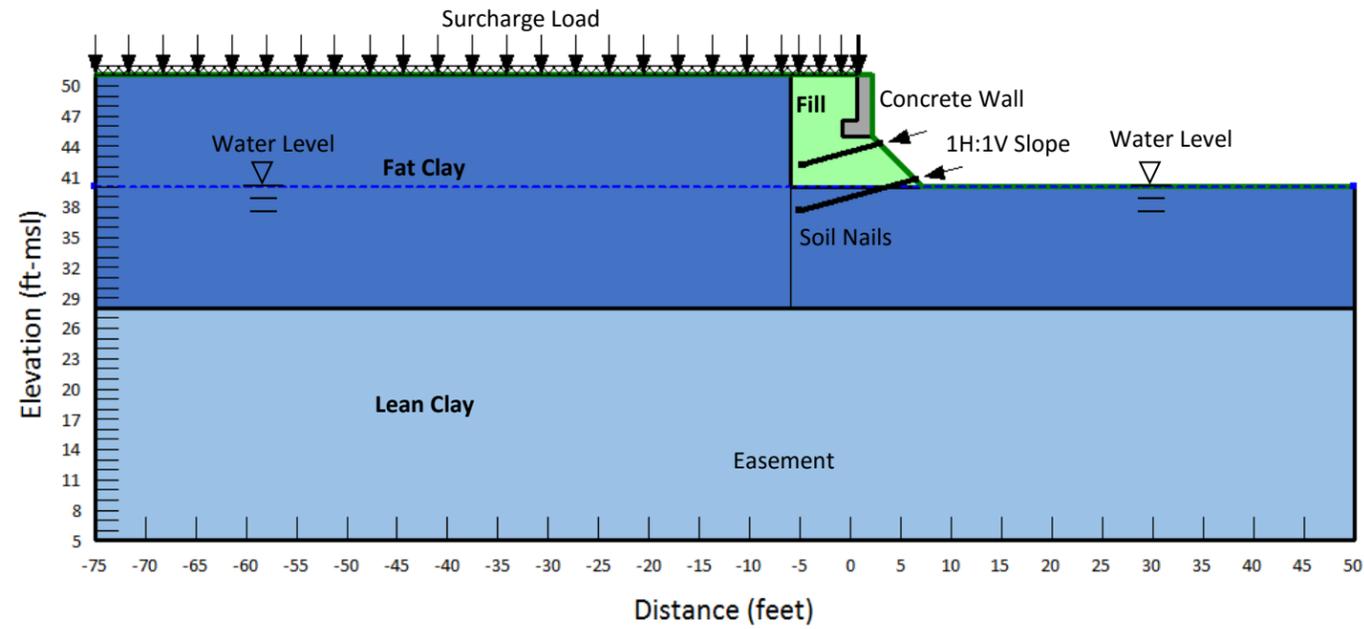
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

**FRESE NICHOLS**  
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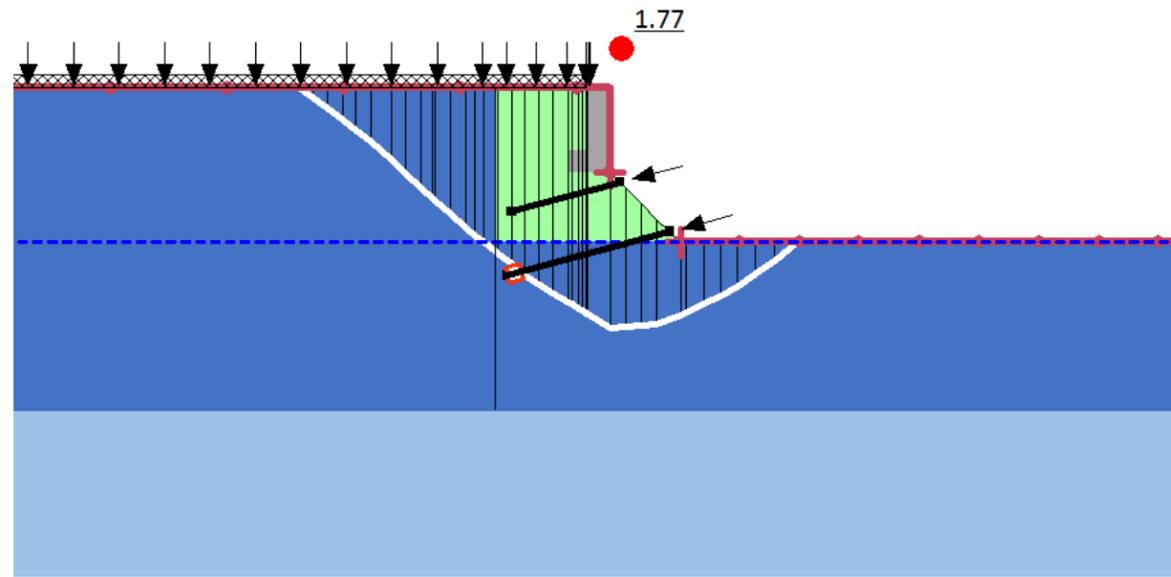


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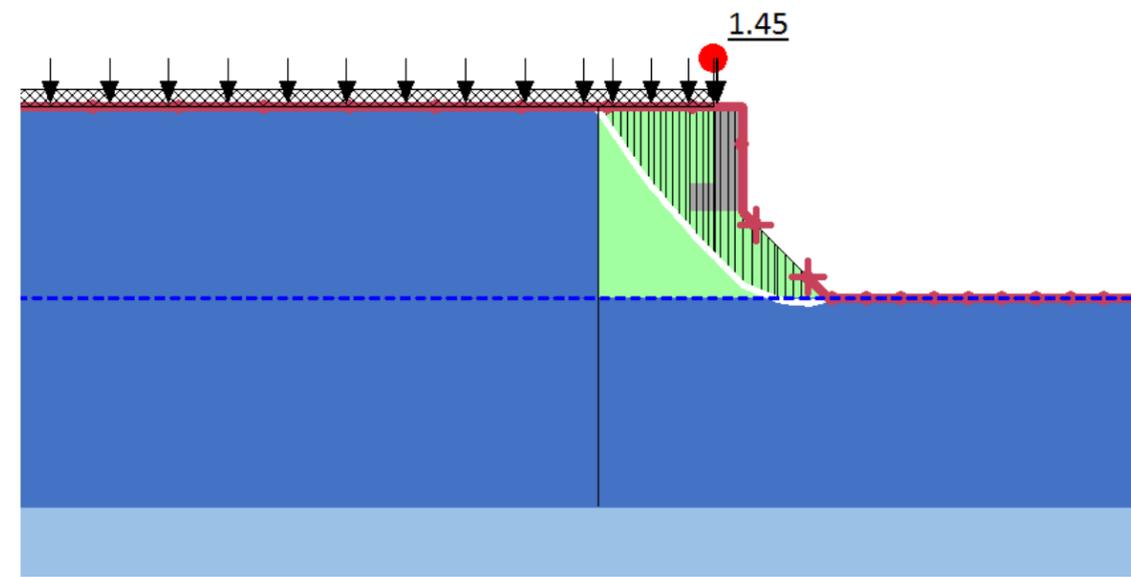
ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE, EFFECTIVE STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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 FILE NAME  
 PREPARED BY Stability Analysis  
 HG

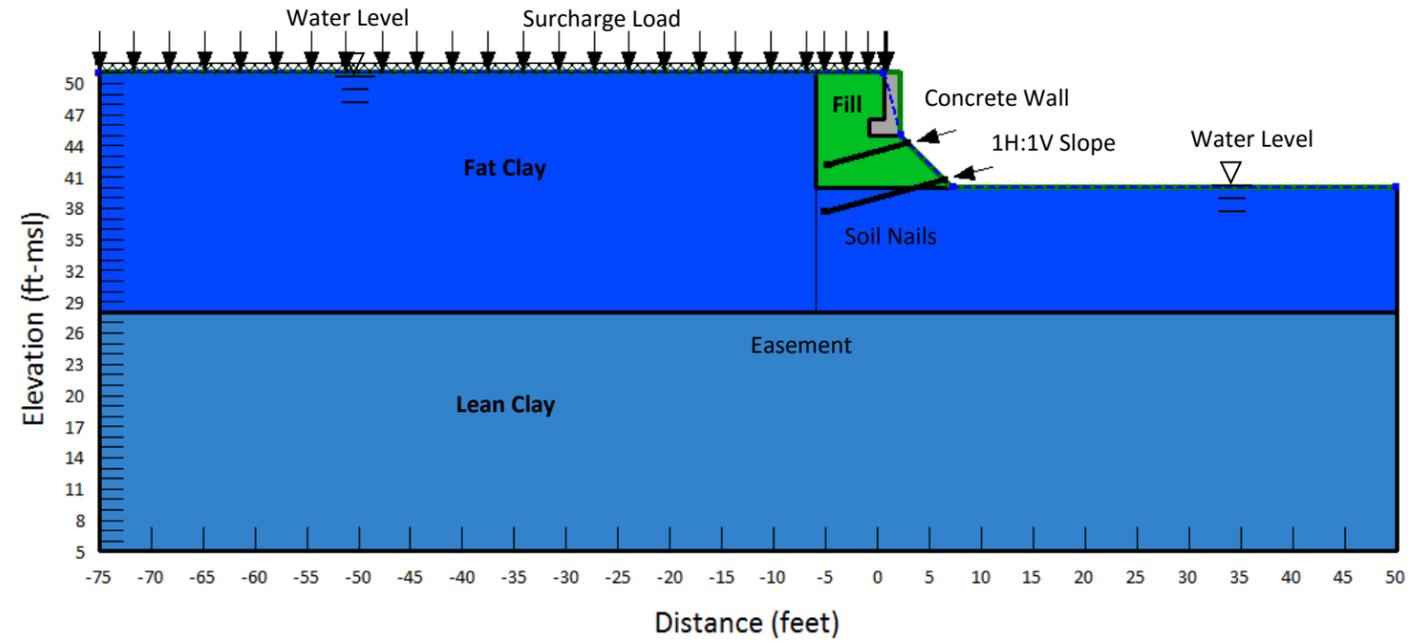
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

**FRESE NICHOLS**  
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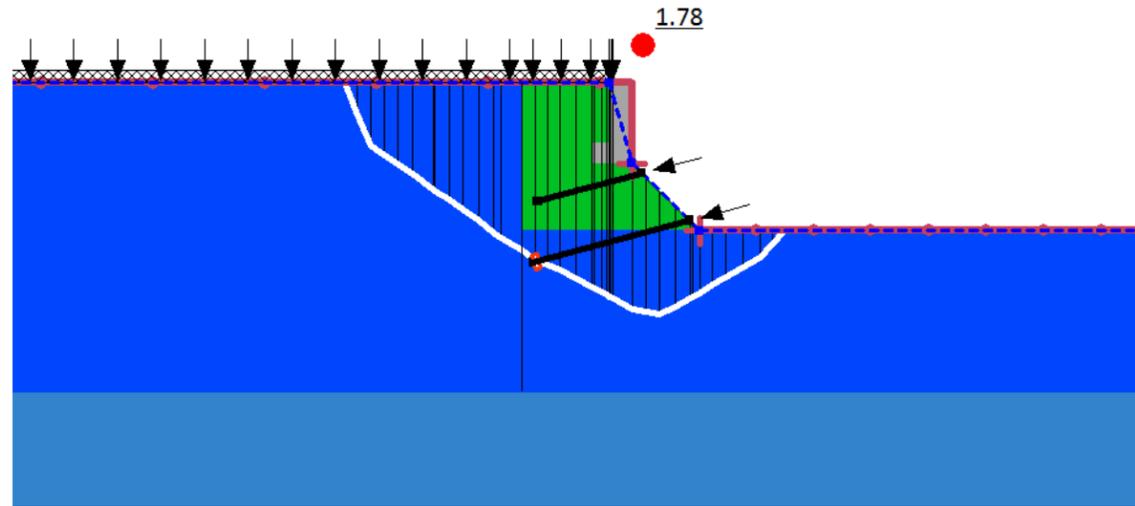
**HARRIS COUNTY**  
**FLOOD CONTROL DISTRICT**

9900 Northwest Freeway  
 Houston, Texas 77092

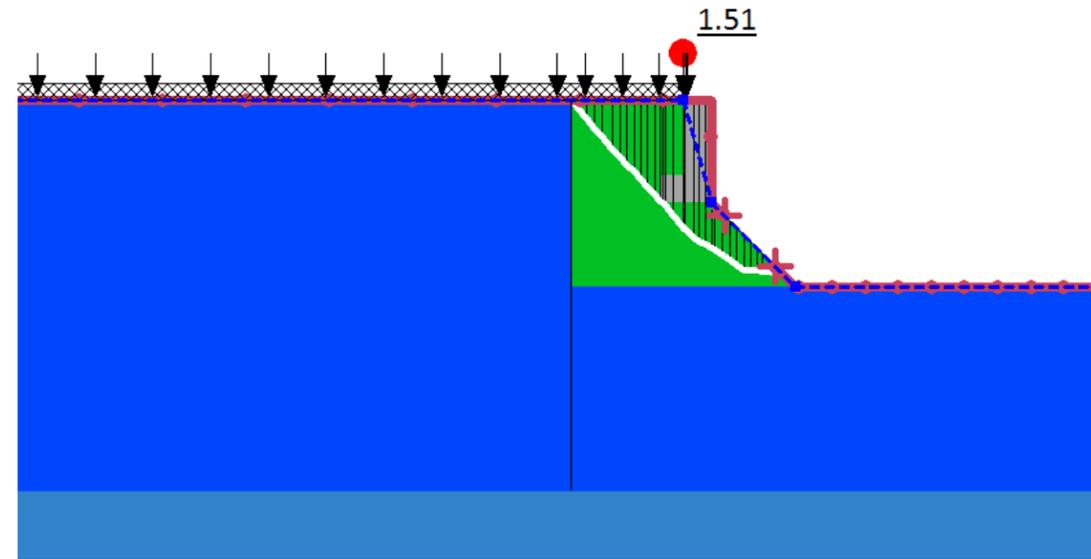
**ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE, TOTAL STRENGTH**



**REINFORCED WITH PERMANENT SOIL NAILS**



**UNREINFORCED SLOPE**



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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 FILE NAME  
 PREPARED BY Stability Analysis  
 HG

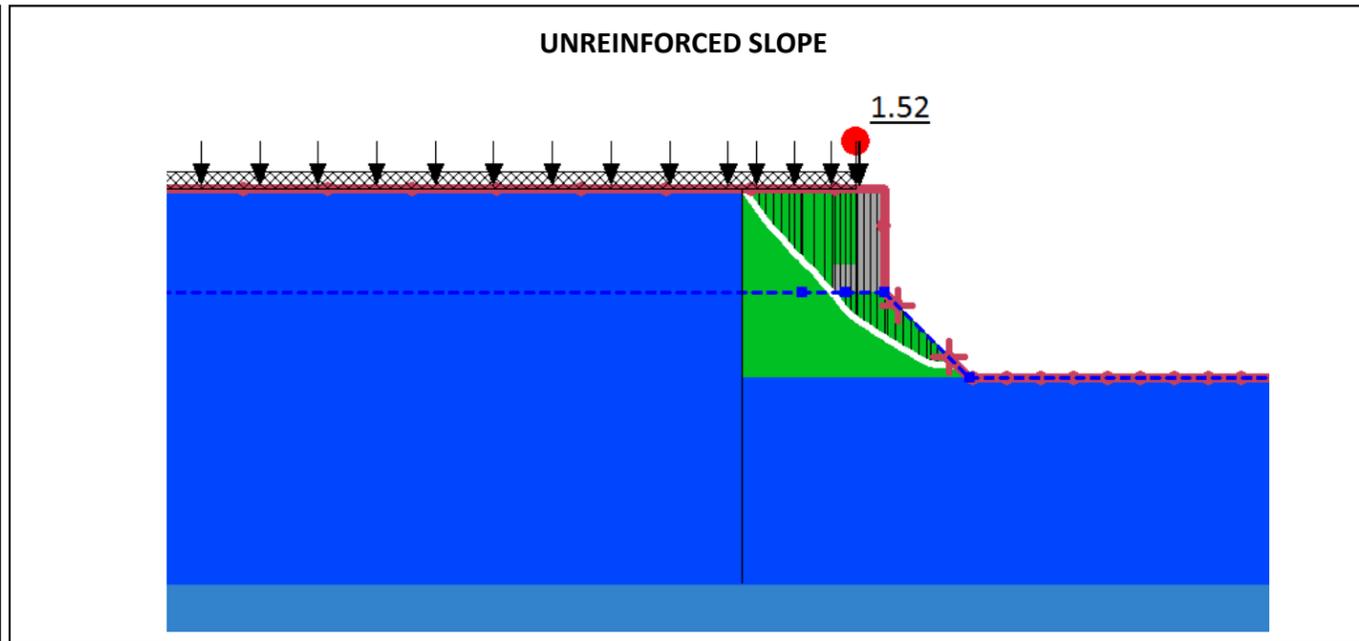
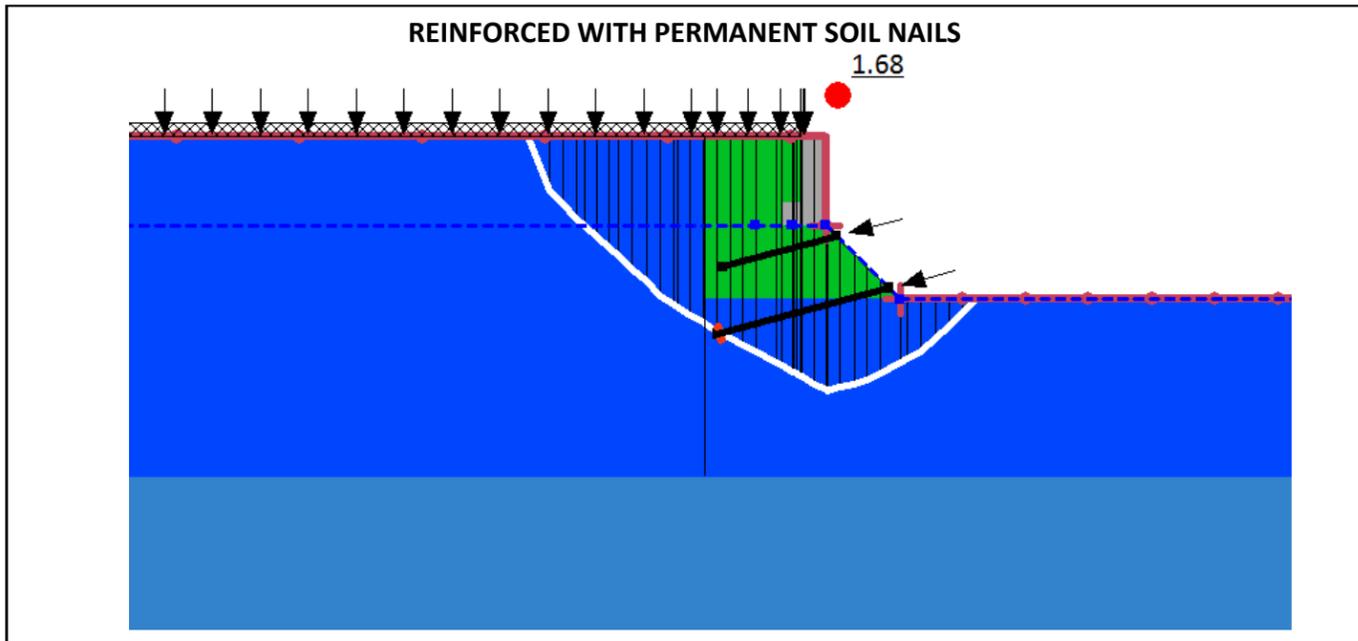
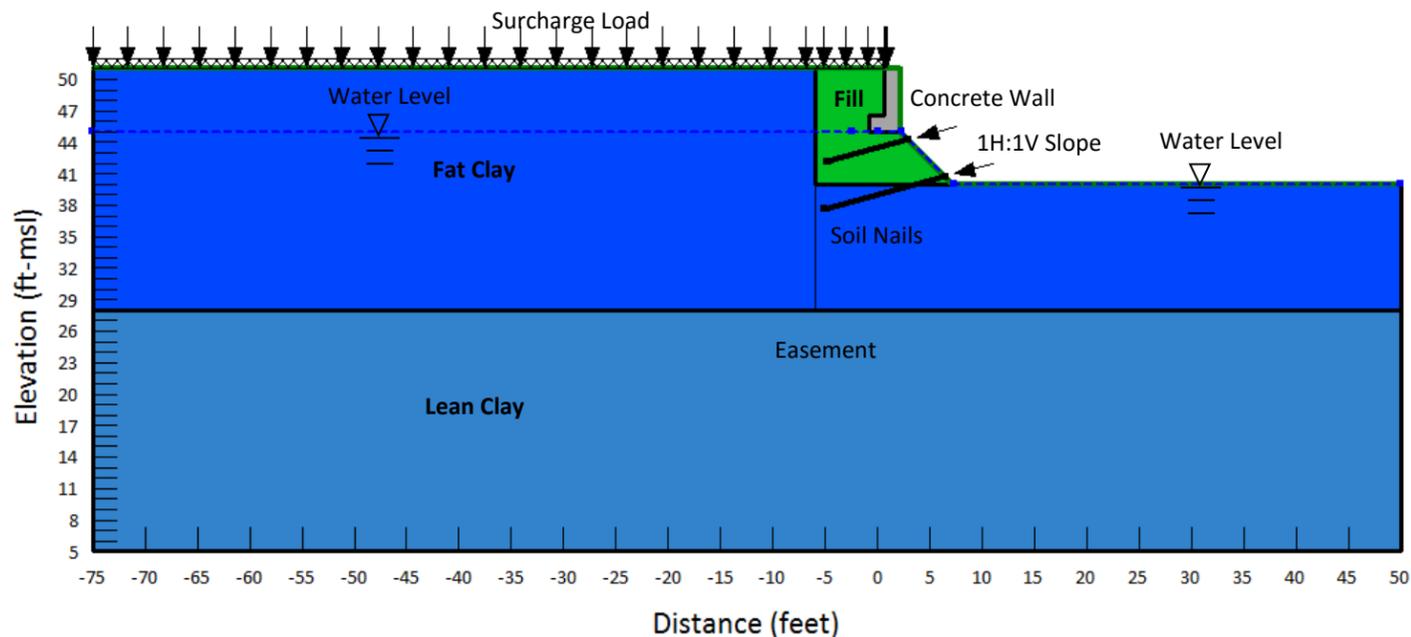
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

**FRESE NICHOLS**  
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 HOUSTON, TEXAS 77024  
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ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON PARTIALLY SATURATED SLOPE, TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

General Notes:

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FN PROJECT NO. HCF16148  
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 FILE NAME  
 PREPARED BY Stability Analysis  
 HG

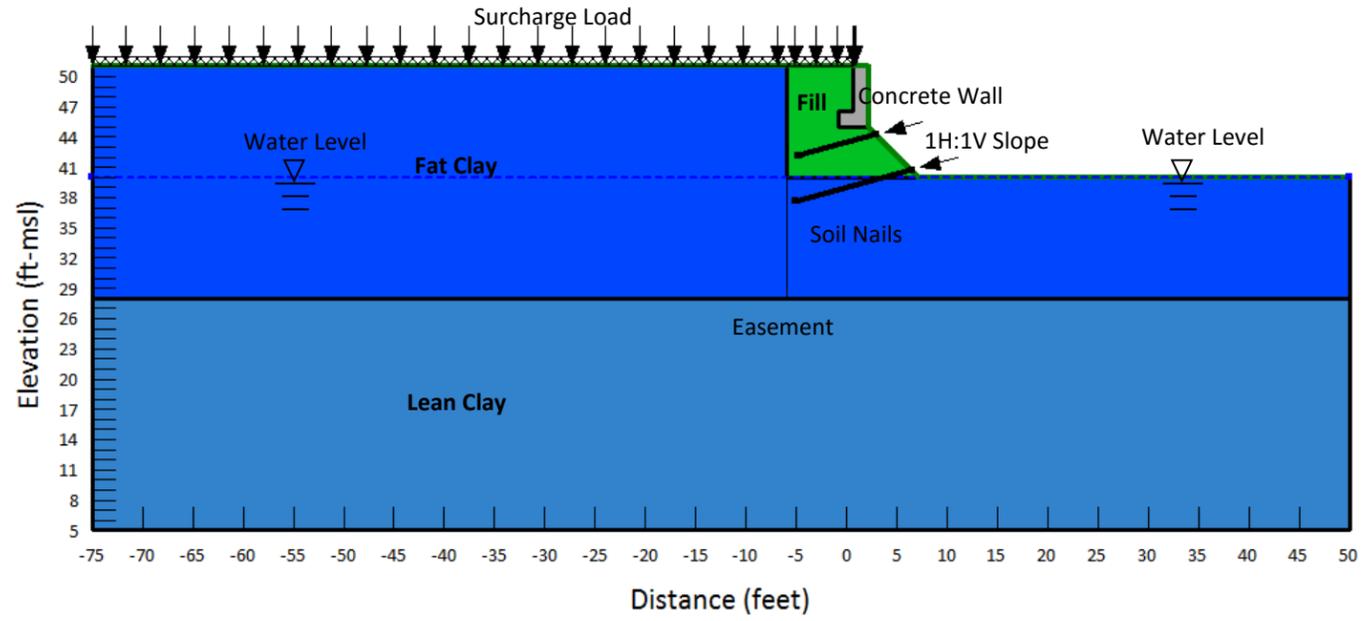
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
 Slope Stability Analysis  
 Alternative 3B Left Slope

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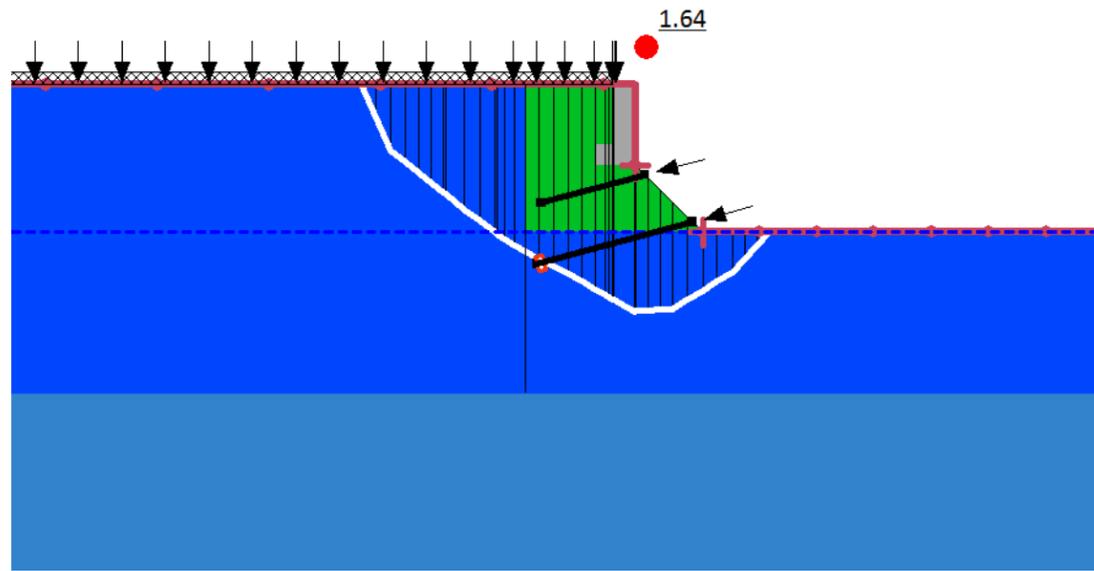
**HARRIS COUNTY FLOOD CONTROL DISTRICT**

9900 Northwest Freeway  
 Houston, Texas 77092

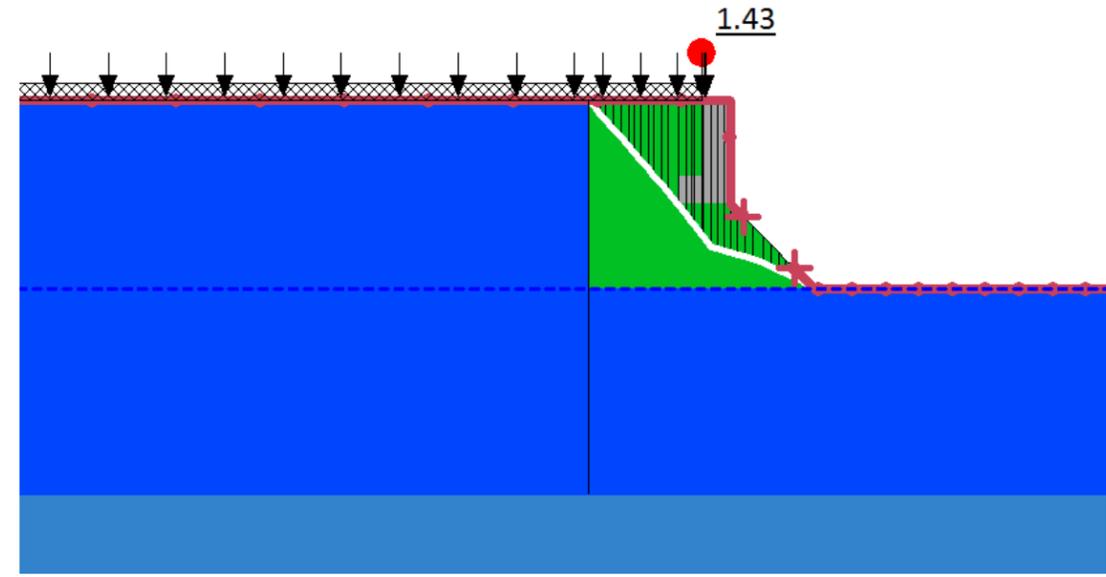
ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE, TOTAL STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
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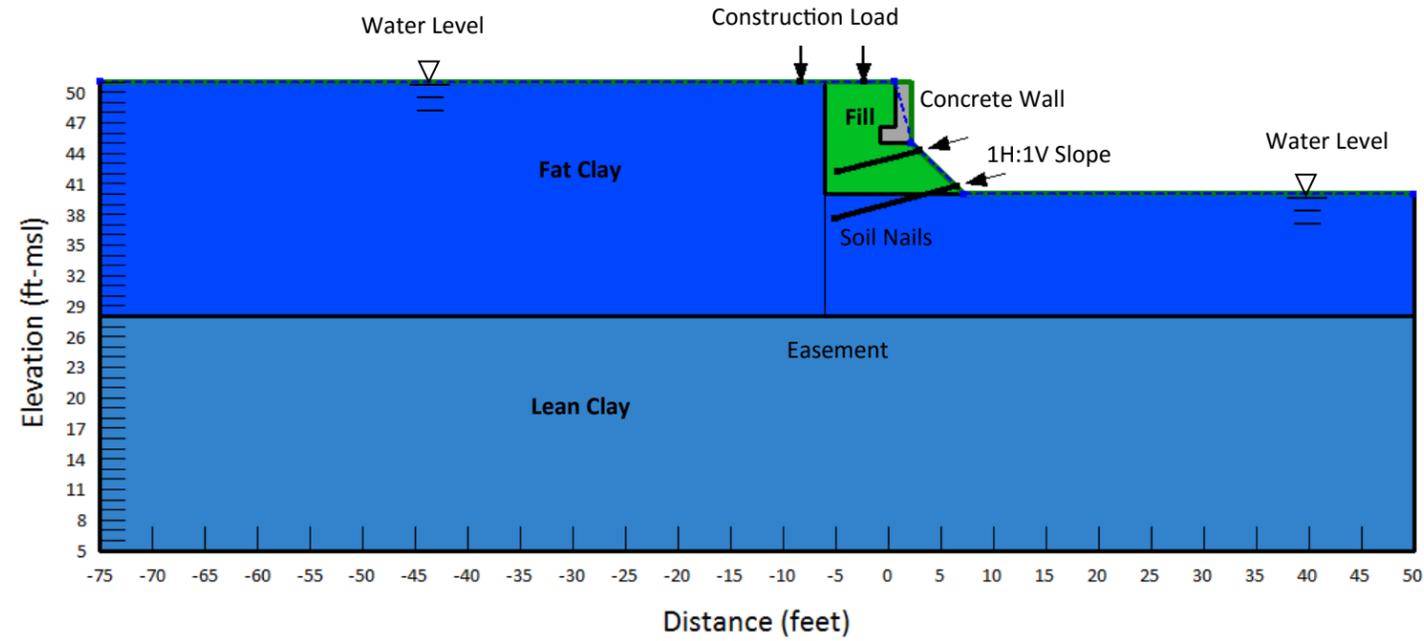
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

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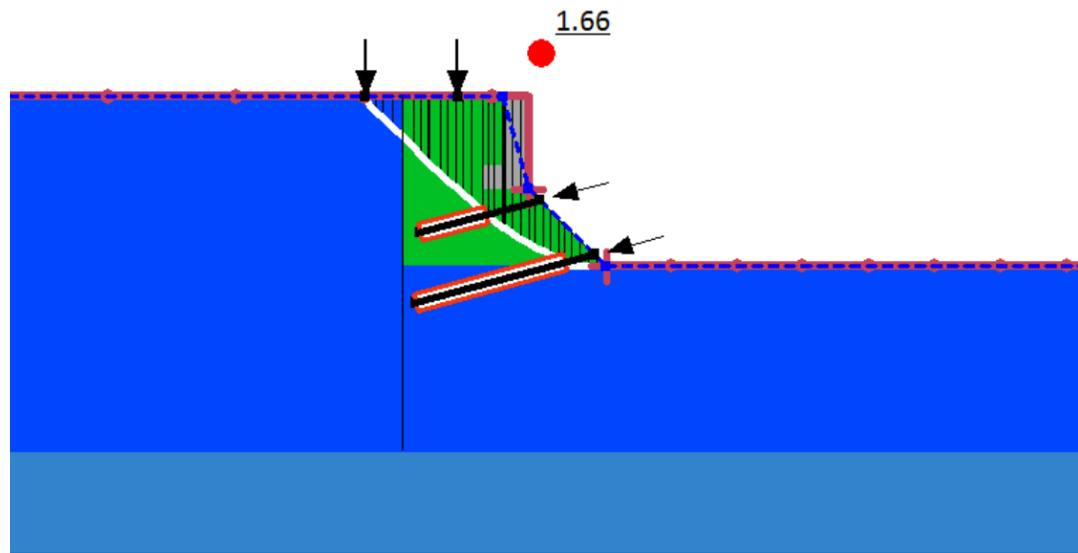


9900 Northwest Freeway  
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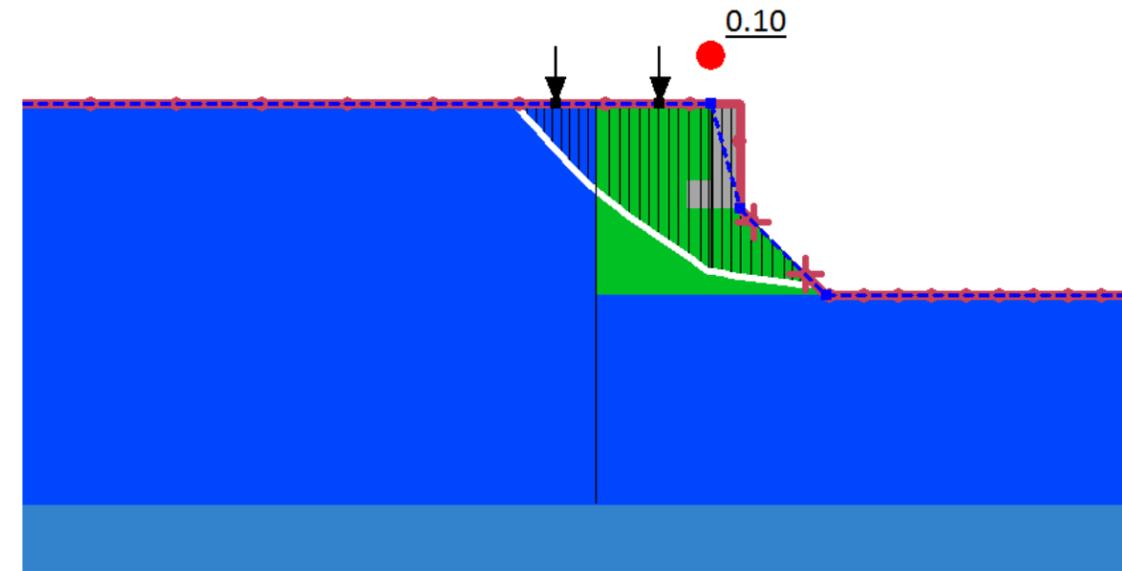
ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD ON FULLY SATURATED SLOPE, TOTAL STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
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 FILE NAME  
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 HG

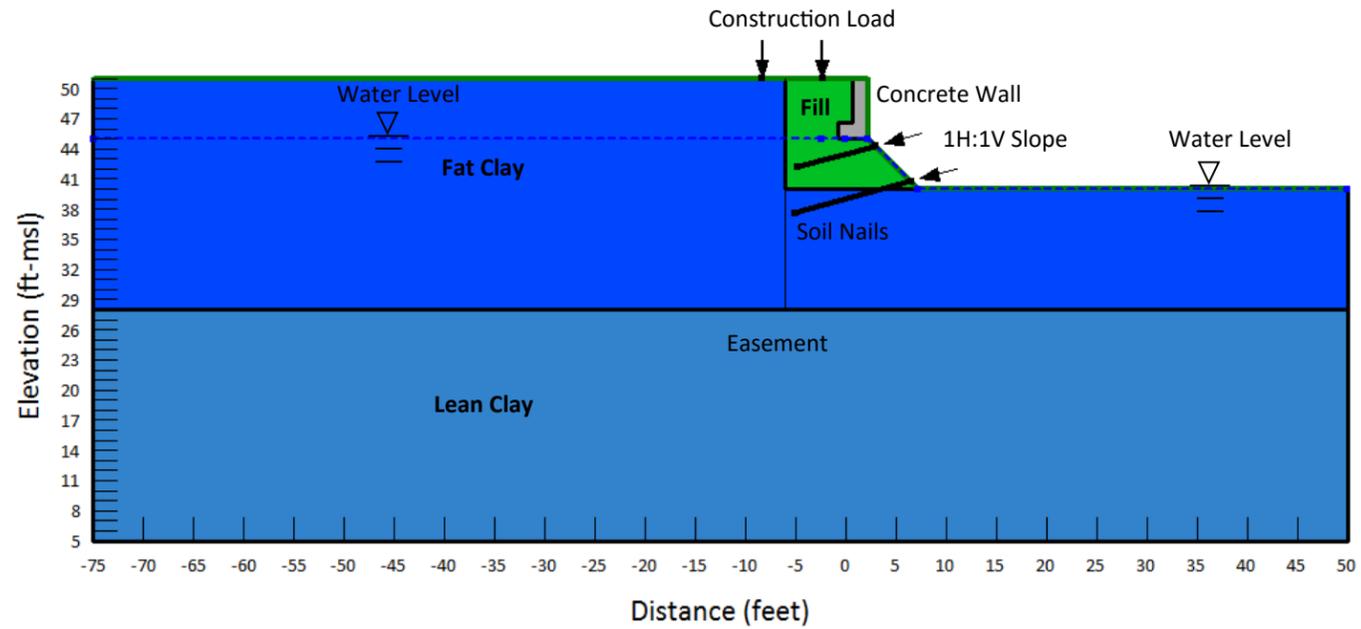
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

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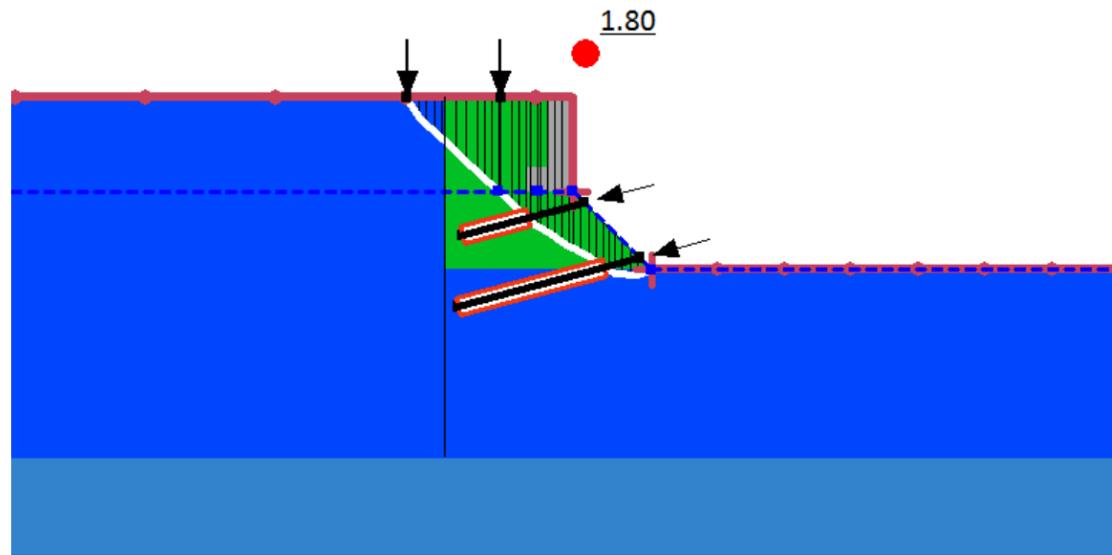


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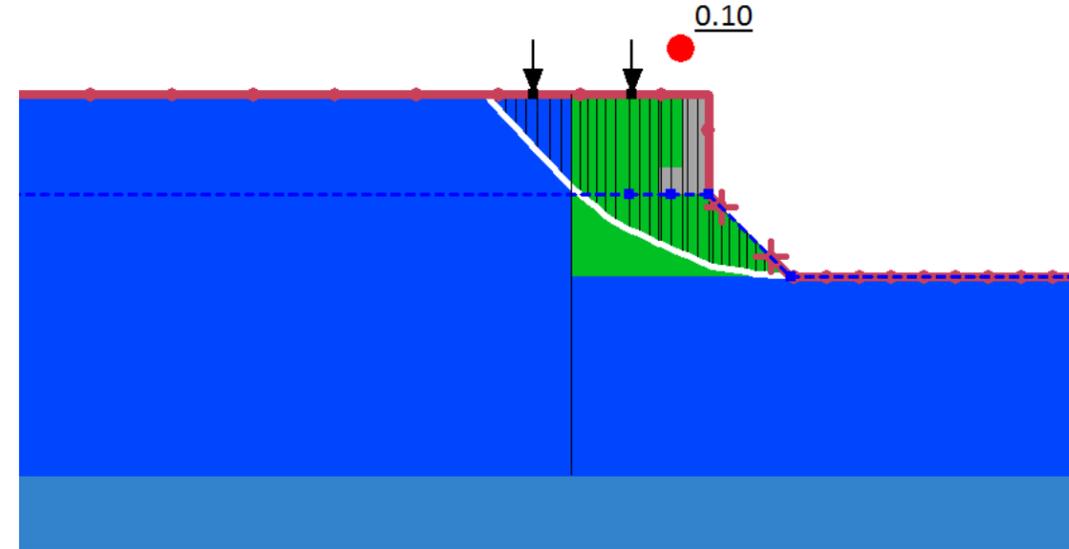
ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD ON PARTIALLY SATURATED SLOPE ,TOTAL STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

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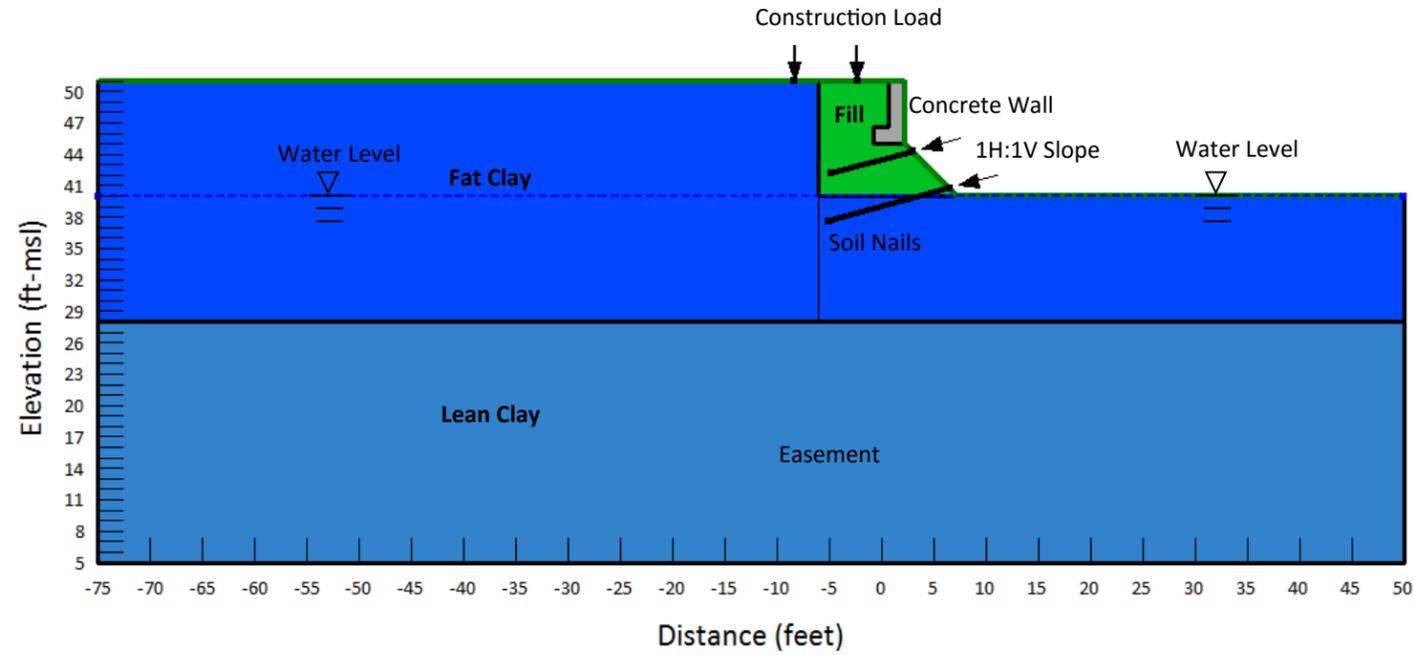
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

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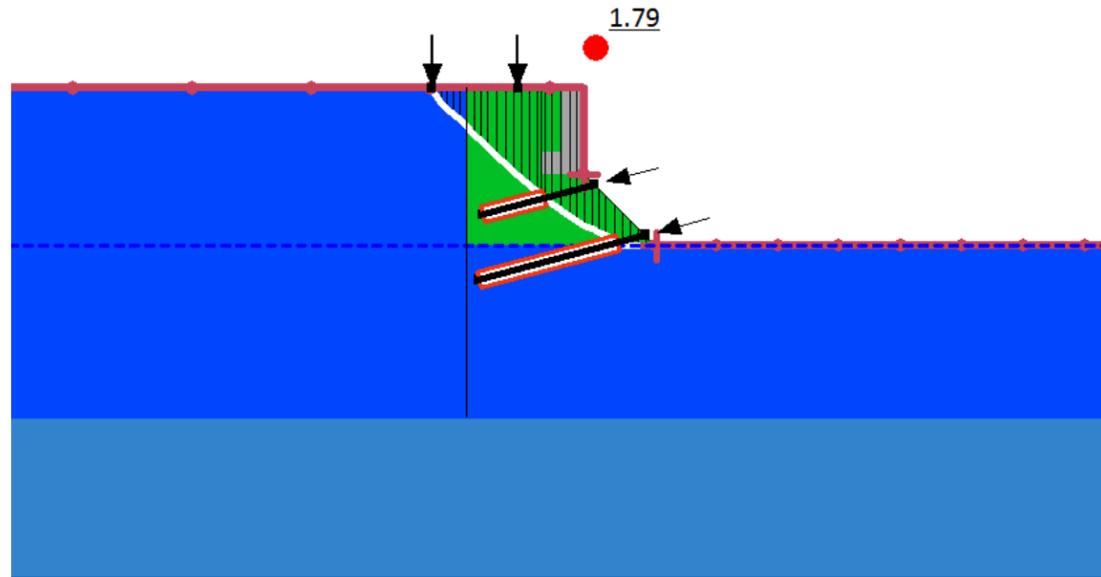


9900 Northwest Freeway  
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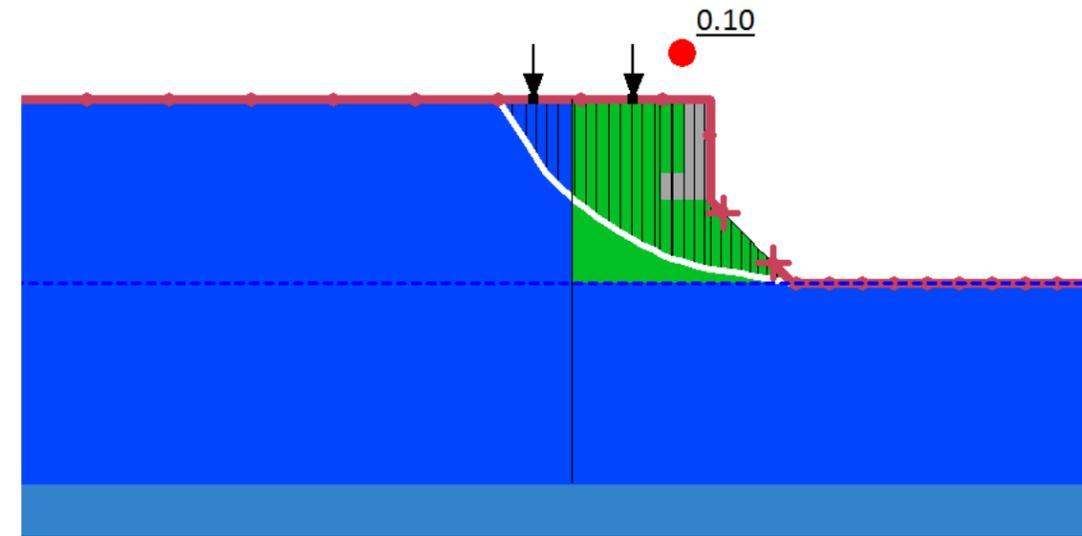
ALTERNATIVE 3B LEFT SLOPE REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD WITH WATER AT CHANNEL BASE, TOTAL STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
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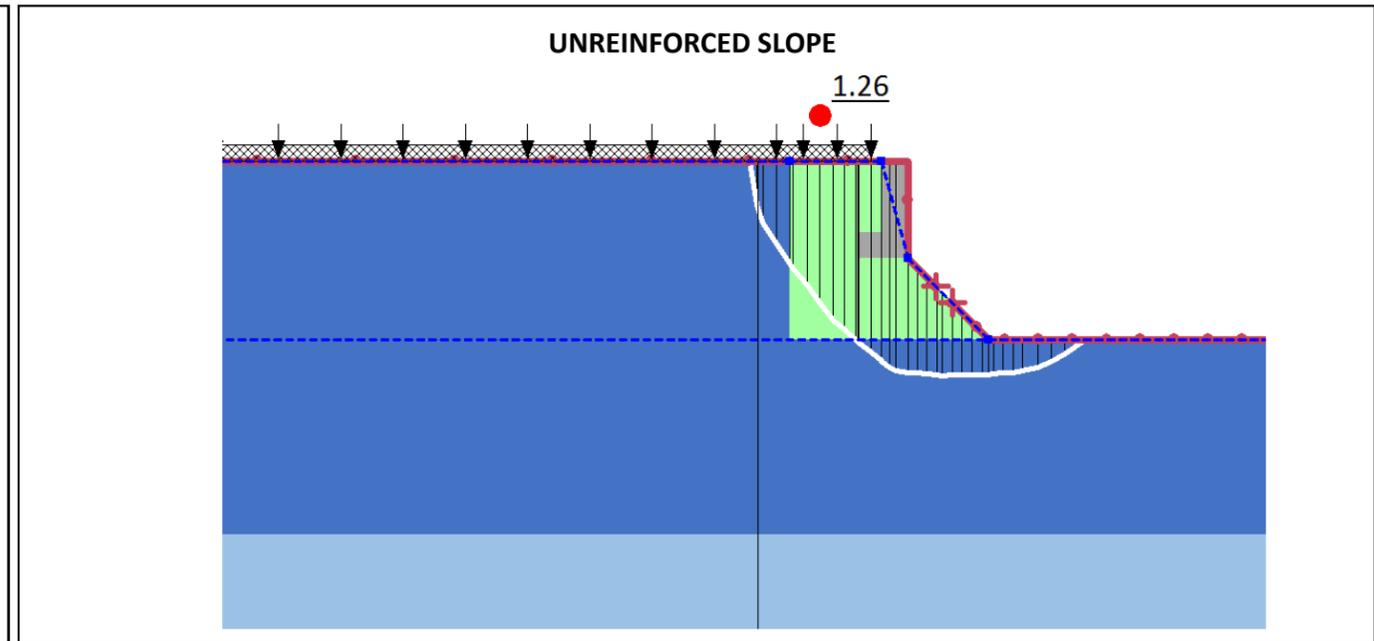
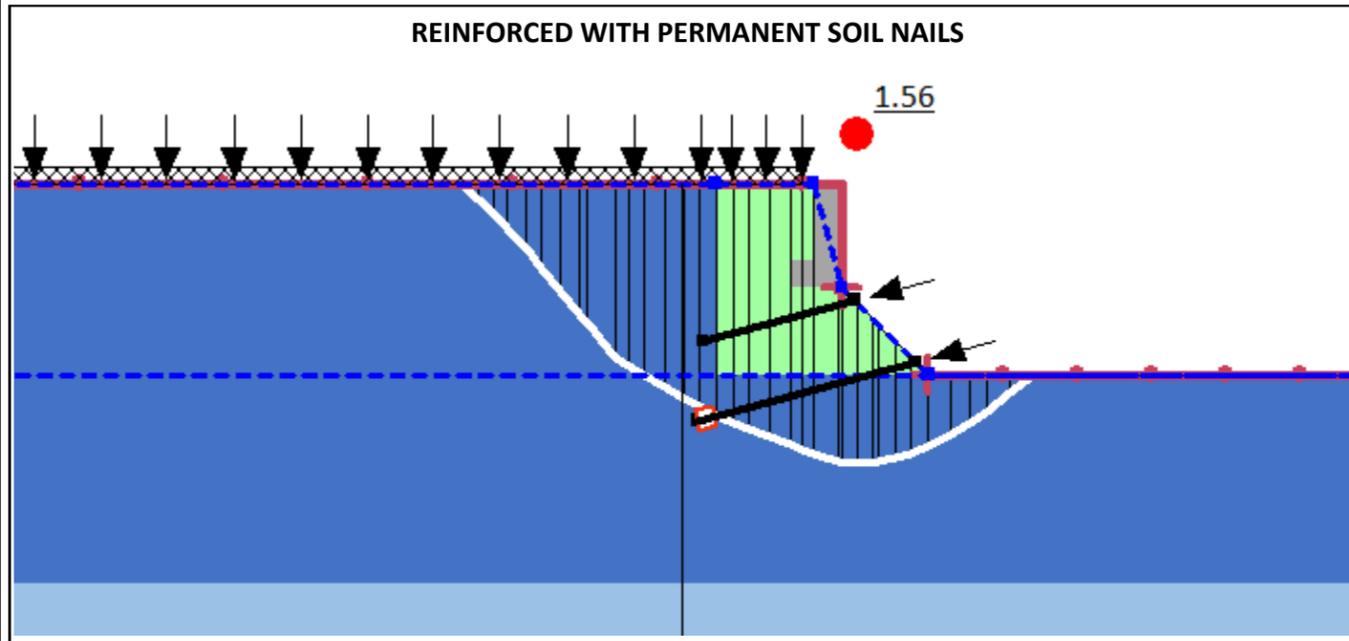
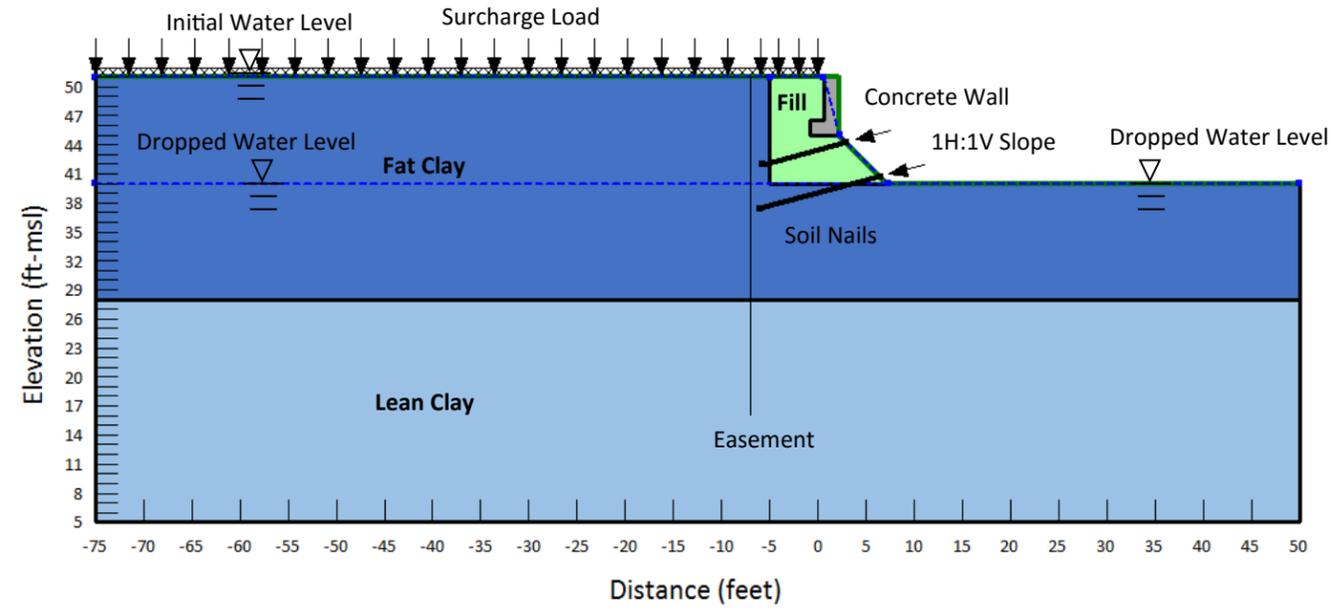
POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
**Slope Stability Analysis**  
**Alternative 3B Left Slope**

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ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD, RAPID DRAWDOWN



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
	Phreatic Surface
	Slip Surface Entry and Exit
	Calculated Factor of Safety
	250 psf Surcharge Load
	2,000 lbs Point Load (Construction Load)
	Soil Nails

General Notes:

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FN PROJECT NO.	HCF16148
DATE CREATED	1/27/2017
DATUM & COORDINATE SYSTEM	NAVD83 State Plane (feet) Texas South Central
FILE NAME	Stability Analysis
PREPARED BY	HG

POOR FARM DITCH IMPROVEMENTS  
HARRIS COUNTY FLOOD CONTROL

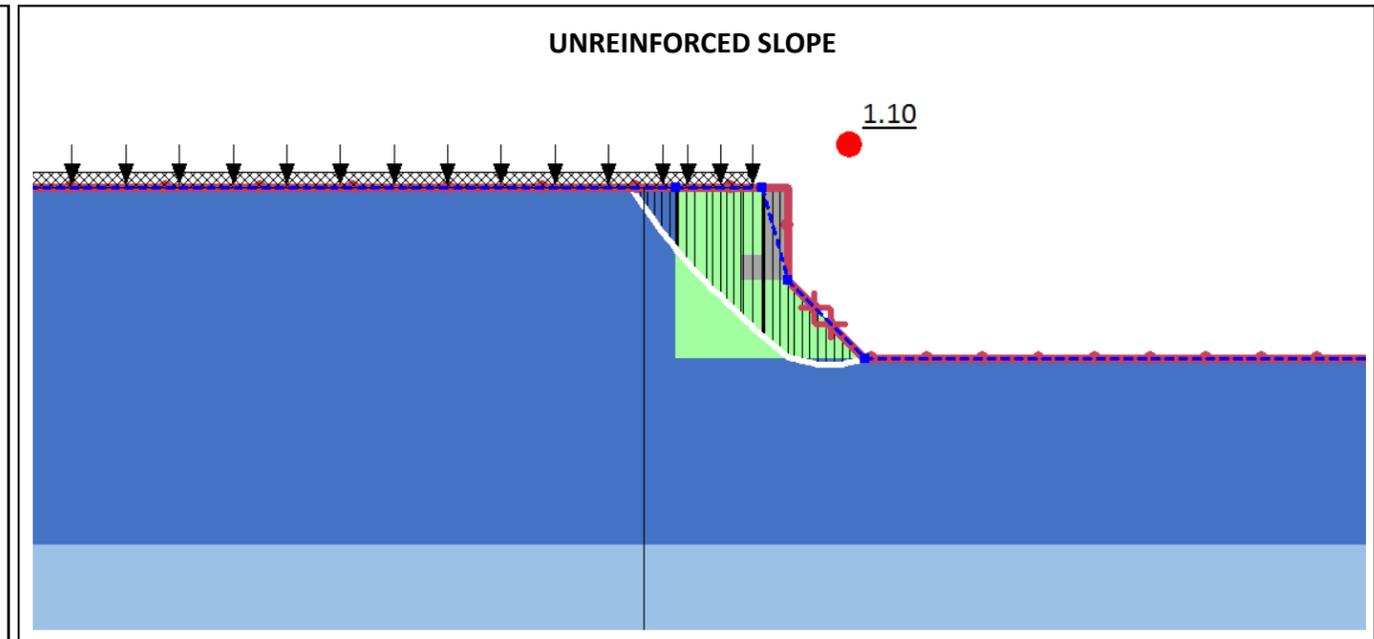
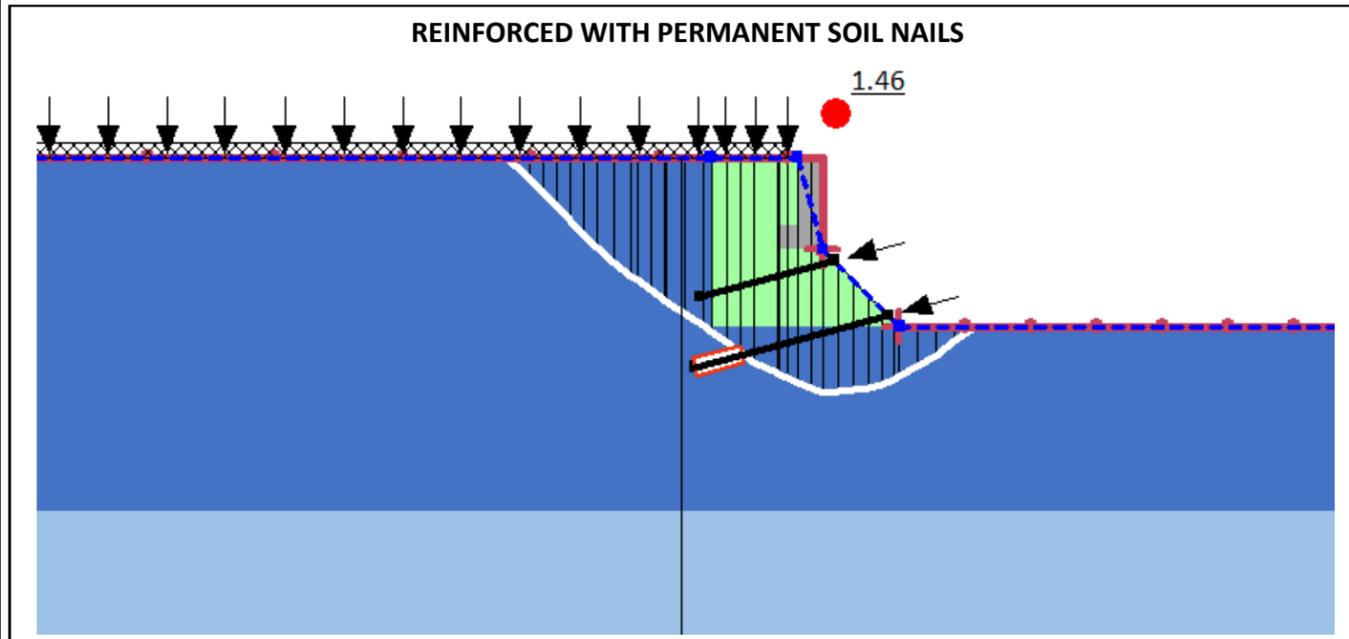
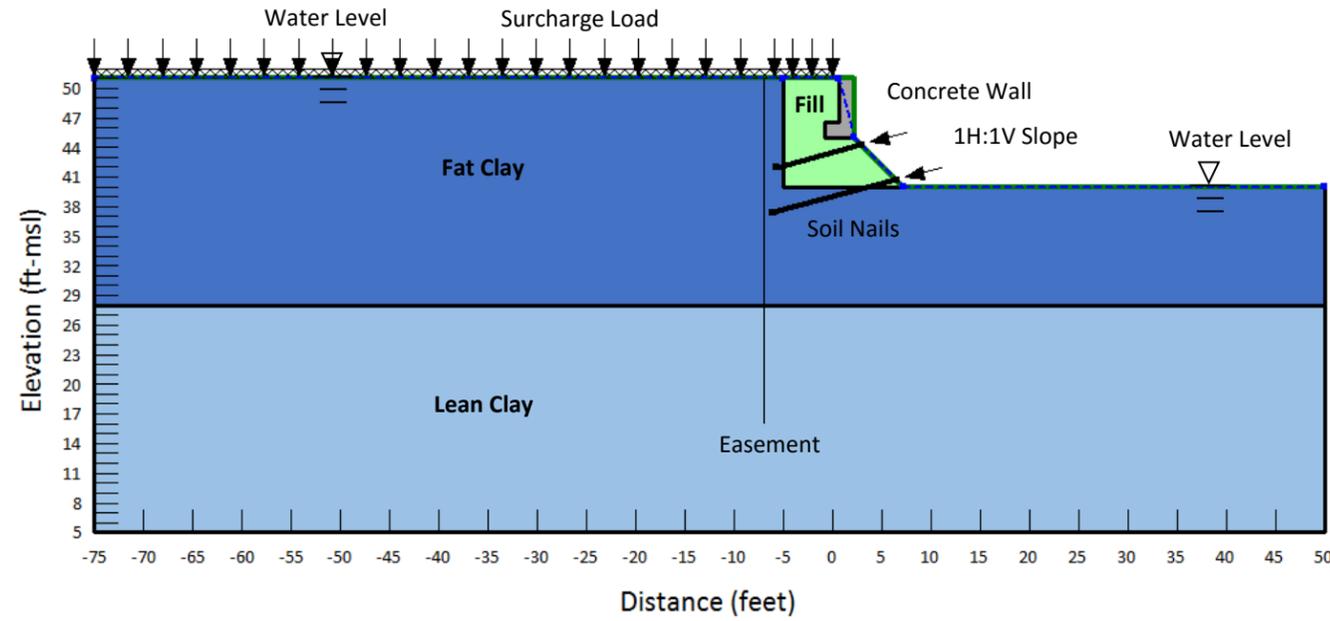
Slope Stability Analysis  
Alternative 3A and 3B Right Slopes

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ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE, EFFECTIVE STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
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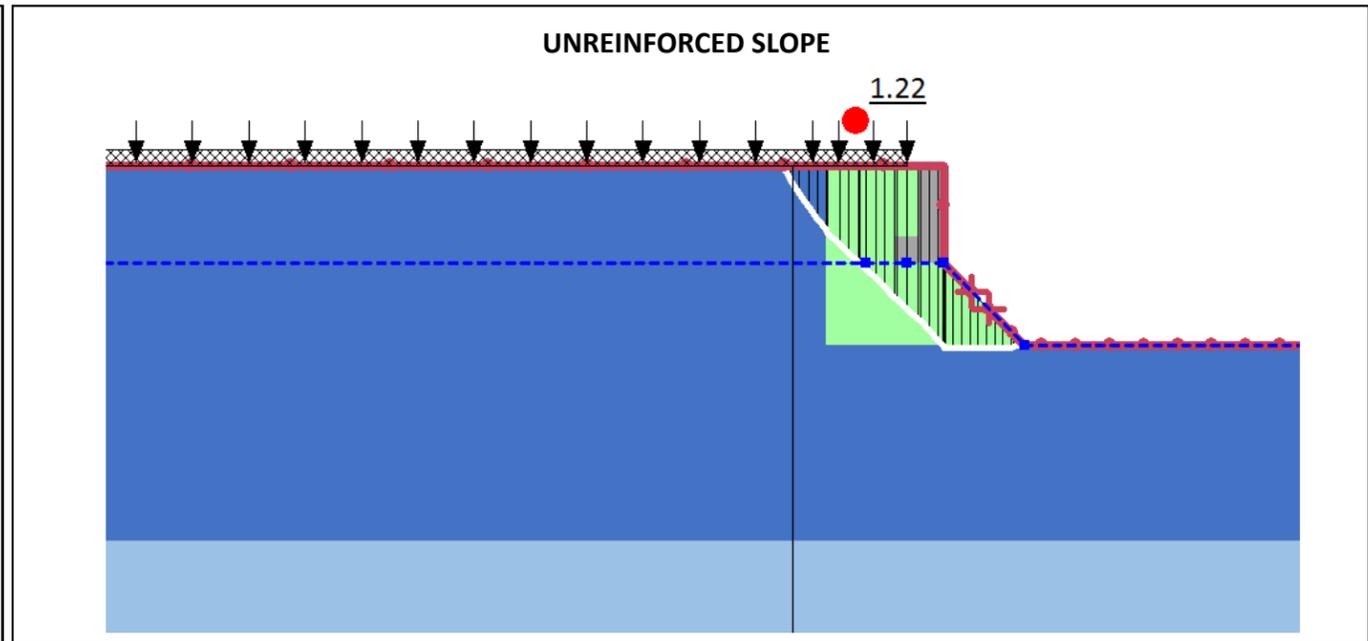
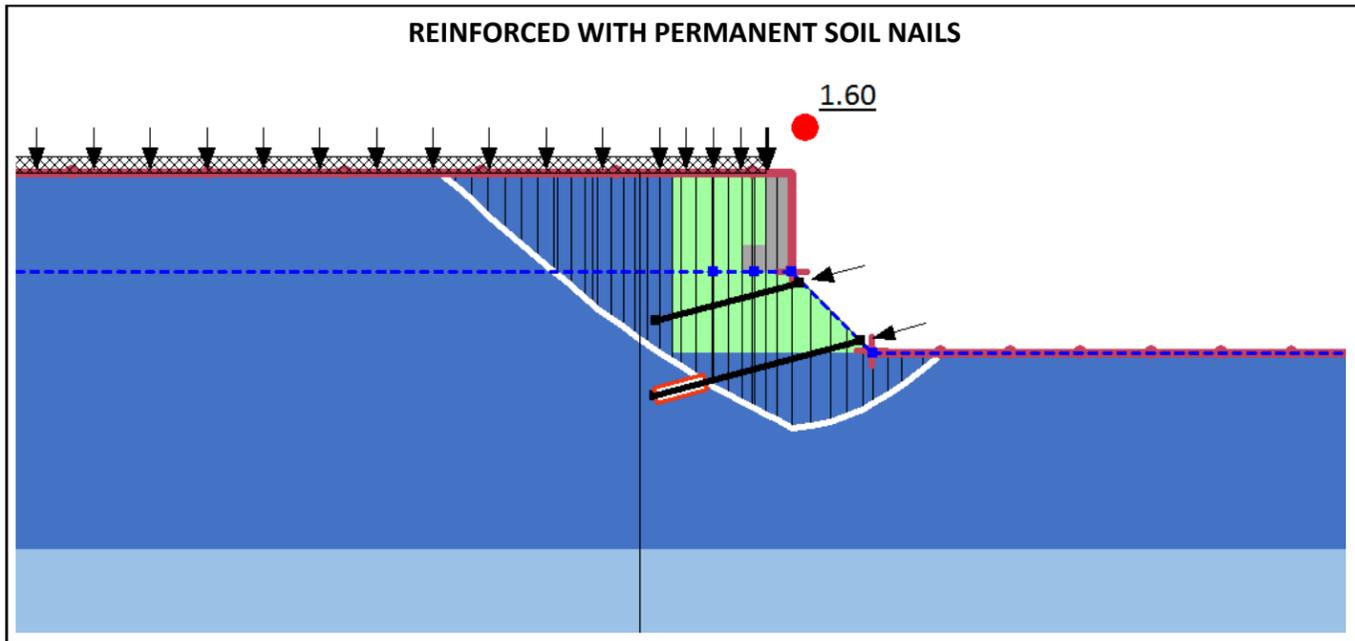
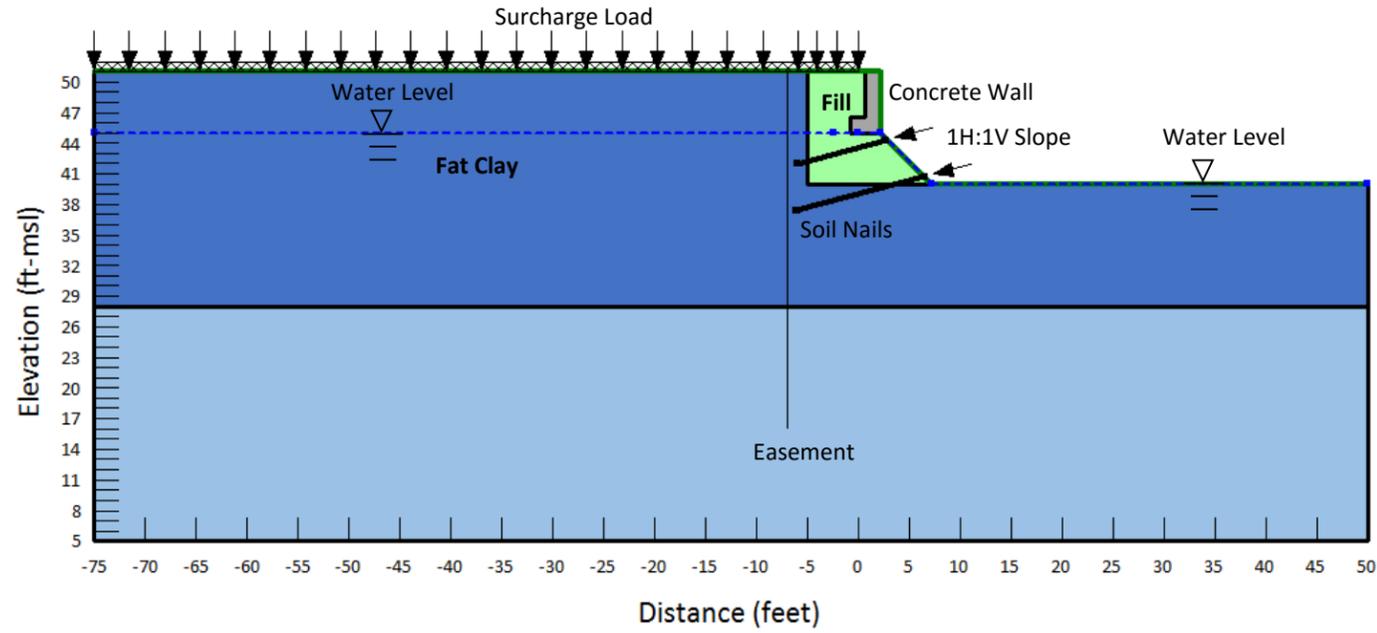
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Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
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 HARRIS COUNTY FLOOD CONTROL

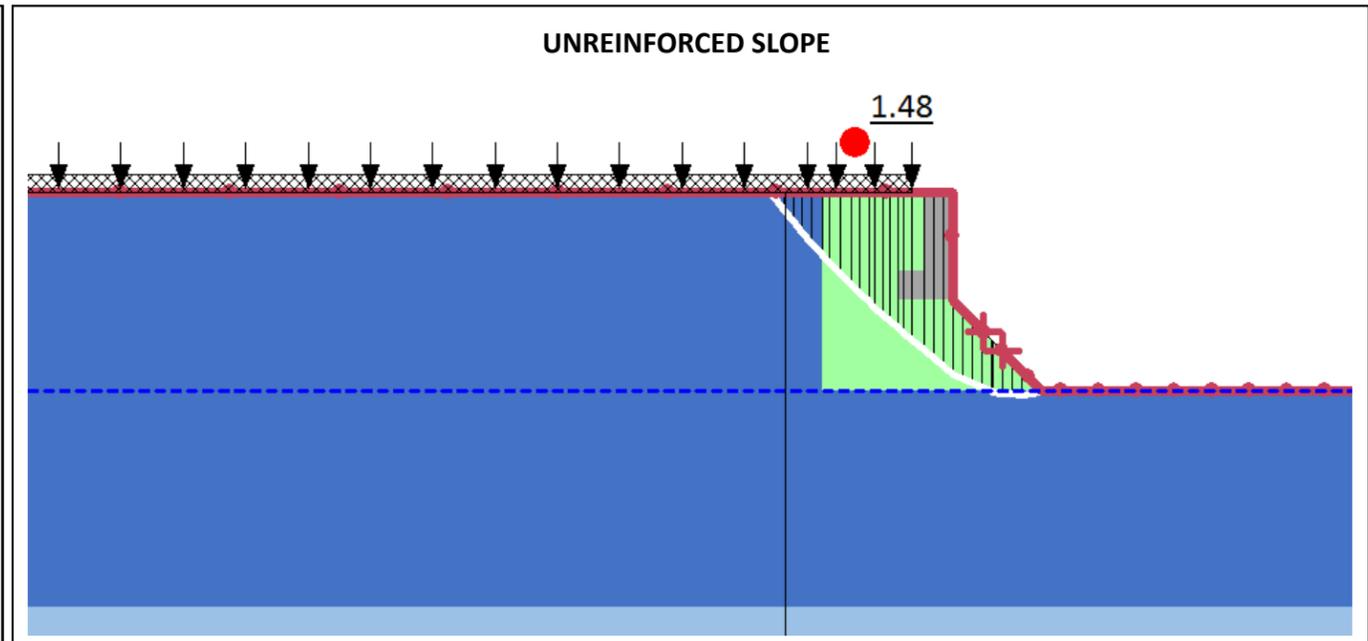
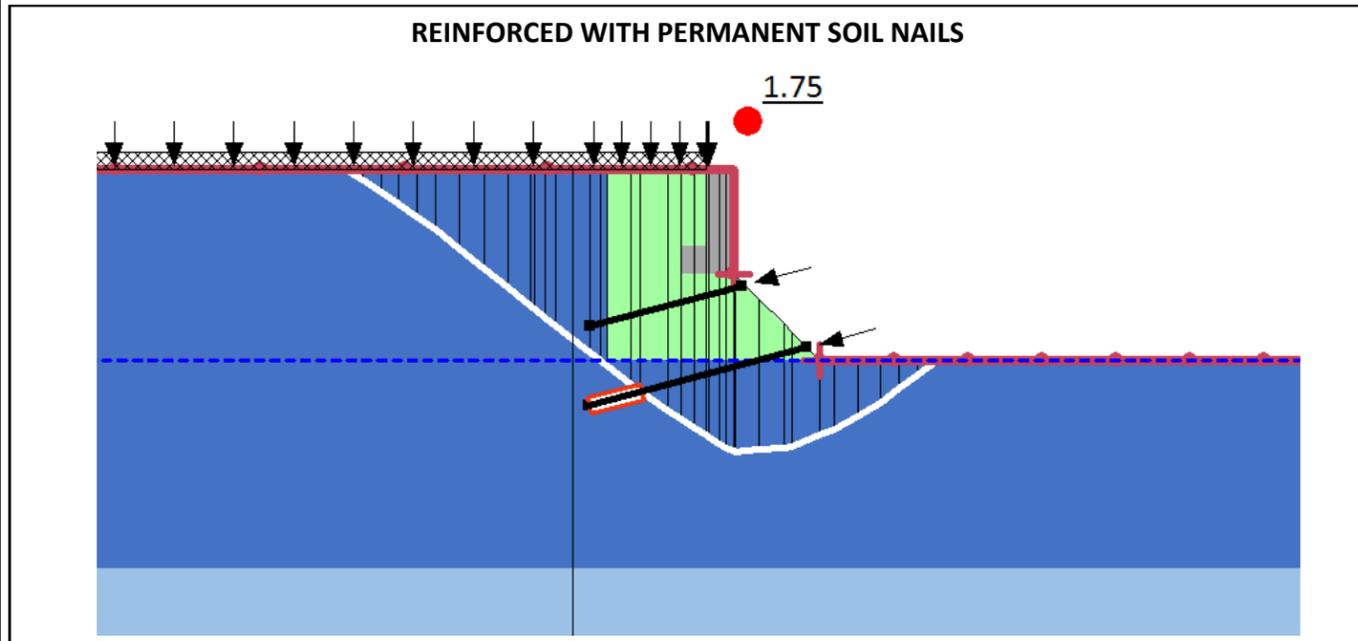
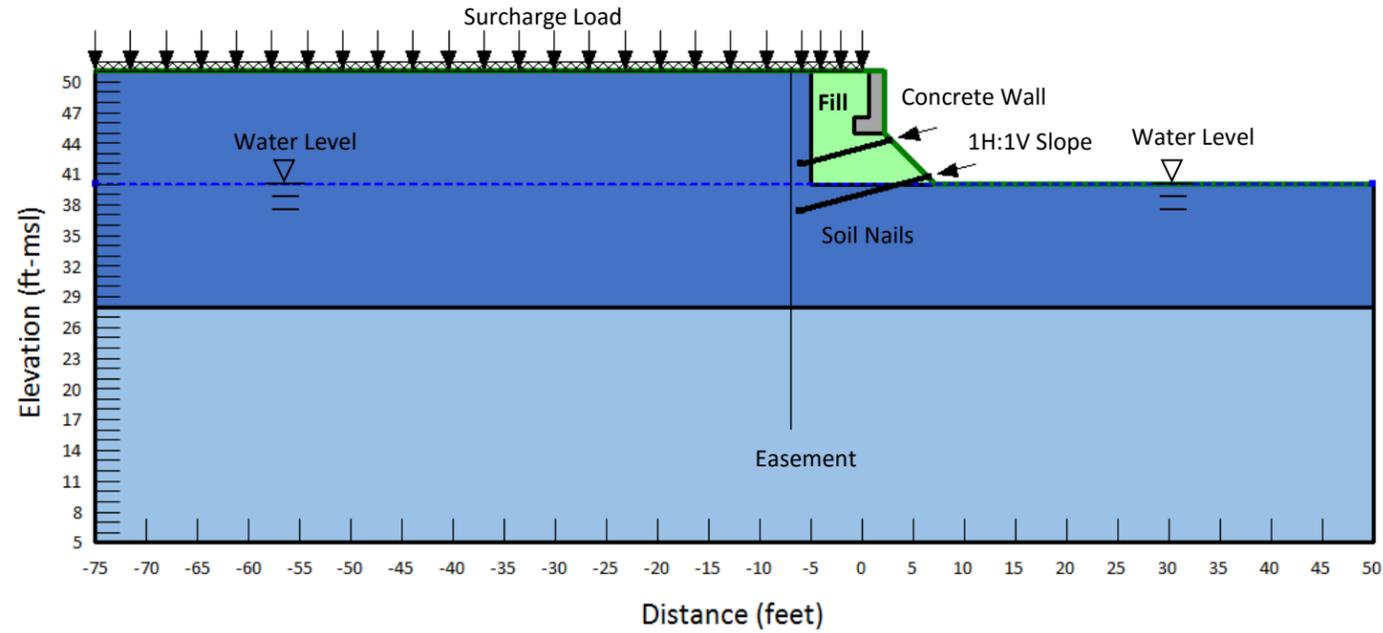
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ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE, EFFECTIVE STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
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	Slip Surface Entry and Exit
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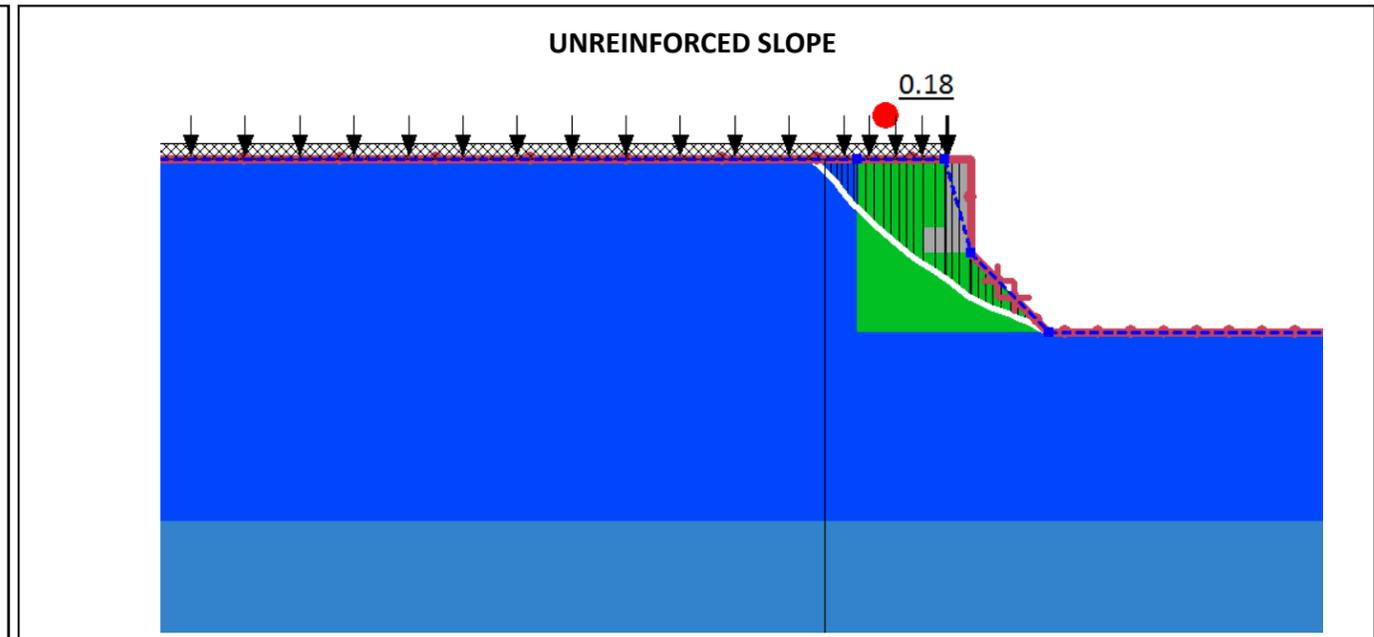
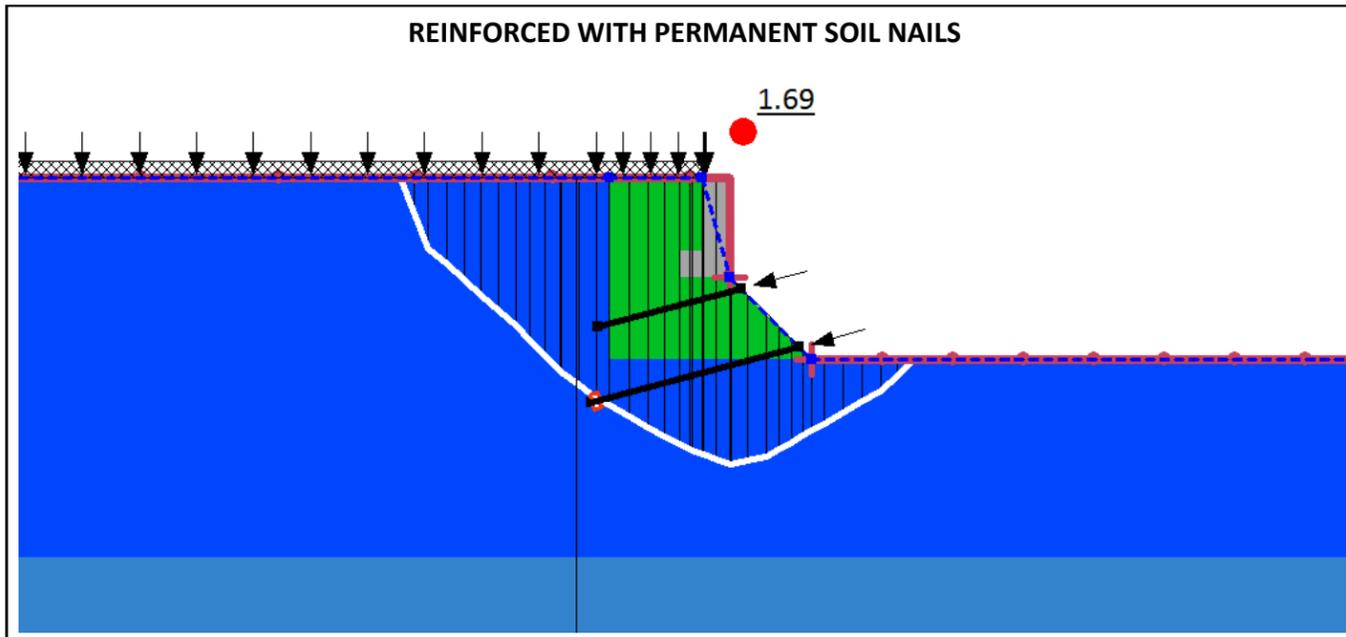
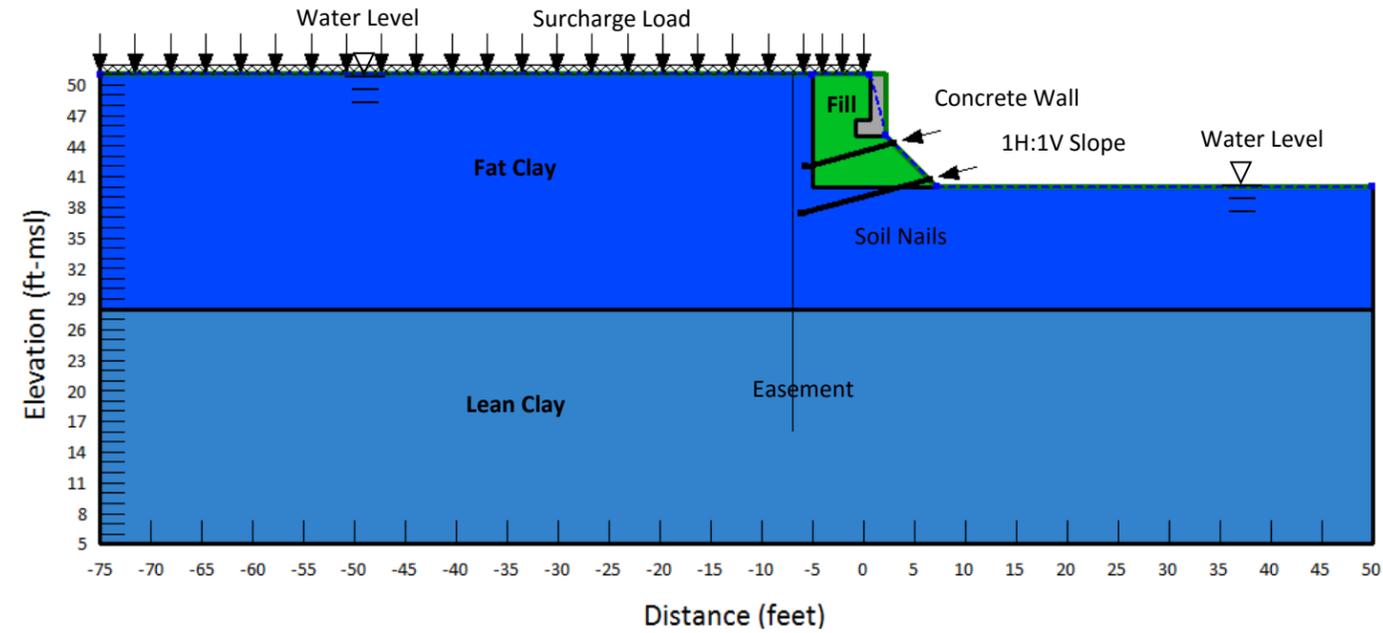
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ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD ON FULLY SATURATED SLOPE, TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
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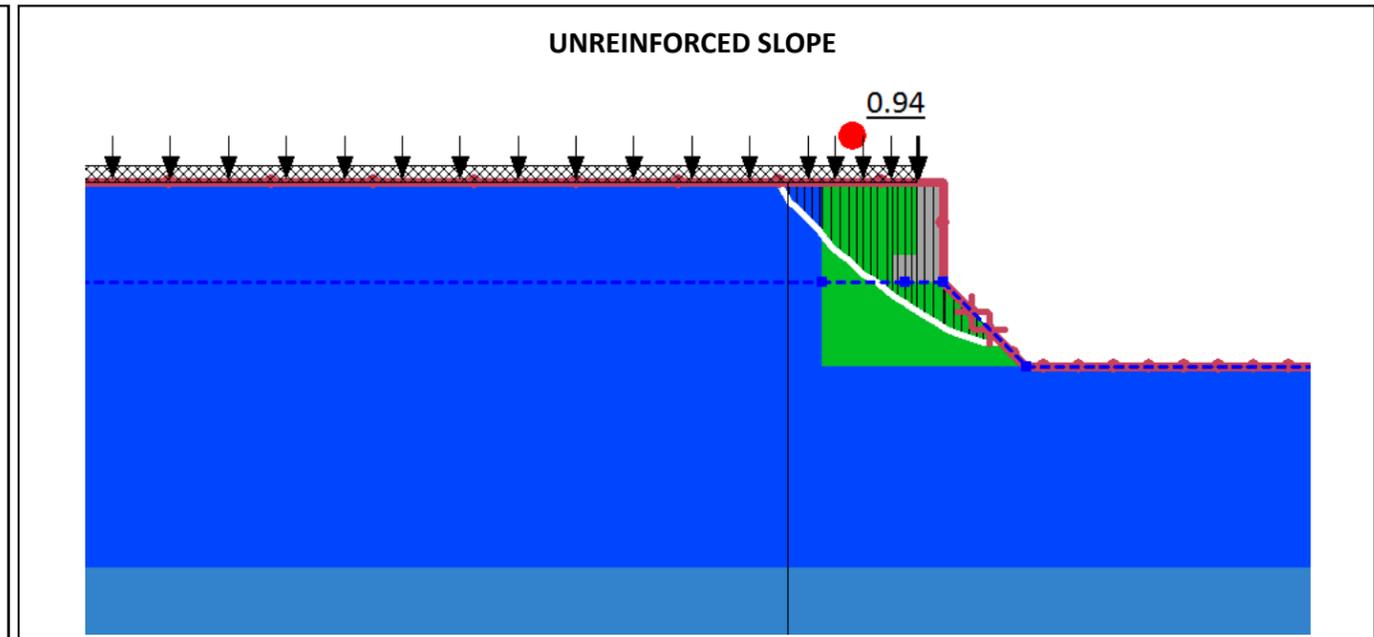
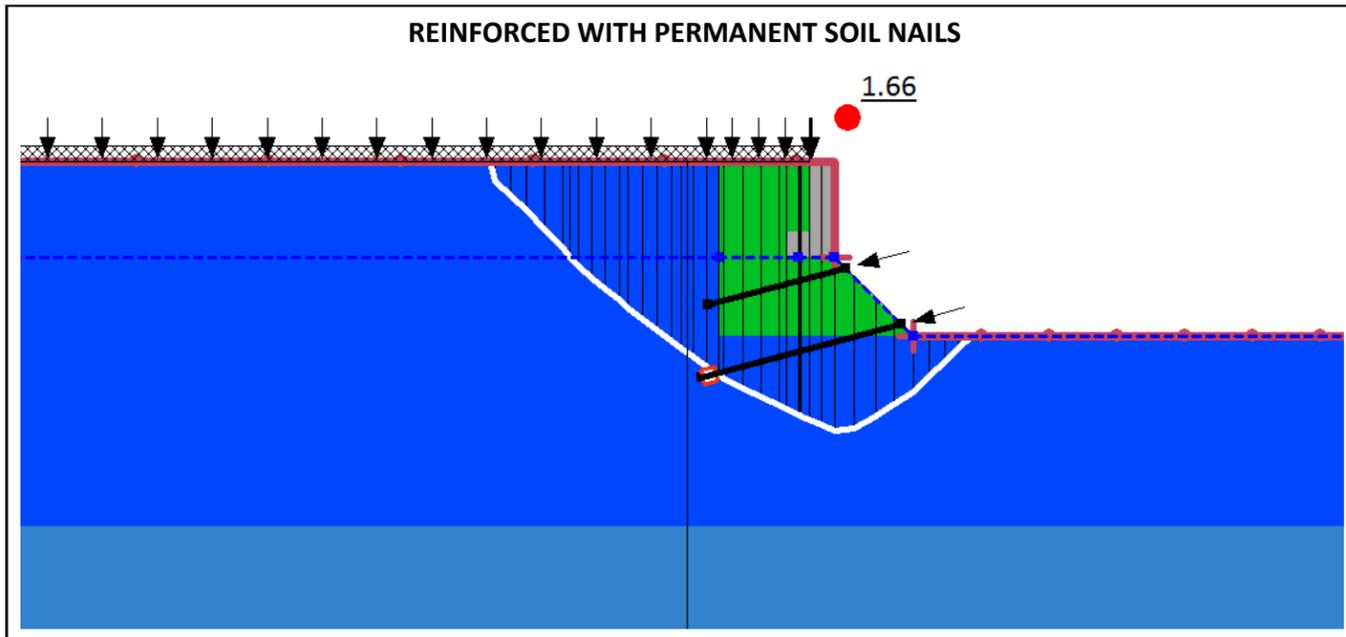
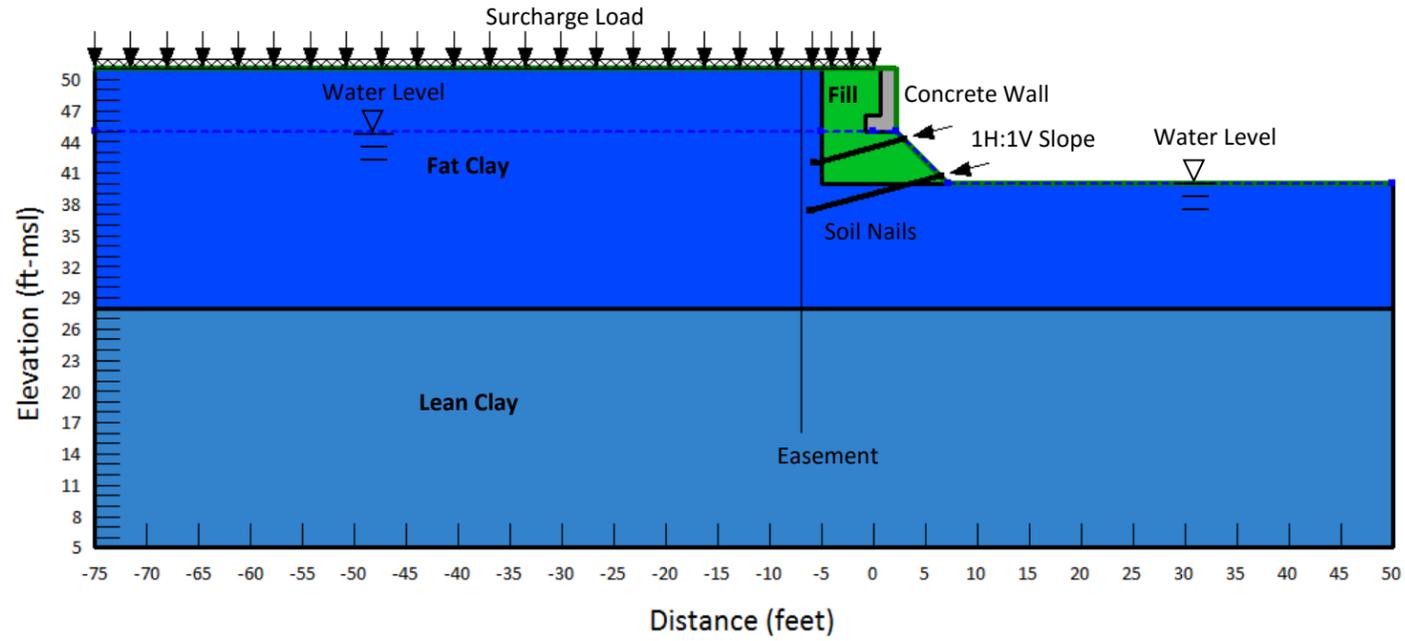
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Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

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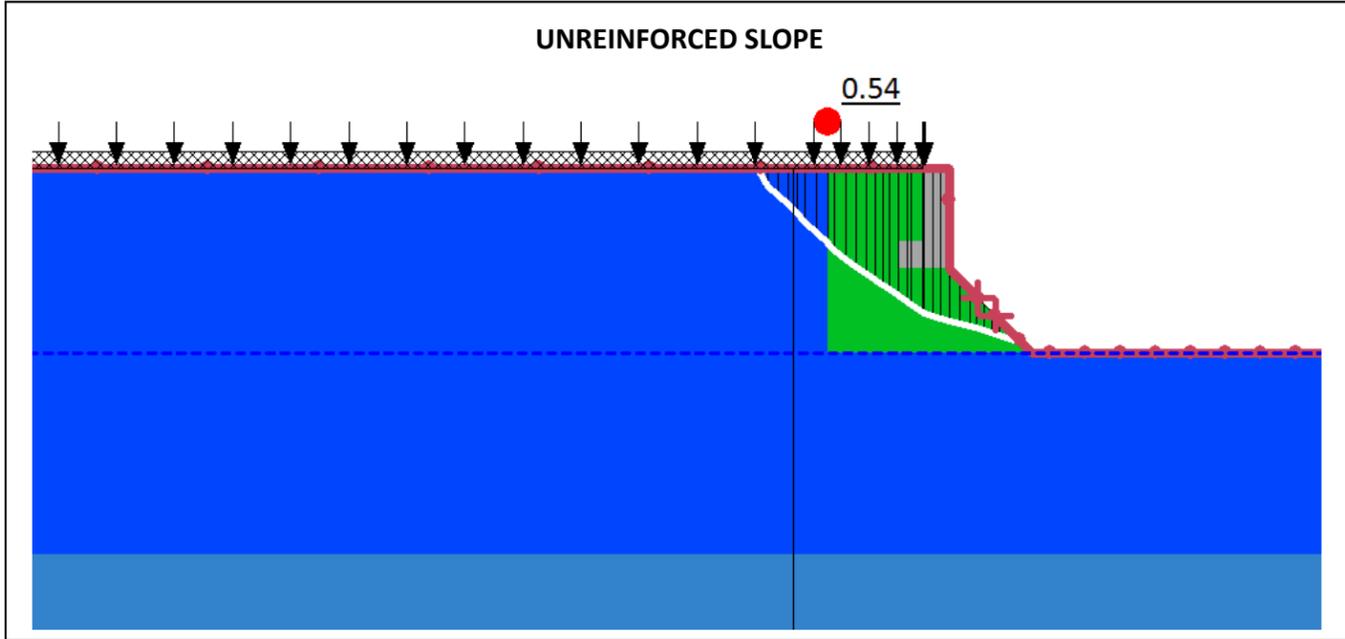
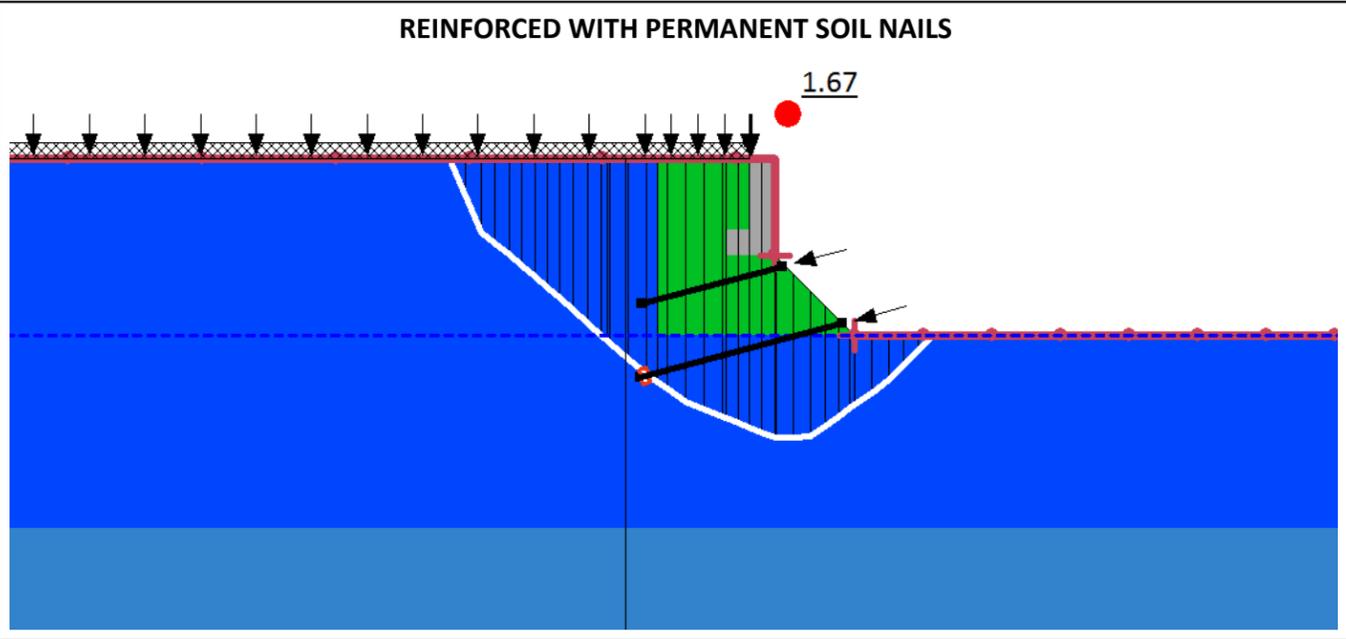
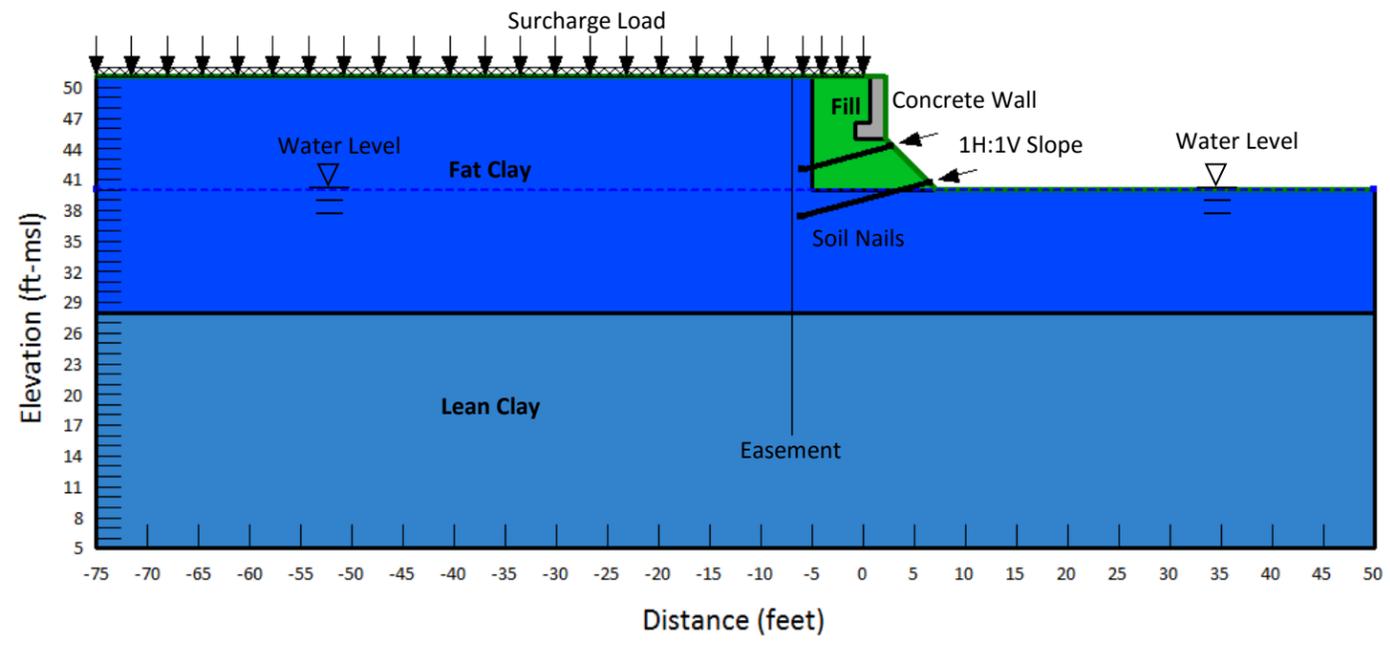
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ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING SURCHARGE LOAD WITH WATER AT CHANNEL BASE, TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	c' (psf)	$\phi$ (deg)	c, psf
CH	CH	122	129	18	250	0	700
CL	CL	125	134	28	150	0	1000
Fill Material	Fill Material	125	129	26	0	0	500
Wall		145		28	100	--	--

Legend	
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	Slip Surface Entry and Exit
	Calculated Factor of Safety
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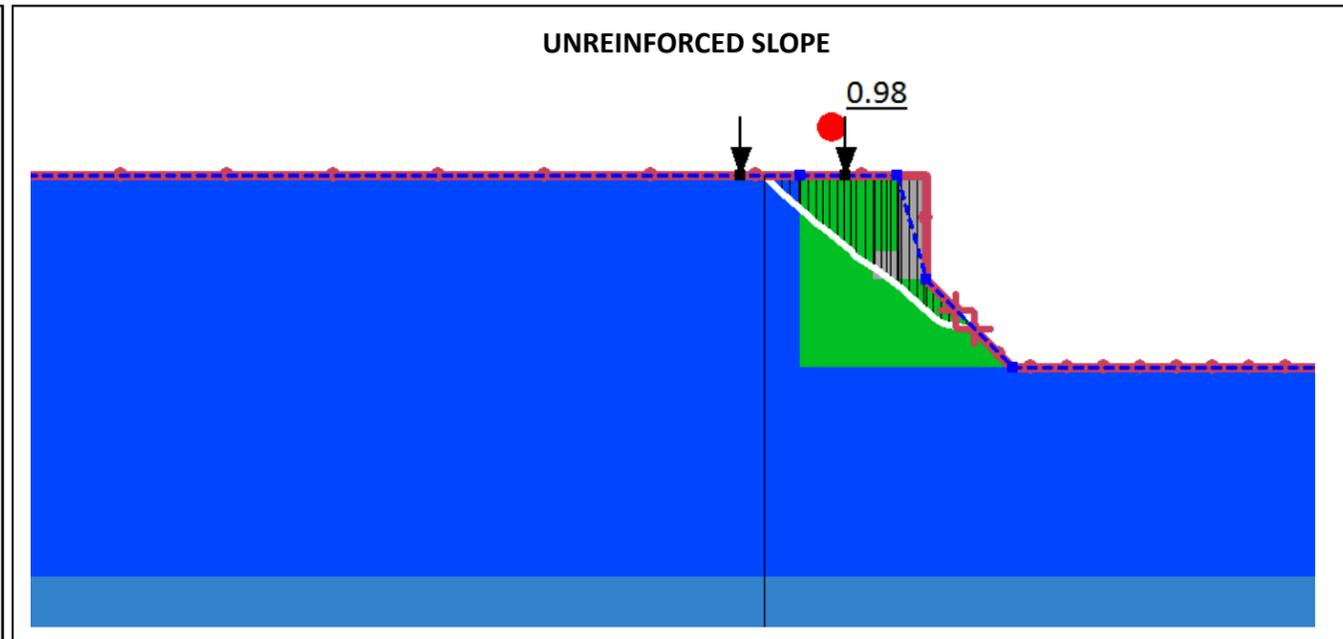
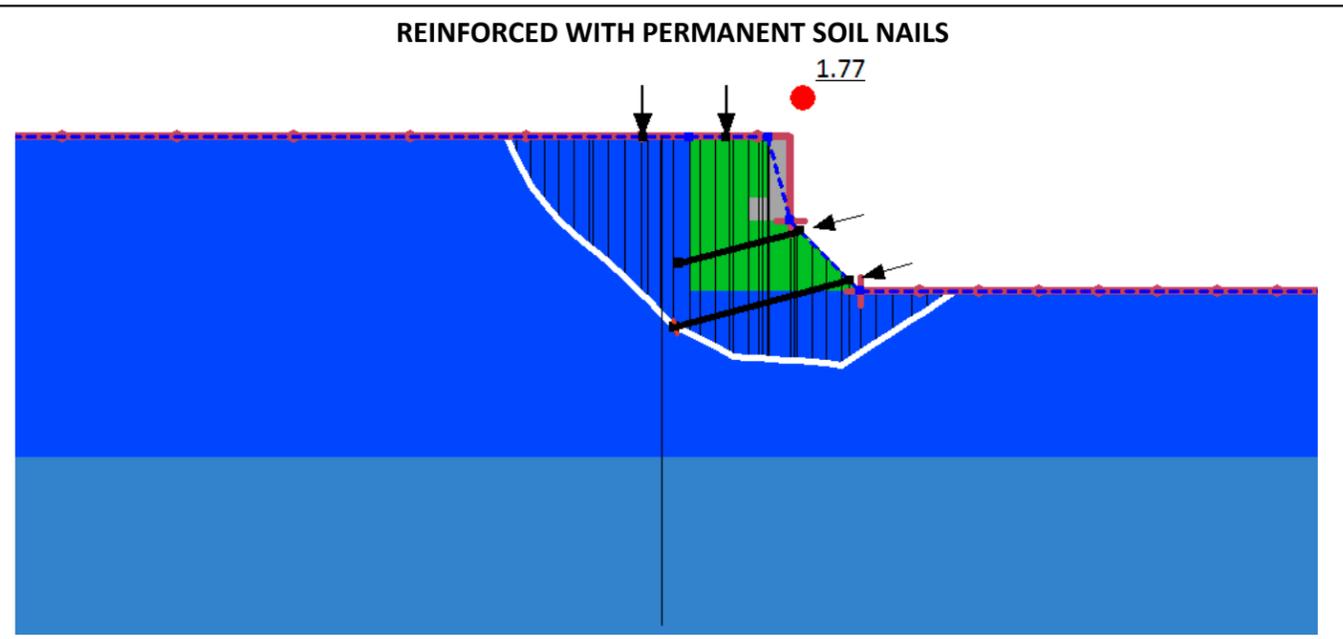
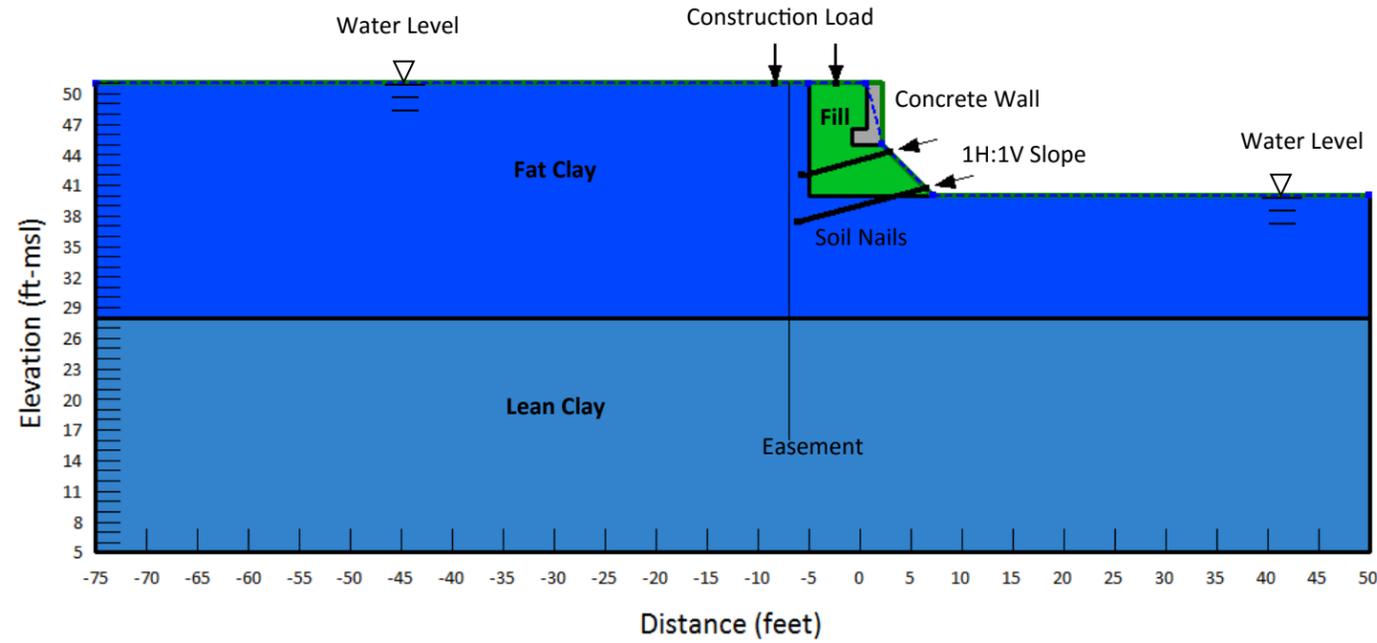
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ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD ON FULLY SATURATED SLOPE, TOTAL STRENGTH



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
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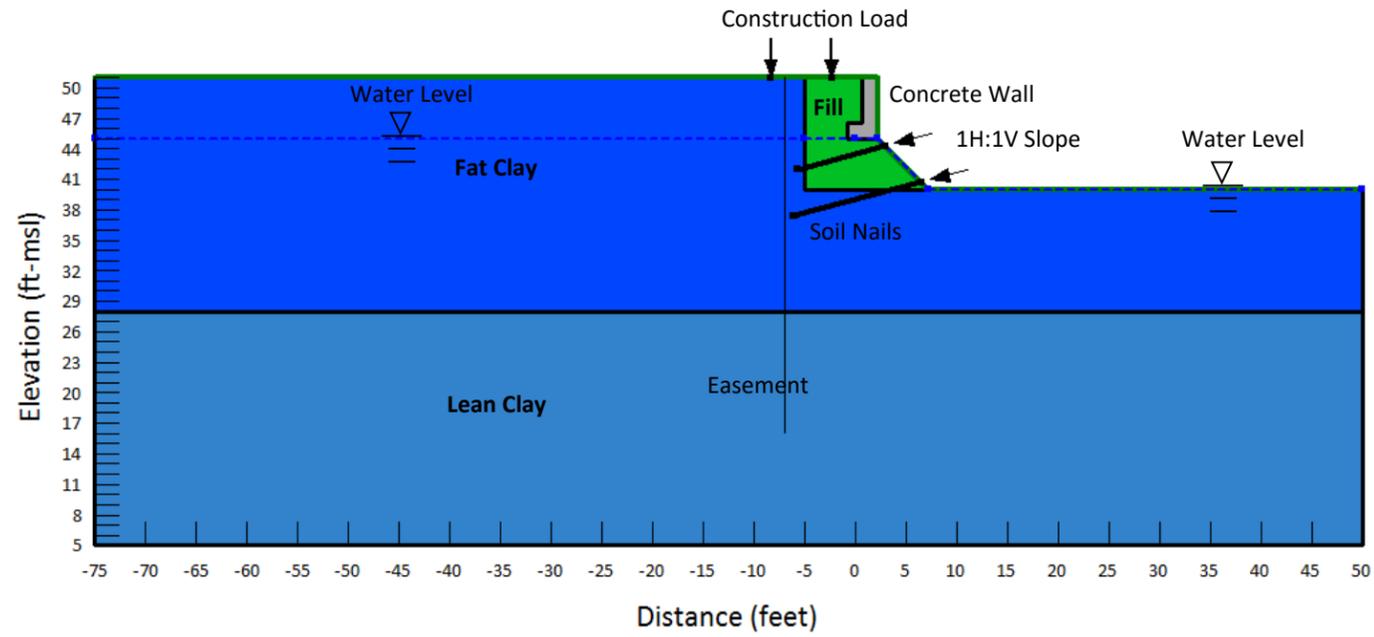
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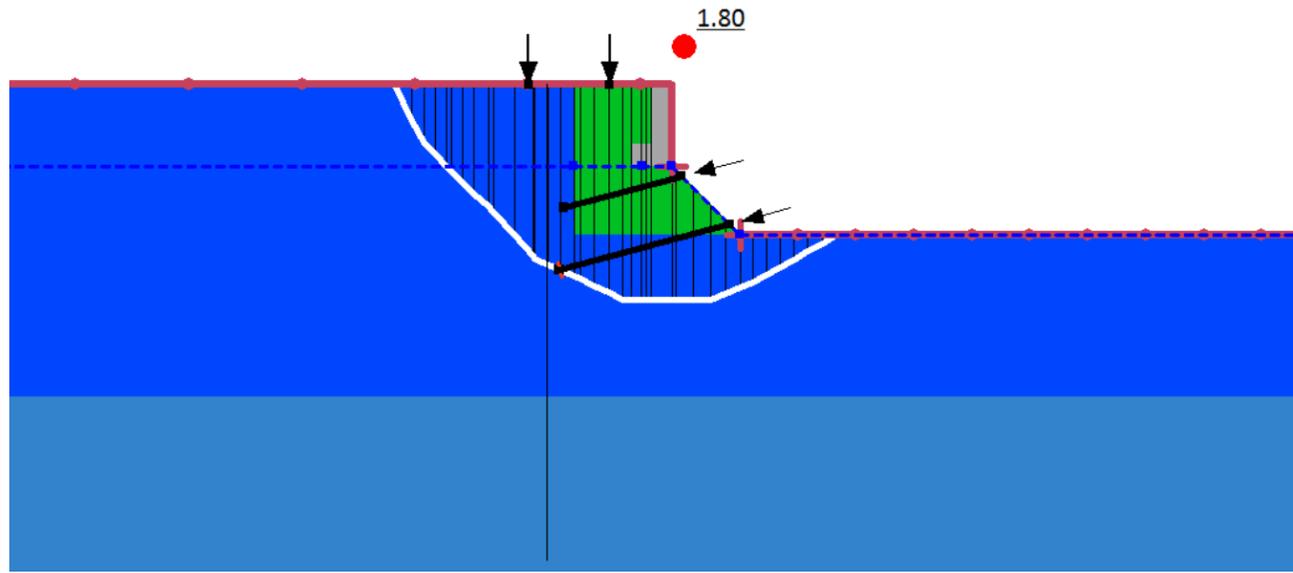
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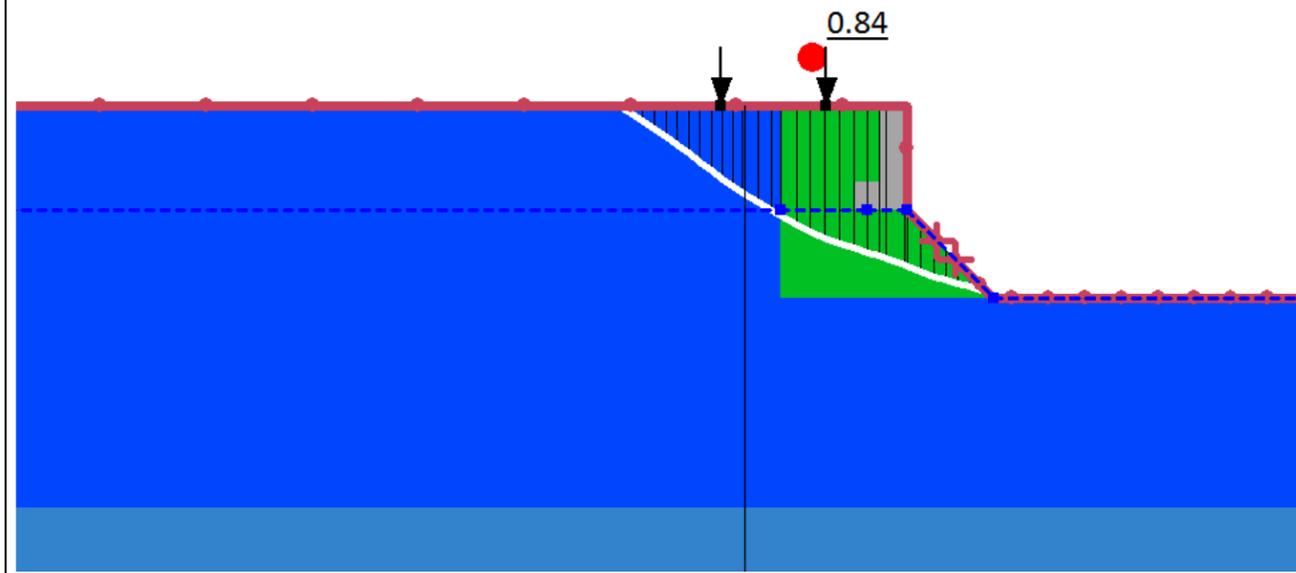
ALTERNATIVE 3A AND 3B RIGHT SLOPES REINFORCED WITH PERMANENT SOIL NAILS INCLUDING CONSTRUCTION LOAD ON PARTIALLY SATURATED SLOPE ,TOTAL STRENGTH



REINFORCED WITH PERMANENT SOIL NAILS



UNREINFORCED SLOPE



Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
		Moist	Sat.	$\phi'$ (deg)	$c'$ (psf)	$\phi$ (deg)	$c$ , psf
CH	CH	122	129	18	250	0	700
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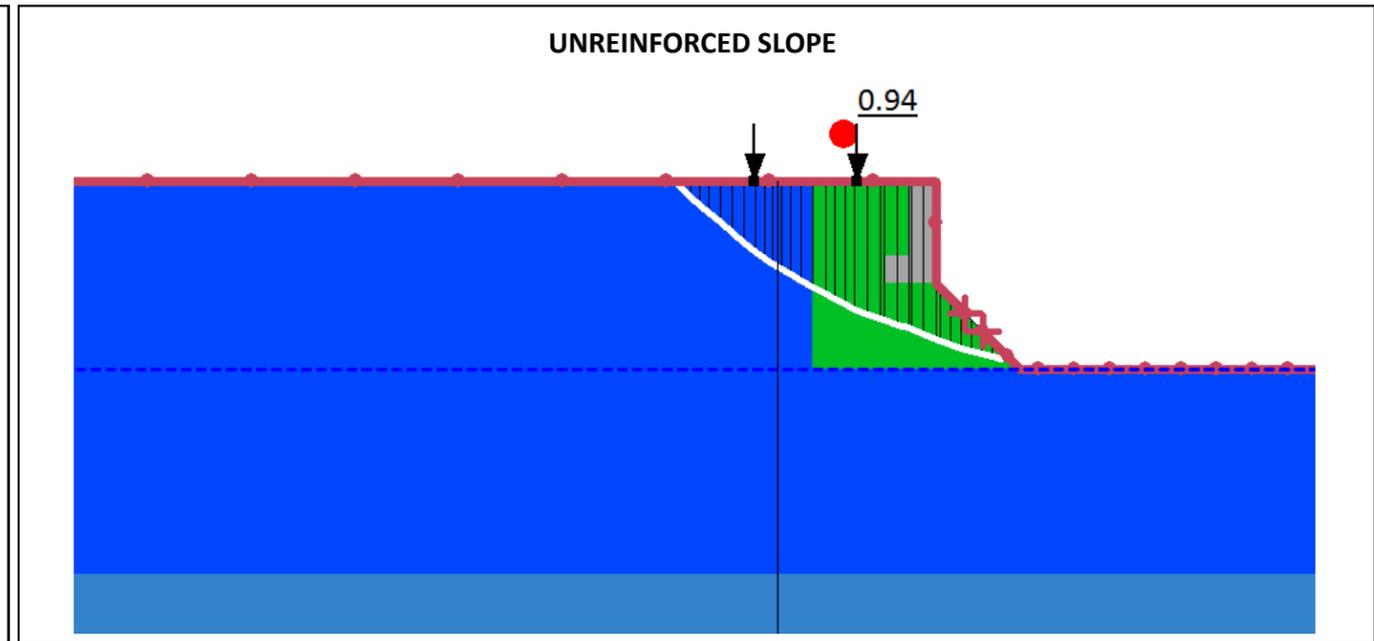
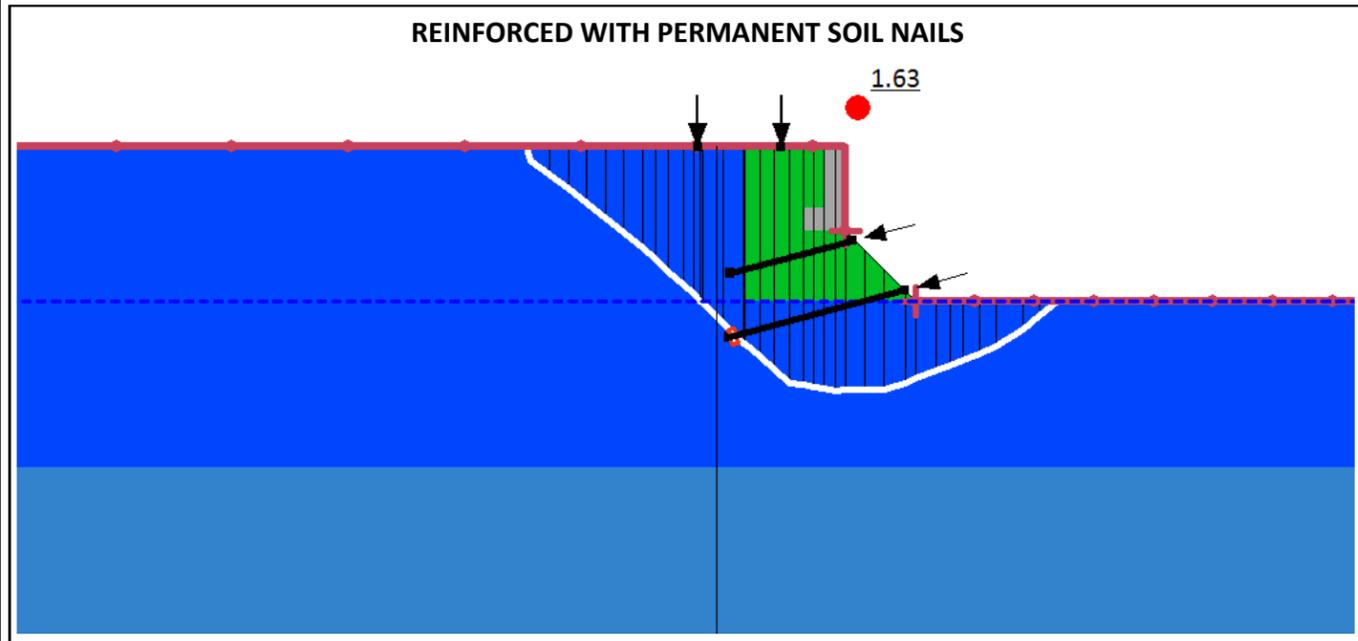
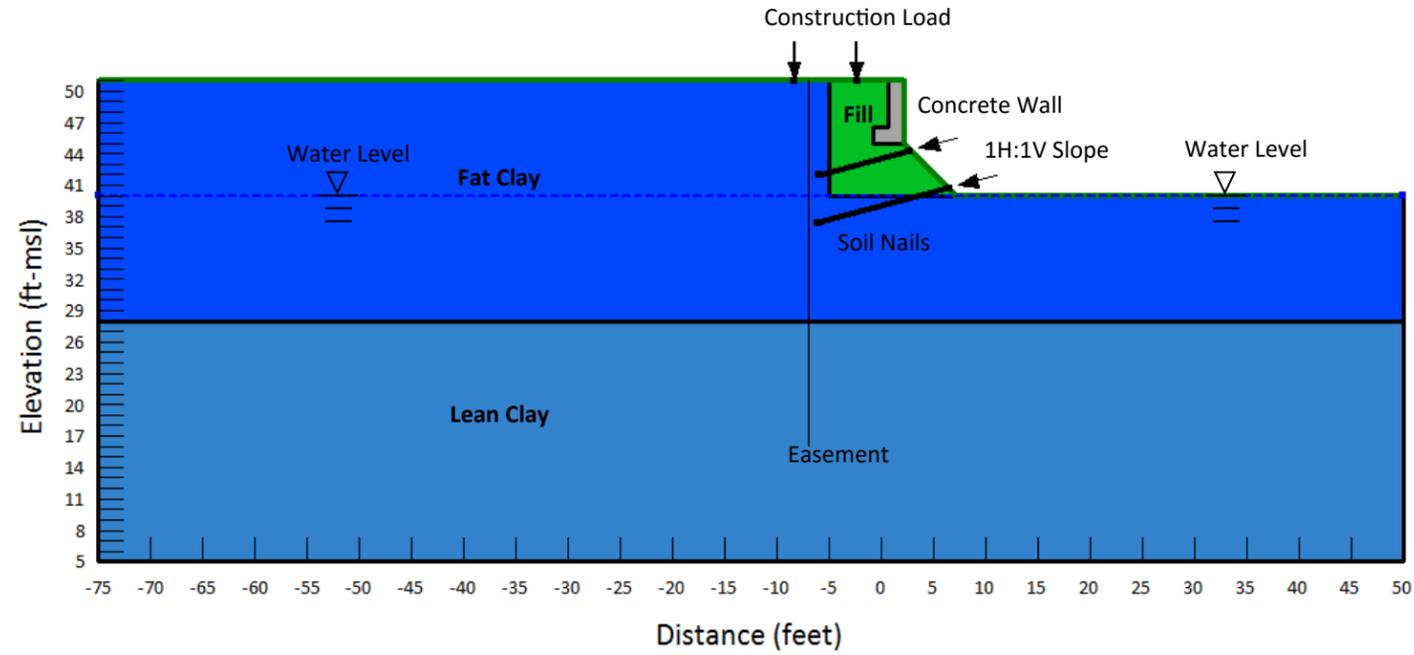
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Material Type	Material Type	Unit Weight (pcf)		Drained		Undrained	
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Rev.	Author	Author Initials	Reviewer	Reviewer Initials	Date
0	Hande Gerkus, Ph.D., E.I.T.		Marc T. Miller, P.E.		November 3, 2016

## 1.0 PURPOSE

This worksheet summarizes the material parameters for soil materials that are used to analyze the stability of the proposed excavations for the Poor Farm Ditch Conveyance project. The parameter analysis is based on the geotechnical investigations summarized in the reports prepared by:

- Tolunay-Wong Engineers, Inc. (TWEI) and submitted to Freese and Nichols, Inc. in January 2016,
- TWEI and submitted to Harris County Flood Control District in November 2009,
- Aviles Engineering Corporation in June 1994 and provided in the Appendix E of the TWEI, 2009 geotechnical investigation report,
- Atser L.L.C. Engineering and Environmental in January 1997 and provided in the Appendix F of the TWEI, 2009 geotechnical investigation report.

The geotechnical information was collected from the legacy borings B-1, B-2, B-3 and B-4 (by Aviles in 1994), Borings CB-6, CB-7 and CB-8 (by TWEI in 2002), and Boring B-1 (by TWEI in 2016). An excerpt of the boring locations is provided in Figure 1.



Figure 1. Borings in Area of Interest

## 2.0 TEST DATA

Field testing of the subject borings included penetration tests, and laboratory testing included a variety of classification and index testing and shear strength tests. Table 1 summarizes the classification data and Table 2 summarizes the strength data. Results show that most of the soil stratigraphy mainly has Fat Clay (CH) and Lean Clay (CL) with minor intrusions of sandy material (SM/SP-SM).

Table 1. Material Classification Data Summary

Reference Report	Boring No.	Sample Depth	USCS	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Percent Fines
						LL	PL	PI	
TWEI 2016	B-1	0	CH	31	92	54	20	34	83
TWEI 2016	B-1	2	CH	23	101	--	--	--	--
TWEI 2016	B-1	4	CH	22	101	--	--	--	--
TWEI 2016	B-1	6	CH	21	107	--	--	--	--
TWEI 2016	B-1	8	CH	18	114	--	--	--	--
TWEI 2016	B-1	10	CH	18	114	62	21	41	96
TWEI 2016	B-1	12	CH	27	98	--	--	--	--
TWEI 2016	B-1	14	CH	30	95	--	--	--	--
TWEI 2016	B-1	16	CH	29	95	--	--	--	--
TWEI 2016	B-1	18	CH	26	101	64	20	44	98
TWEI 2016	B-1	23	CL	14	118	41	17	24	82
TWEI 2016	B-1	0	CH	31	92	54	20	34	83



Poor Farm Ditch Conveyance

Project Number:

HCF15148

Calculation Title:

**Material Parameter Selection of Soils for  
Excavation Stability Analysis**

Revision Number:

0

Date:

11/03/2016

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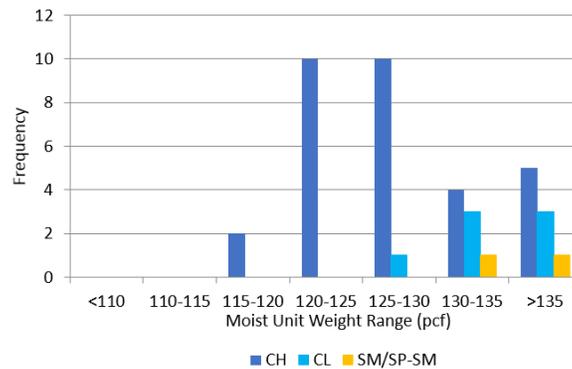
Page 2 of 16

Table 1. Material Classification Data Summary (Continued)

Reference Report	Boring No.	Sample Depth	USCS	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Percent Fines
						LL	PL	PI	
TWEI 2016	B-1	28	CL	17	114	--	--	--	--
TWEI 2009	CB-6	0.5	CH	17	--	--	--	--	--
TWEI 2009	CB-6	2	CH	--	--	--	--	--	--
TWEI 2009	CB-6	4	CH	25	102	71	24	47	--
TWEI 2016	CB-6	6	CH	24	--	--	--	--	85
TWEI 2016	CB-6	8	CH	23	108	--	--	--	--
TWEI 2016	CB-6	10	CH	23	104	--	--	--	--
TWEI 2016	CB-6	12	CH	26	--	69	26	43	98
TWEI 2016	CB-6	14	CH	26	102	--	--	--	--
TWEI 2016	CB-6	16	CH	28	--	--	--	--	--
TWEI 2016	CB-6	18	CH	27	100	--	--	--	--
TWEI 2016	CB-6	24	CL	18	--	34	16	18	85
TWEI 2009	CB-7	1.5	SM	--	--	--	--	--	6
TWEI 2009	CB-7	4	SP-SM	33	--	75	26	49	--
TWEI 2009	CB-7	6	CH	34	92	--	--	--	--
TWEI 2009	CB-7	8	CH	26	94	--	--	--	--
TWEI 2009-Appx. E	B-1	1	CH	31	--	--	--	--	--
TWEI 2009-Appx. E	B-1	3	CH	31	--	67	25	42	--
TWEI 2009-Appx. E	B-1	5	CH	29	98	--	--	--	--
TWEI 2009-Appx. E	B-1	7	CH	34	--	81	29	52	--
TWEI 2009-Appx. E	B-1	8	CH	35	105	--	--	--	--
TWEI 2009-Appx. E	B-1	14	CH	36	93	--	--	--	--
TWEI 2009-Appx. E	B-1	19	CH	29	--	--	--	--	--
TWEI 2009-Appx. E	B-1	24	CH	23	112	69	26	43	--
TWEI 2009-Appx. E	B-2	1	CH	24	--	59	23	36	--
TWEI 2009-Appx. E	B-2	3	CH	31	106	--	--	--	--
TWEI 2009-Appx. E	B-2	5	CH	39	--	84	30	54	--
TWEI 2009-Appx. E	B-2	7	CH	36	--	--	--	--	--
TWEI 2009-Appx. E	B-2	9	CH	28	--	--	--	--	--
TWEI 2009-Appx. E	B-2	14	CH	30	--	69	26	43	--
TWEI 2009-Appx. E	B-2	19	CH	29	113	--	--	--	--
TWEI 2009-Appx. E	B-2	24	CH	22	--	--	--	--	--
TWEI 2009-Appx. E	B-3	1	CH	31	--	--	--	--	--
TWEI 2009-Appx. E	B-3	3	CH	26	106	67	25	42	--
TWEI 2009-Appx. E	B-3	5	CH	31	--	--	--	--	--
TWEI 2009-Appx. E	B-3	7	CH	31	111	--	--	--	--
TWEI 2009-Appx. E	B-3	9	CH	24	--	72	27	45	--
TWEI 2009-Appx. E	B-3	14	CH	21	--	--	--	--	--
TWEI 2009-Appx. E	B-3	19	CH	29	117	66	25	41	--
TWEI 2009-Appx. E	B-3	24	CH	18	--	--	--	--	--
TWEI 2009-Appx. E	B-4	0.5	CH	17	--	--	--	--	--
TWEI 2009-Appx. E	B-4	1.5	CH	20	109	--	--	--	--
TWEI 2009-Appx. E	B-4	2.5	CH	21	--	--	--	--	--
TWEI 2009-Appx. E	B-4	3.5	CH	21	--	--	--	--	--
TWEI 2009-Appx. E	B-4	4.5	CH	20	98	76	28	48	--
TWEI 2009-Appx. E	B-4	5.5	CH	23	--	--	--	--	--
TWEI 2009-Appx. E	B-4	6.5	CH	22	--	--	--	--	--
TWEI 2009-Appx. E	B-4	7.5	CH	23	--	--	--	--	--
TWEI 2009-Appx. E	B-4	8.5	CH	35	--	36	16	20	--
TWEI 2009-Appx. E	B-4	9.5	CH	15	--	--	--	--	--
TWEI 2009-Appx. E	B-4	14	CL	30	113	--	--	--	--
TWEI 2009-Appx. E	B-4	19	CH	24	118	--	--	--	--
TWEI 2009-Appx. E	B-4	24	CH	29	--	65	25	40	--

### 3.0 ANALYSIS OF UNIT WEIGHT

The frequency of measured moist unit weights among the samples are presented in Figure 2 with a histogram. Table 3 summarizes the average and standard deviation of the moist and saturated unit weights for each soil group. The unit weight values are presented in pounds per cubic feet (pcf).



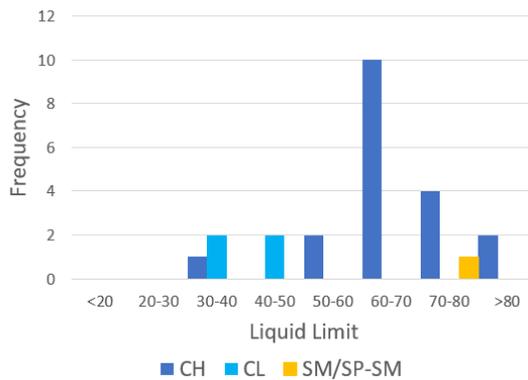
**Figure 2. Moist Unit Weight Histogram**

**Table 2. Unit Weight Summary**

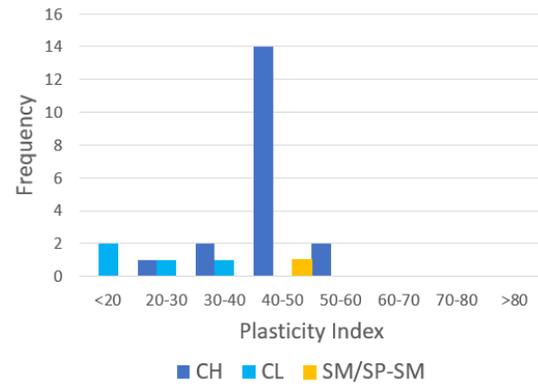
Soil Group	Moist Unit Weight (pcf)		Saturated Unit Weight (pcf)	
	Average	Std. Dev.	Average	Std. Dev.
CH	129	9	130	8
CL	136	5	137	5
SM/SP-SM	136	7	137	6

#### 4.0 ANALYSIS OF SOIL CLASSIFICATION

The frequency of measured liquid limit (LL) and plasticity index (PI) among the soil samples are presented with histograms in **Error! Reference source not found.** and Figure 4, respectively. Table 3 summarizes the average and standard deviation soil classification parameters for each soil group. Figure 5 plots the data for the clays on the USCS plasticity chart. The data plots as generally expected for these soil types.



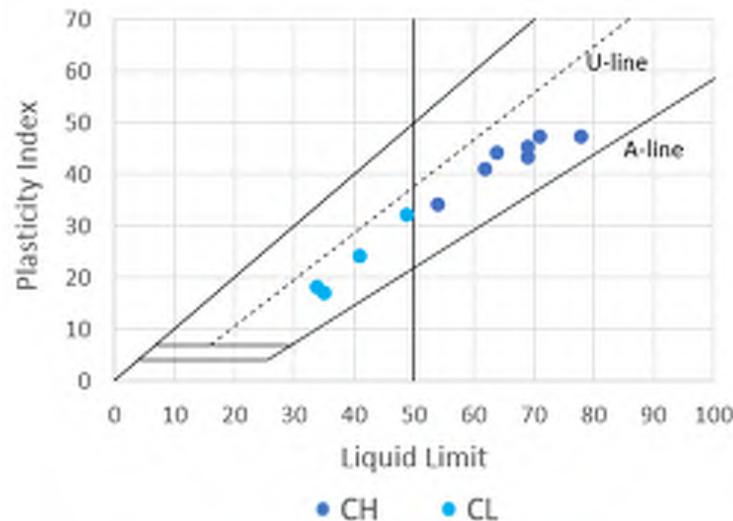
**Figure 3. Liquid Limit Histogram**



**4. Plasticity Index Histogram**

**Table 3. Classification Data Summary**

Soil Group	Liquid Limit		Plasticity Index		%Passing No. 200 Sieve	
	Average	Std. Dev.	Average	Std. Dev.	Average	Std. Dev.
CH	69	10	42	7	93	7
CL	40	7	23	7	80	9
SM/SP-SM	75	NP	26	NP	6	NP



**Figure 5. Plasticity Chart Plot**

**5.0 SHEAR STRENGTH PARAMETERS OF CLAY**
**Consolidated Undrained Tests, Effective and Total Shear Strength Parameters**

The effective and total shear strength parameters for clays were measured by performing the consolidated-undrained (CU) triaxial shear test with pore water pressure measurements. Table 4 summarizes the CU triaxial test results obtained by testing the Fat Clay (CH) sample and presented in the TWEI (2009) geotechnical investigation report. The ranges of the effective and total shear strength parameters presented for the Fat Clay (CH) in the Aviles (1994) and Atser (1997) geotechnical investigation reports are summarized in Table 5.

**Table 4. CU Triaxial Test Summary**

Reference Report	Boring No	Sample Depth (feet)	USCS	LL	PI	%-200	$\phi'$ (deg)	$c'$ (psf)	$\phi_{11}$ (deg)	$c_u$ (psf)
TWEI, 2009	CB-6	10-12	CH	69	43	97.6	19.1	420	25.1	380

**Table 5. Previously Reported Shear Strength Data for Clay**

Reference Report	USCS	Effective Shear Strength		Total Shear Strength	
		$\phi'$ (deg)	$c'$ (psf)	$\phi_{11}$ (deg)	$c_u$ (psf)
Aviles, 1994	CH	0-12	250-500	0	400-900
Atser, 1997	CH	22.6-36.5	200-330	20.3-31.9	110-410

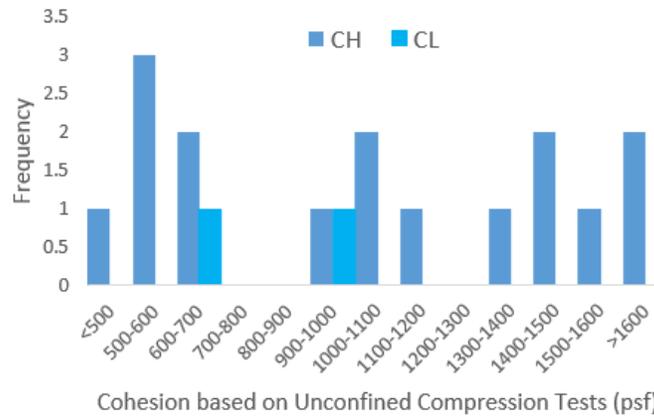
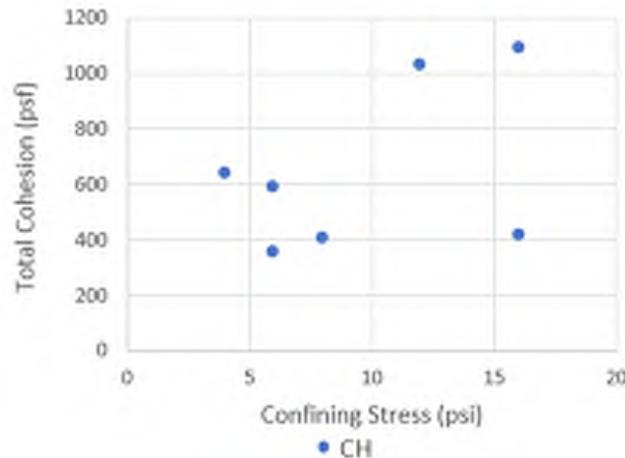
The effective and total shear strength parameters selected as representative of the soil profiles along the Poor Farm Ditch are summarized in Table 6. It is stated that the drained cohesion ( $c'$ ) values were adjusted to account for the effect of weathered conditions in clay (TWEI,2009).

**Table 6. Soil Parameters Selected for Clay Samples (TWEI, 2009)**

Reference Report	Depth (ft)	Description	Moist Unit Weight (pcf)	Effective Shear Strength		Total Shear Strength	
				$\phi'$ (deg)	$c'$ (psf)	$\phi_{uu}$ (deg)	$c_{uu}$ (psf)
TWEI, 2009	0-2	Fat Clay (CH), Fill	127	22.1	120	0	1200
TWEI, 2009	2-16	Fat Clay (CH)	126	19.5	40	0	700
TWEI, 2009	16-20	Lean Clay (CL)	134	25.1	75	0	1000
TWEI, 2009	Below 20	Fat Clay (CH),	126	25.1	380	0	1000

**Unconsolidated Undrained Tests and Unconfined Compression Tests, Total Shear Strength Parameters**

The undrained cohesion values were measured by the unconsolidated-undrained (UU) triaxial tests and the unconfined compression tests. Figure 6 shows the frequency of the cohesion values calculated from the unconfined compression tests for the Fat Clay (CH) and the Lean Clay (CL). The UU triaxial test results for the Fat Clay (CH) are presented in terms of confining stress and the total cohesion in Figure 7. Test results show that the cohesion of the soil along the channel (CH) varies between 380 psf to 1100 psf for unconsolidated undrained conditions.


**Figure 6. Histogram of Cohesion from Unconfined Compression Tests**

**Figure 7. UU Triaxial Test Results for the Fat Clay (CH)**

## 6.0 PARAMETER ANALYSIS SUMMARY

Based on the above analysis, the recommended unit weight and strength parameters for the Fat Clay (CH) and the Lean Clay (CL) to analyze the stability of temporary excavation of the Poor Farm Ditch are summarized in Table 7.

**Table 7. Summary of Analysis Parameters**

Material Type	Unit Weight (pcf)		Drained		Undrained	
	Moist	Saturated	$\phi'$ (deg)	$c'$ (psf)	$\phi_u$ (deg)	$c_u$ (psf)
Fat Clay (CH)	125	129	20	300	0	700
Lean Clay (CL)	125	134	20	250	0	1000

A backfill material is considered in the excavation stability analysis assuming the backfill will be formed at site by mixing the in-situ soil with leaner material. The shear strength parameters for the backfill material are assumed by slightly adjusting the shear strength parameters of the Fat Clay (CH). The selected parameters for the backfill material for the excavation stability analysis are summarized in Table 8.

**Table 8. Assigned Shear Strength Parameters for the Backfill Material**

Soil	Effective Shear Strength		Total Shear Strength	
	$\phi'$ (deg)	$c'$ (psf)	$\phi_u$ (deg)	$c_u$ (psf)
Backfill Material	25	300	0	500

## 7.0 REFERENCES

Atser L.L.C. Engineering and Environmental, (1997), File No. 26-3454-24.

Aviles Engineering Corporation, (1994), Report No. 228-94.

Tolunay-Wong Engineers, Inc., (20016). "Geotechnical Study Proposed Improvements to Poor Farm Ditch from University Boulevard to Bellaire Harris County, Texas", Project No. 15.13.139, Houston, Texas.

Tolunay-Wong Engineers, Inc., (2009). "Geotechnical Evaluation Poor Farm Ditch (HCFCD D111-00-00) Kilmarnock (HCFCD D113-00-00) Channel Improvements, Cities of Houston, West University, Southside Place and Bellaire, Texas", Project No. 02-665, Houston, Texas.

ATTACHMENT A. SOIL BORING LOGS

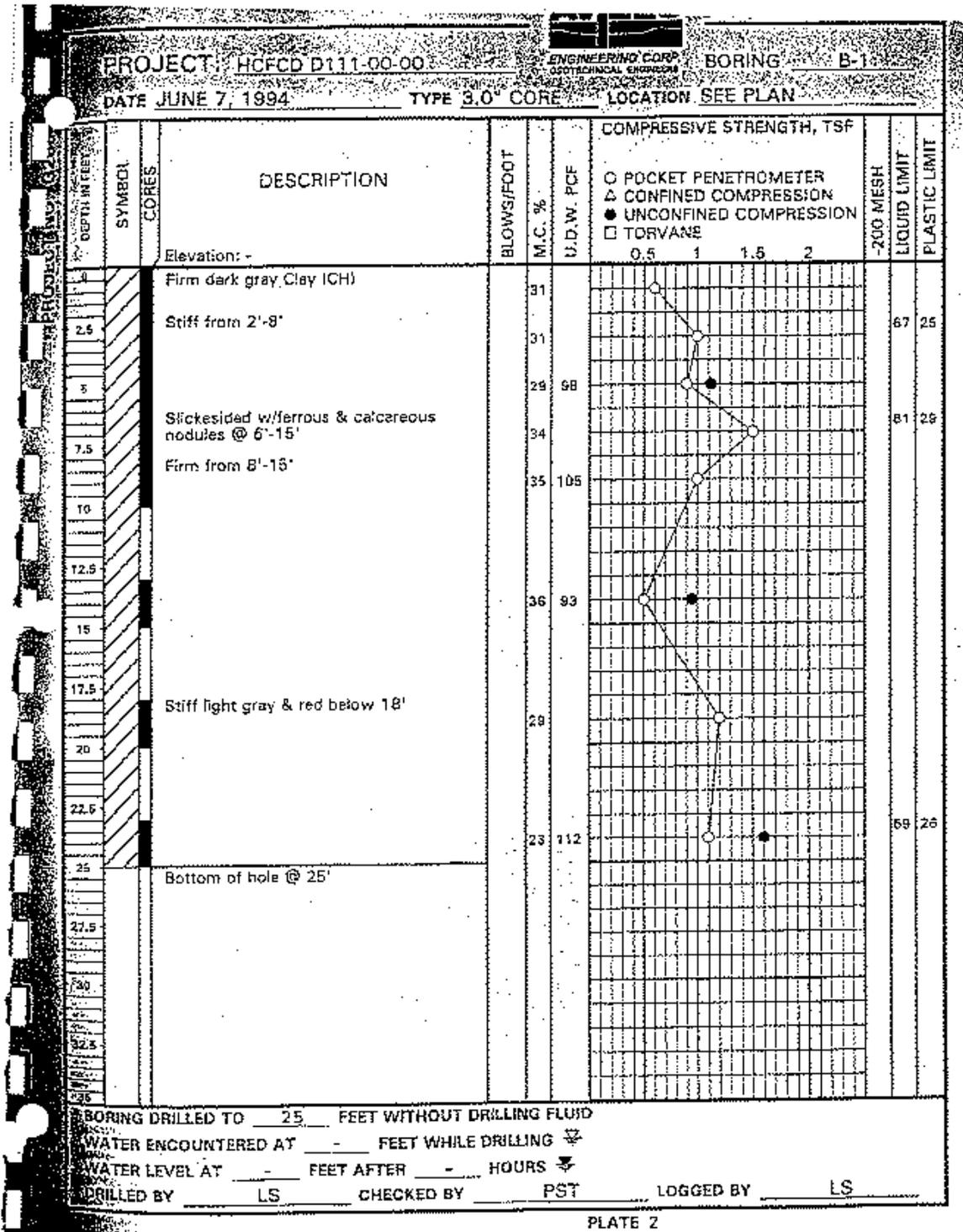


Figure A.1. Log of Boring B-1 by Aviles (1994)

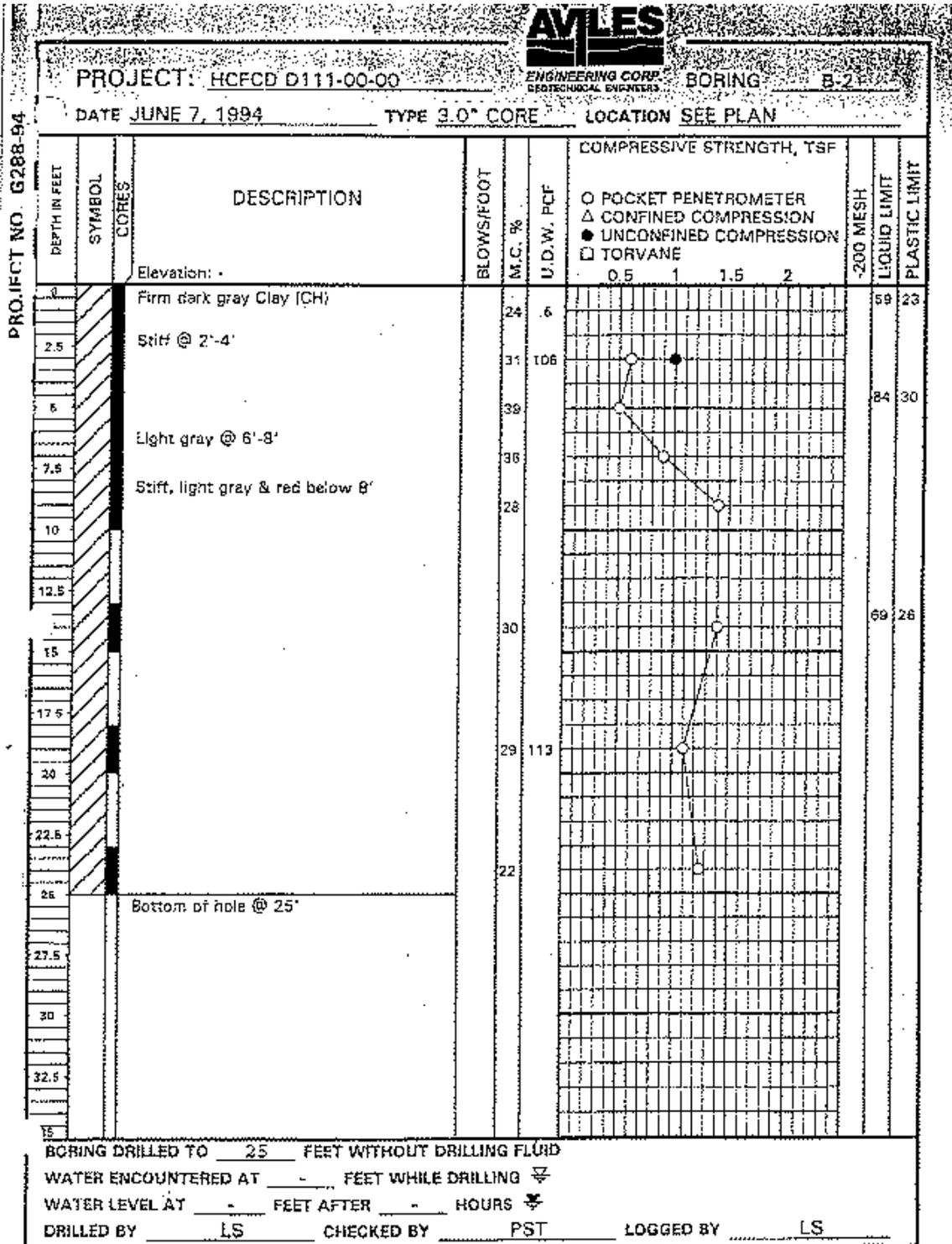


PLATE 3

Figure A.2. Log of Boring B-2 by Aviles (1994)

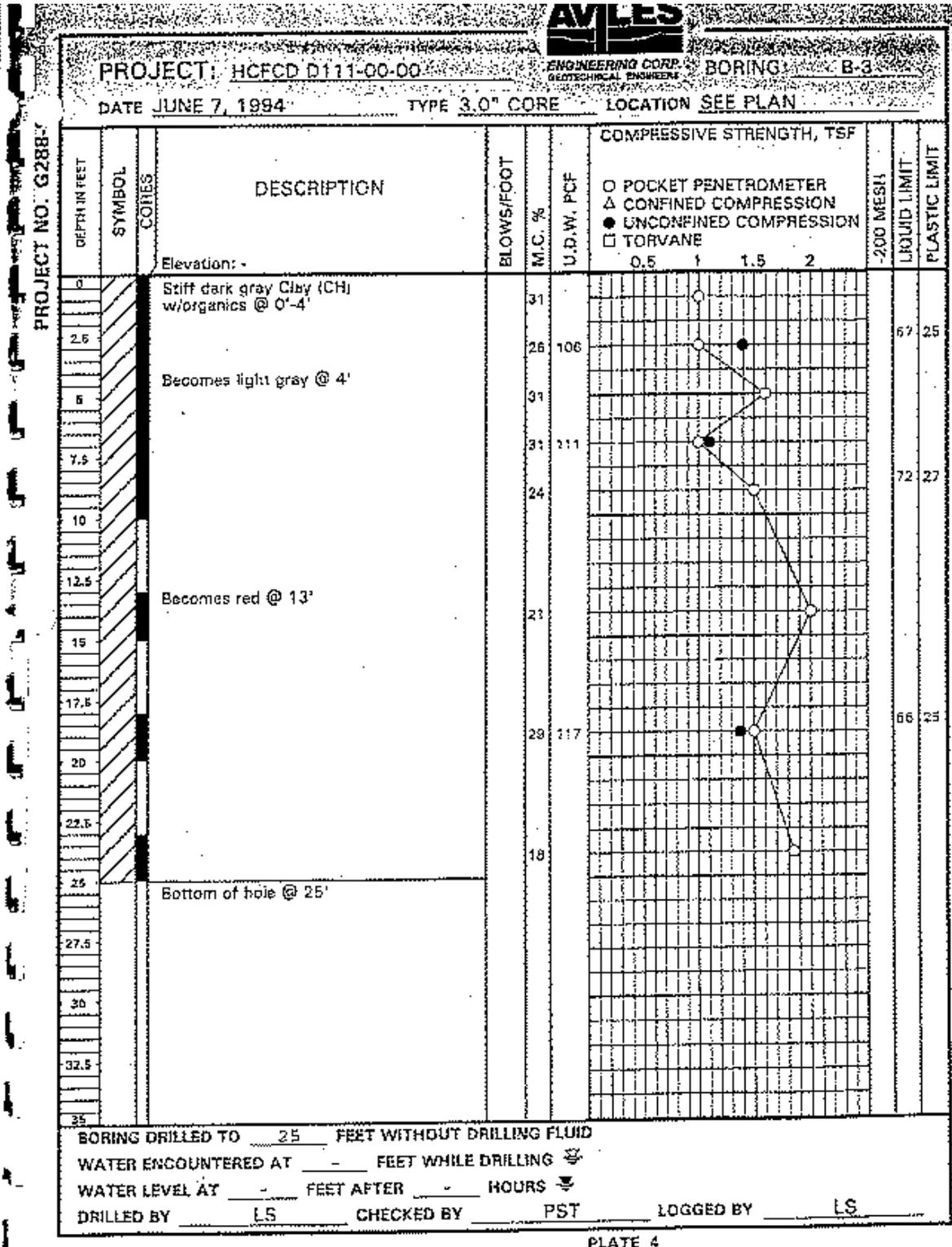


Figure A.3. Log of Boring B-3 by Aviles (1994)



**Material Parameter Selection of Soils for  
Excavation Stability Analysis**

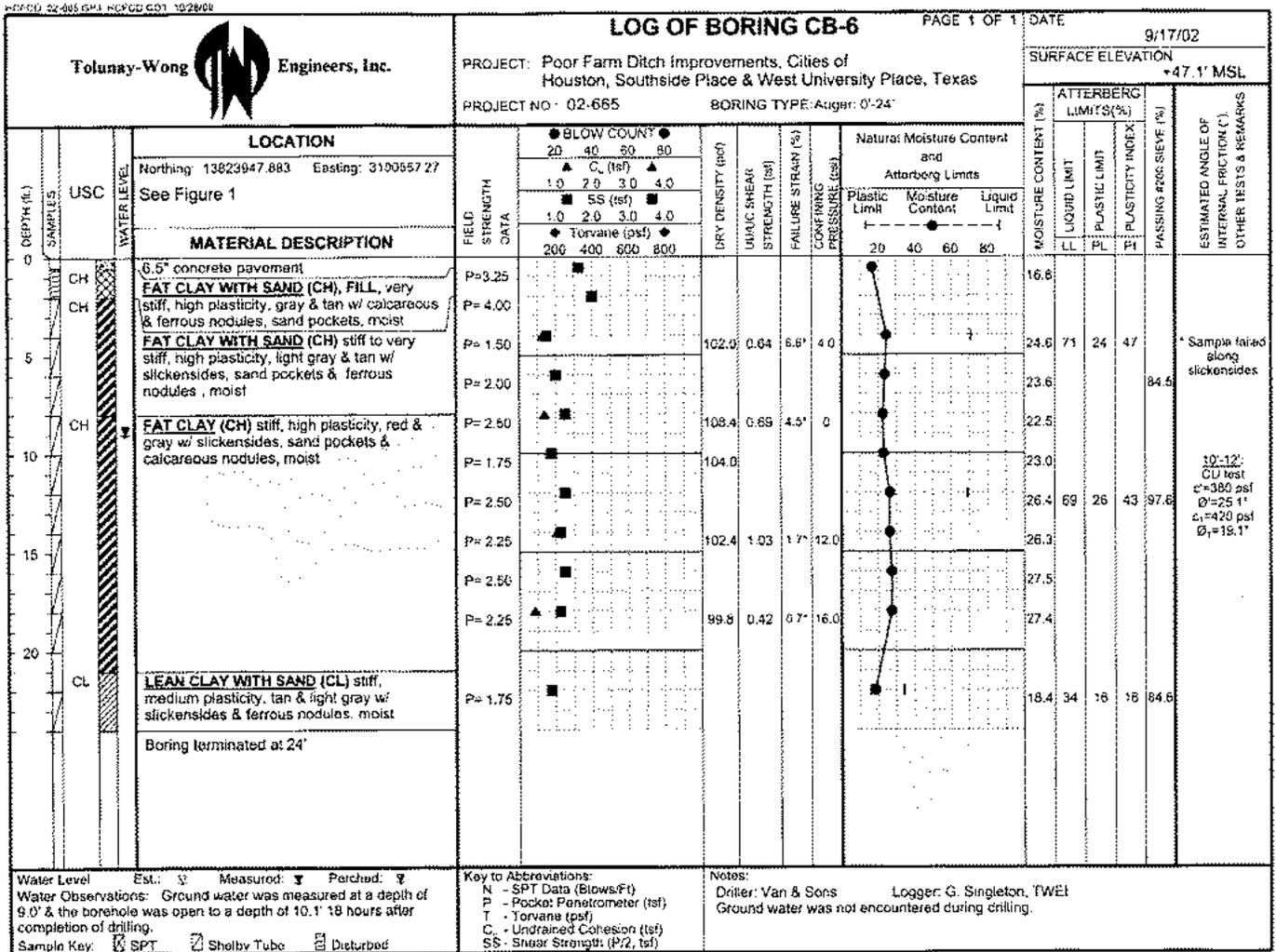


Figure A.5. Log of Boring CB-6 by TWEI (2002)

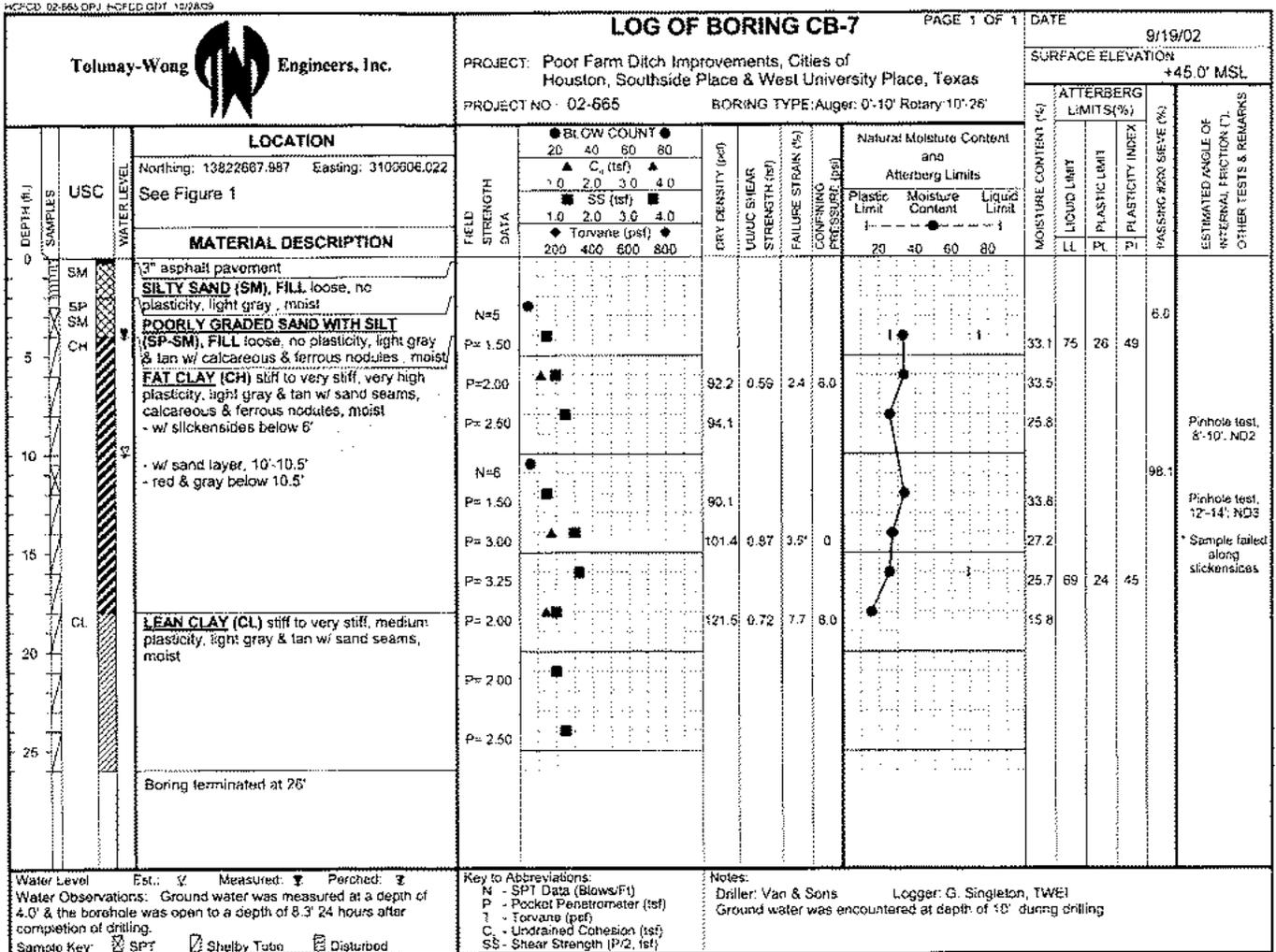


Figure A.6. Log of Boring CB-7 by TWEI (2002)

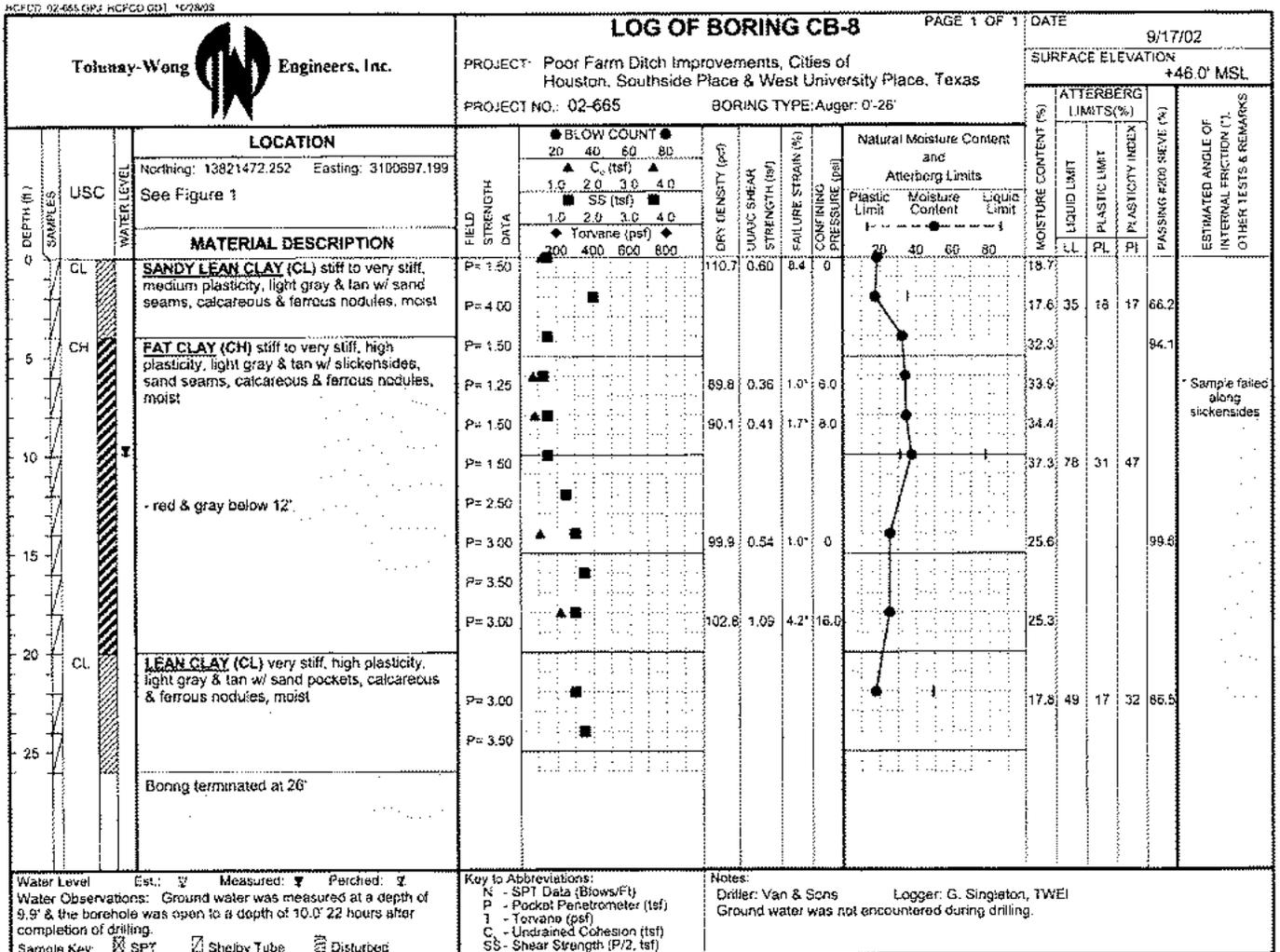


Figure A.7. Log of Boring CB-8 by TWEI (2002)

HFCO 15.13.139.62 HFCO.02F.10132

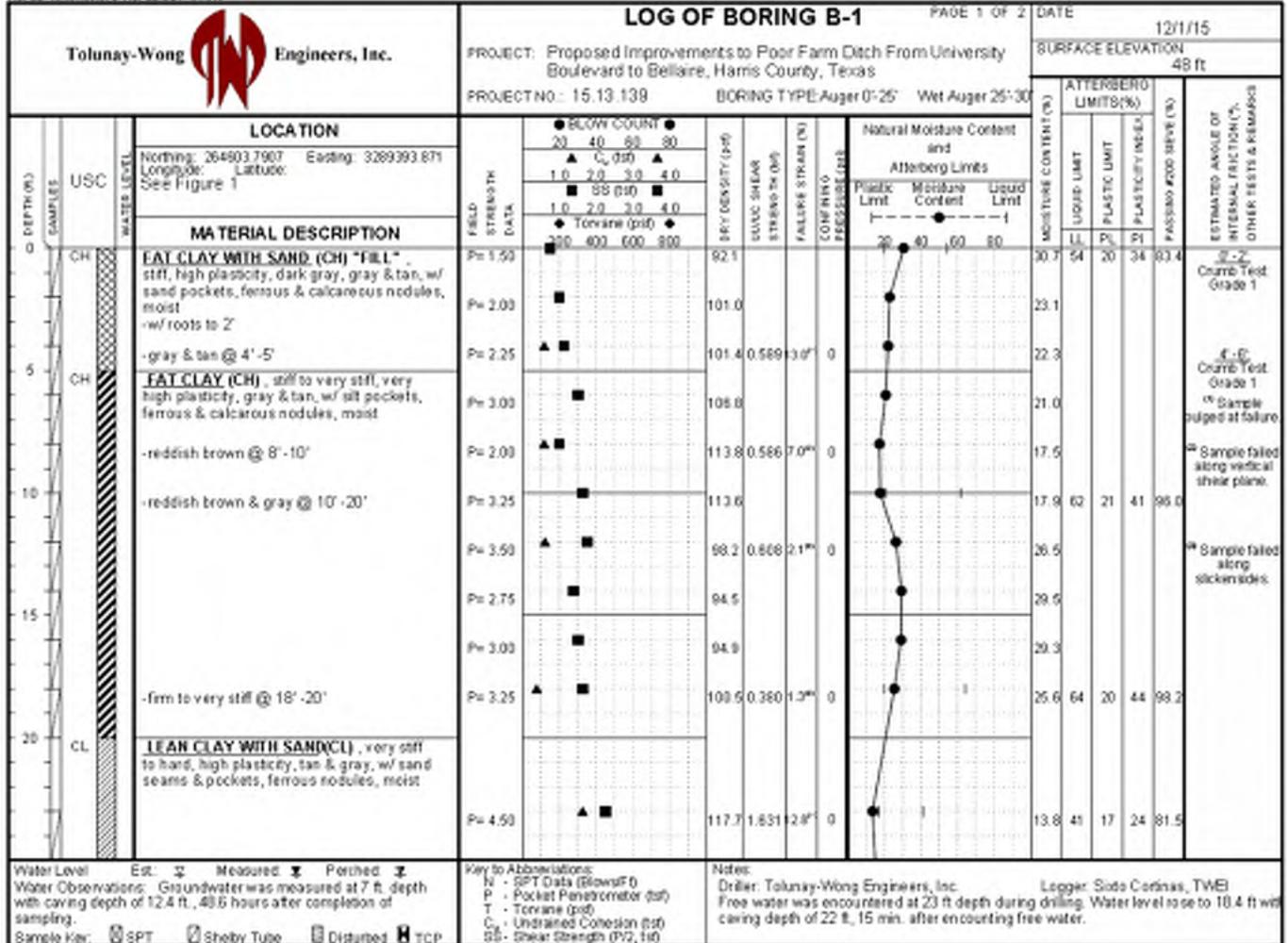


Figure A.8. Log of Boring B-1 by TWEI (2016)



Poor Farm Ditch Conveyance

Project Number:  
**HCF15148**

Calculation Title:

**Material Parameter Selection of Soils for  
Excavation Stability Analysis**

Revision Number:  
**0**

Date:  
**11/03/2016**

Page: **Page 16 of 16**

HCF15148-02-01-01 HCF15148-02-01-01

Tolanay-Wong Engineers, Inc.		LOG OF BORING B-1				DATE: 12/1/15		
PROJECT: Proposed Improvements to Poor Farm Ditch From University Boulevard to Bellaire, Harris County, Texas		PROJECT NO.: 15.13.139 BORING TYPE: Auger 0'-25" Wet Auger 25'-30"				SURFACE ELEVATION: 48 ft		
DEPTH (ft) SAMPLES	USC	FIELD STRENGTH DATA	DRY DENSITY (pcf)	LIQUID SHEAR STRENGTH (kN)	FAILURE STRAIN (%)	NATURAL MOISTURE CONTENT AND ATTERBERG LIMITS	ATTERBERG LIMITS (%)	
	WATER LEVEL							MOISTURE CONTENT (%)
<b>LOCATION</b> Northing: 264603.7907 Easting: 3269393.871 Longitude: See Figure 1 Latitude:		● BLOW COUNT ● 20 40 60 80 ▲ C <sub>u</sub> (psf) ▲ 1.0 2.0 3.0 4.0 ■ SS (psf) ■ 1.0 2.0 3.0 4.0 ◆ Torvane (psf) ◆ 200 400 600 800				Plastic Limit Liquid Limit Shrinkage Limit Plasticity Index		
<b>MATERIAL DESCRIPTION</b> LEAN CLAY WITH SAND (CL) - very stiff to hard, high plasticity, tan & gray, w/ sand seams & pockets, ferrous nodules, moist (continued) Boring terminated @ 30 ft		P= 4.50	113.5	1.590	8.8%	0	17.3	
Water Level Est. <input type="checkbox"/> Measured <input checked="" type="checkbox"/> Perched <input type="checkbox"/> Water Observations: Groundwater was measured at 7 ft. depth with casing depth of 12.4 ft., 48 hours after completion of sampling. Sample Key: <input checked="" type="checkbox"/> SPT <input type="checkbox"/> Shelby Tube <input type="checkbox"/> Disturbed <input checked="" type="checkbox"/> TCP		<b>Key to Abbreviations:</b> N - SPT Data (Blows/ft) P - Pocket Penetrometer (psf) T - Torvane (psf) C <sub>u</sub> - Undrained Cohesion (psf) SS - Shear Strength (T/2, ft)		<b>Notes:</b> Driller: Tolanay-Wong Engineers, Inc. Logger: Sidsa Cortinas, TWEI Free water was encountered at 23 ft depth during drilling. Water level rose to 18.4 ft with casing depth of 22 ft, 15 min. after encountering free water.				

Figure A.9. Log of Boring B-1 by TWEI (2016) (continued)

## **APPENDIX D: DESIGN EXHIBITS**

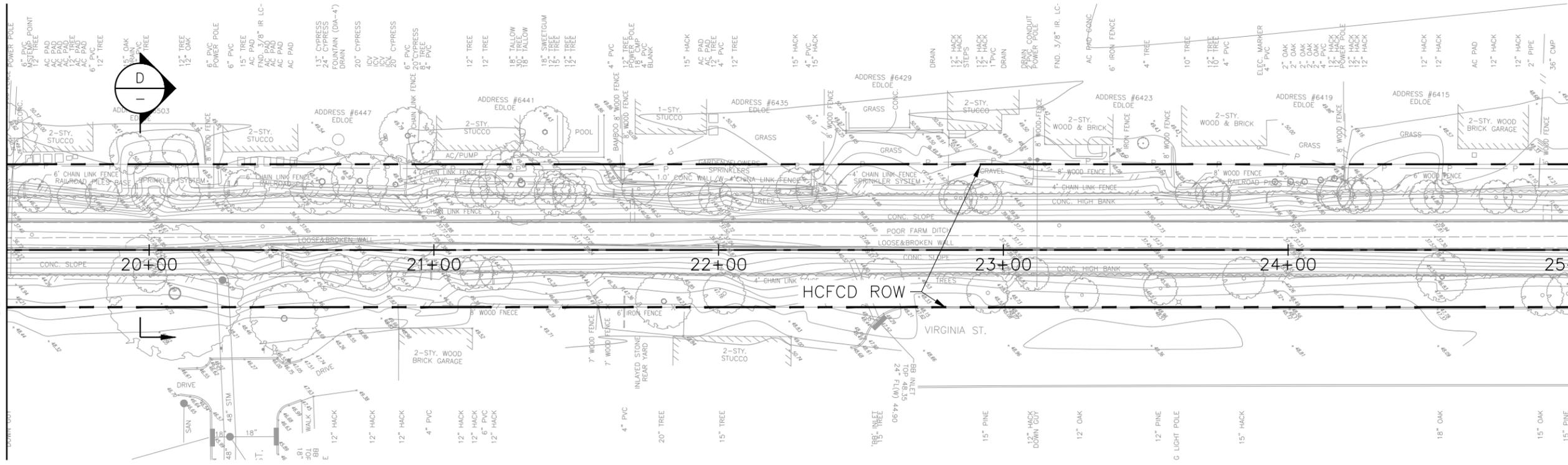




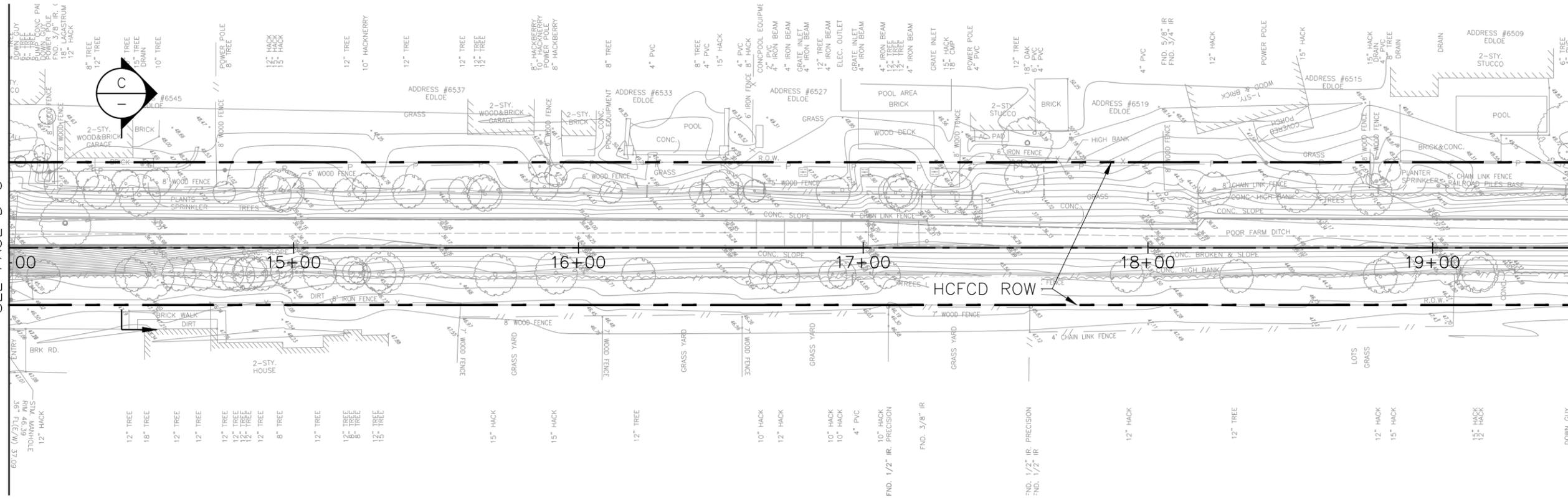


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SEE PAGE D-4

MATCH LINE STA 14+00  
SEE PAGE D-3



MATCH LINE STA 25+00  
SEE PAGE D-5



MATCH LINE STA 19+50  
SEE PAGE D-4

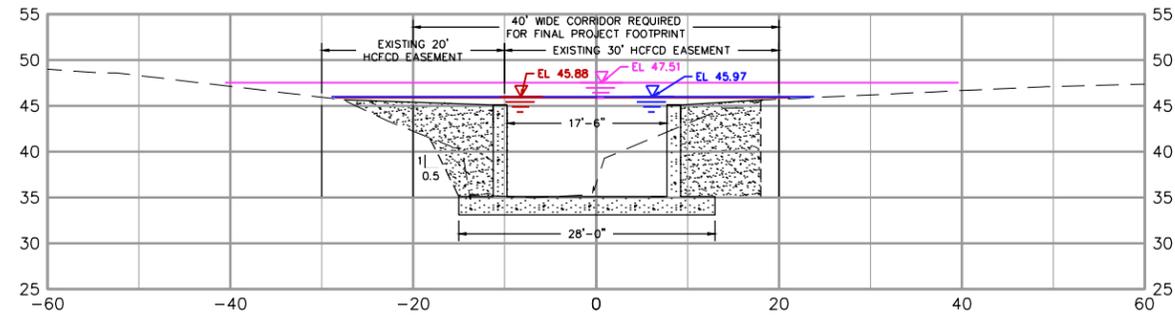
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DESCRIPTION	REV		
APPENDIX D			
POOR FARM DITCH IMPROVEMENTS			
HARRIS COUNTY FLOOD CONTROL			
EXISTING PLAN AND PROFILE			
PREPARED:			
CHECKED:			
APPROVED:			
		10497 Town and Country Way, Suite 600 Houston, Texas 77024 Phone - (713) 600-6600 Fax - (713) 600-6601	
		9900 Northwest Freeway Houston, Texas 77092	
DATE: DECEMBER 2016			
SCALE: AS SHOWN			
PAGE			
D-4			

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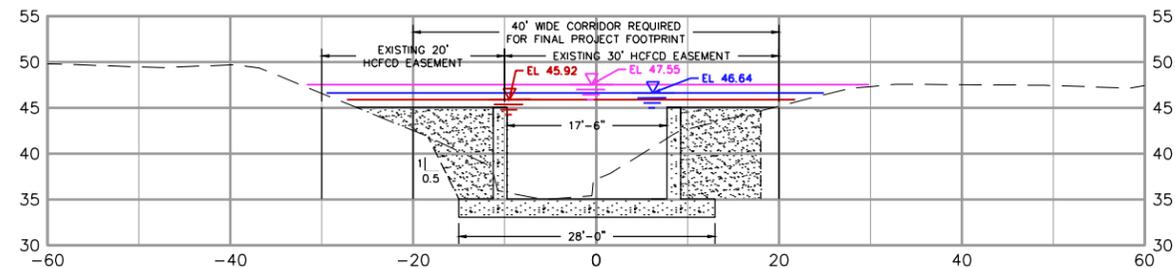




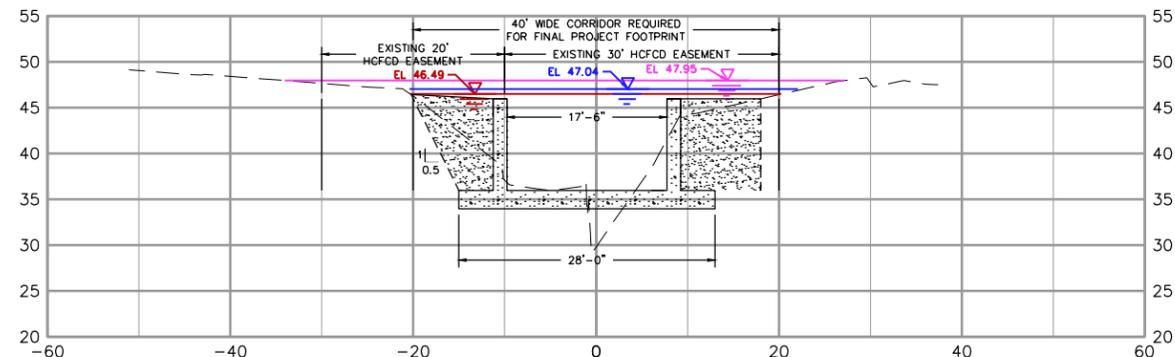




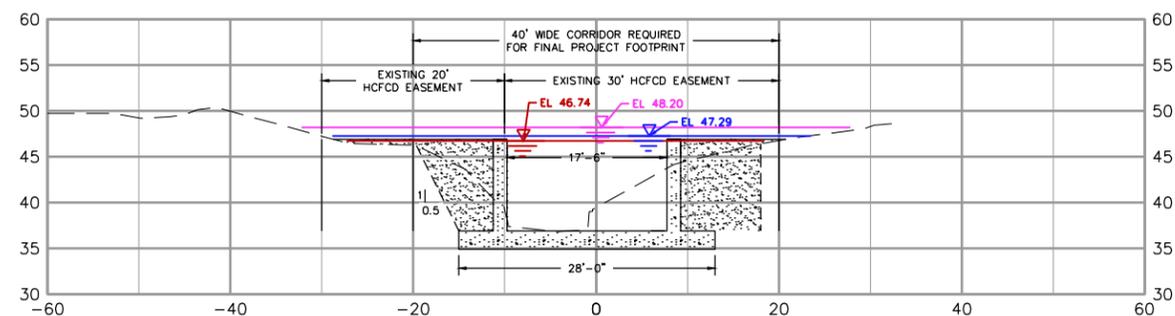
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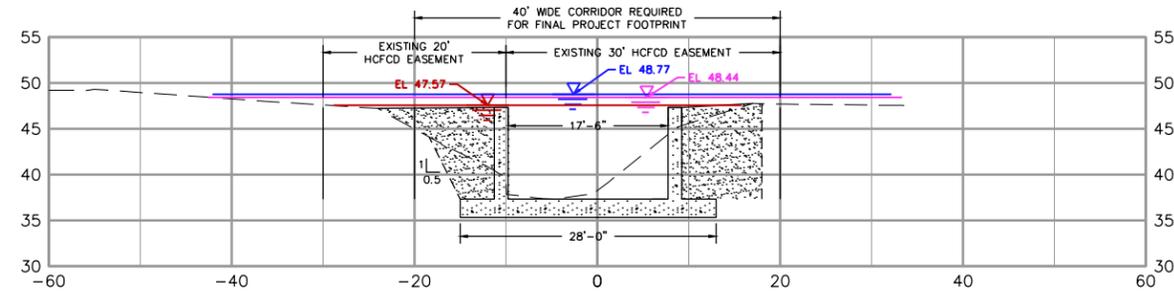
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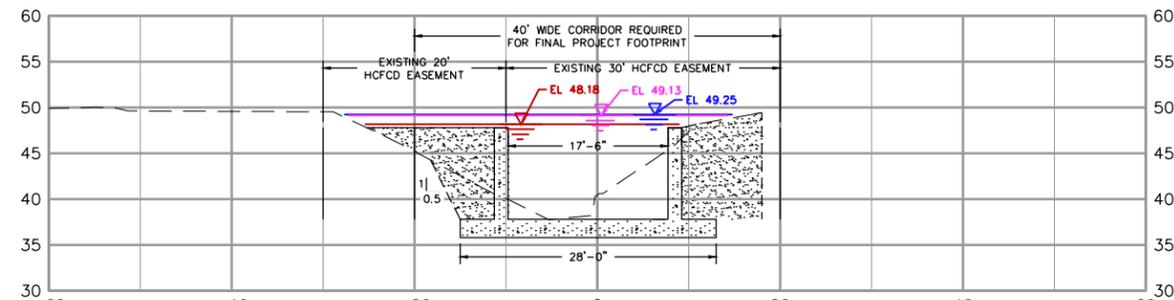
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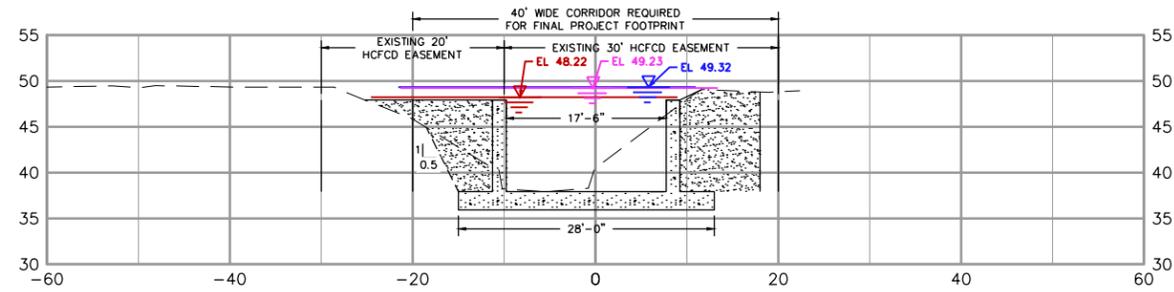
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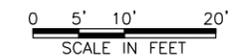
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LEGEND

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- CORRECTED EFFECTIVE MODEL (100-YR)
- PROPOSED WSEL (100-YR)

NOTE:

1. SOIL NAIL AND SHEET PILES NOT SHOWN FOR CLARITY. REFERENCE D-1 AND ANALYSIS INCLUDED IN PER.
2. CROSS SECTIONS ARE LOOKING UPSTREAM.



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REV	DESCRIPTION	DATE	APPR

APPENDIX D  
 POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
 ALTERNATIVE 2C CROSS SECTIONS

PREPARED:  
 CHECKED:  
 APPROVED:

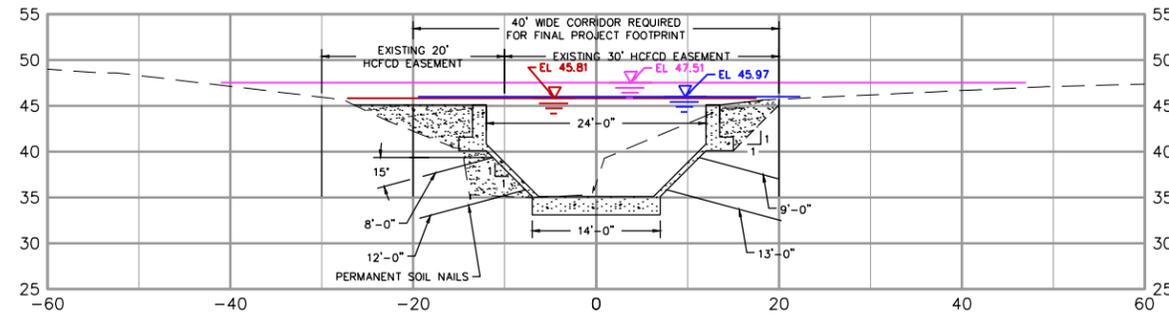
**FRESE & NICHOLS**  
 10497 Town and Country Way,  
 Suite 600  
 Houston, Texas 77024  
 Phone - (713) 600-6800  
 Fax - (713) 600-6801

**HARRIS COUNTY FLOOD CONTROL DISTRICT**  
 9900 Northwest Freeway  
 Houston, Texas 77092

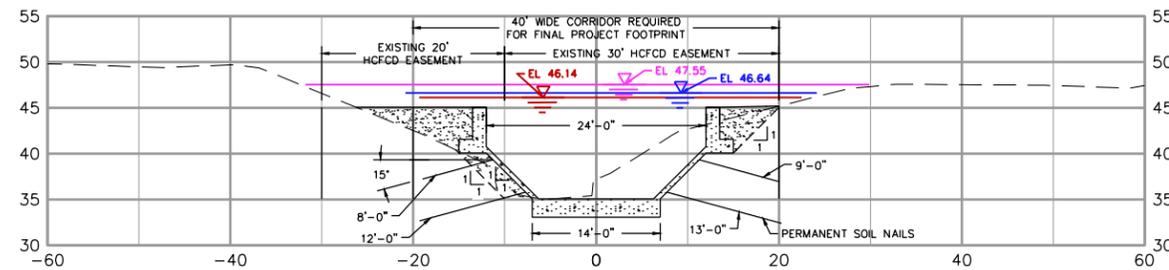
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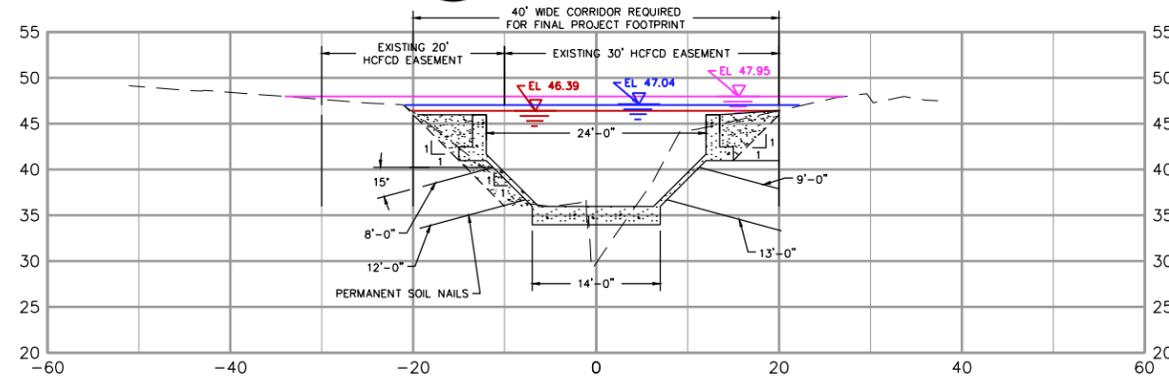




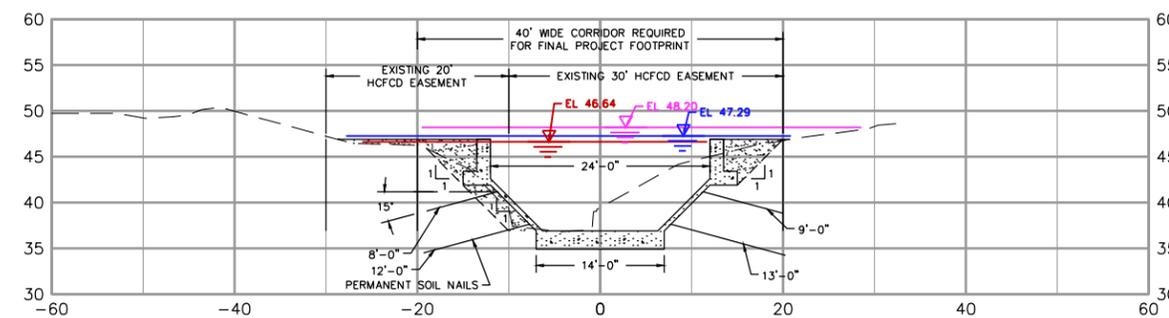
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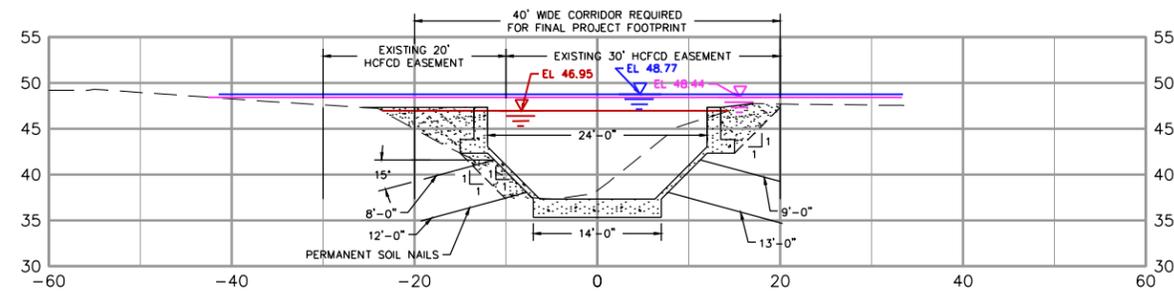
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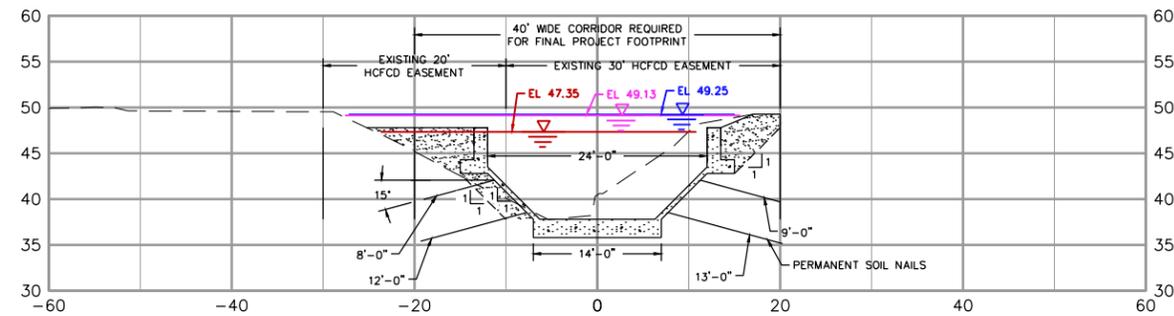
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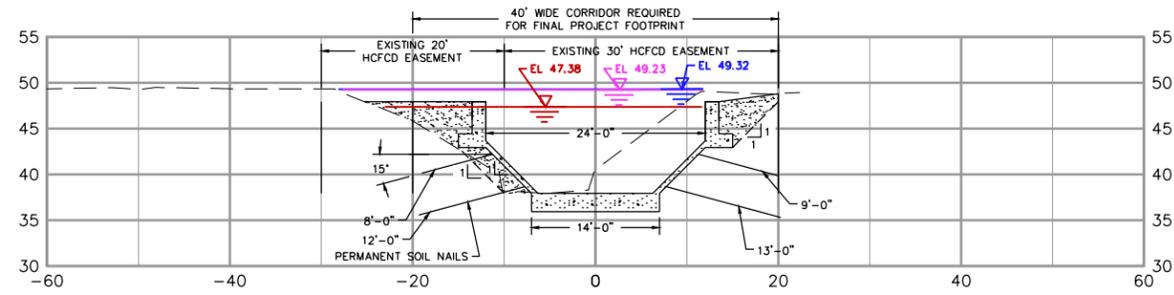
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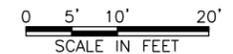
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LEGEND

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- CORRECTED EFFECTIVE MODEL (100-YR)
- PROPOSED WSEL (100-YR)

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REV	DESCRIPTION	DATE	APPR

APPENDIX D  
 POOR FARM DITCH IMPROVEMENTS  
 HARRIS COUNTY FLOOD CONTROL  
 ALTERNATIVE 3B CROSS SECTIONS

PREPARED:  
 CHECKED:  
 APPROVED:

**FRESE & NICHOLS**  
 10497 Town and Country Way,  
 Suite 600  
 Houston, Texas 77024  
 Phone - (713) 600-6800  
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**HARRIS COUNTY FLOOD CONTROL DISTRICT**  
 9900 Northwest Freeway  
 Houston, Texas 77092

DATE: DECEMBER 2016  
 SCALE: AS SHOWN

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User: 02462  
 [HCF15148] IN: STANDARD\HCFCD BORDER GENERAL.DWG LAYOUT: Model  
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## **APPENDIX E: STORMWATER ANALYSIS**

XS	10 Year WSE									Corrected Effective-Effective	WSE Difference from Corrected Effective						
	Effective	Corrected Effective	Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B		Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B
12411.01	48.63	48.81	50.36	51.51	48.48	48.48	48.36	48.34	48.35	0.18	1.55	2.70	-0.33	-0.33	-0.45	-0.47	-0.46
12357.62	48.61	48.79	50.36	51.50	48.46	48.45	48.33	48.31	48.32	0.18	1.57	2.71	-0.33	-0.34	-0.46	-0.48	-0.47
12215.95	48.59	48.77	50.35	51.49	48.43	48.43	48.30	48.28	48.29	0.18	1.58	2.72	-0.34	-0.34	-0.47	-0.49	-0.48
12173.38	48.57	48.76	50.34	51.48	48.42	48.41	48.29	48.27	48.28	0.19	1.58	2.72	-0.34	-0.35	-0.47	-0.49	-0.48
11661.96	48.35	48.56	50.27	51.45	48.17	48.16	48.01	47.98	48.00	0.21	1.71	2.89	-0.39	-0.40	-0.55	-0.58	-0.56
11626.6	48.34	48.55	50.26	51.44	48.15	48.15	48.00	47.98	47.99	0.21	1.71	2.89	-0.40	-0.40	-0.55	-0.57	-0.56
11600	Bridge Sunset Boulevard									Bridge Sunset Boulevard							
11574.81	48.28	48.53	50.11	51.41	48.09	48.08	47.93	47.90	47.92	0.25	1.58	2.88	-0.44	-0.45	-0.60	-0.63	-0.61
11466.71	48.25	48.51	50.10	51.39	48.06	48.06	47.91	47.87	47.89	0.26	1.59	2.88	-0.45	-0.45	-0.60	-0.64	-0.62
10989.81	48.00	48.29	50.06	51.38	47.76	47.75	47.56	47.51	47.53	0.29	1.77	3.09	-0.53	-0.54	-0.73	-0.78	-0.76
10924.99	47.98	48.28	50.01	51.37	47.74	47.74	47.54	47.49	47.52	0.30	1.73	3.09	-0.54	-0.54	-0.74	-0.79	-0.76
10900	Bridge Walkway									Bridge Walkway							
10871.51	47.96	48.26	49.97	51.30	47.71	47.70	47.51	47.35	47.38	0.30	1.71	3.04	-0.55	-0.56	-0.75	-0.91	-0.88
10748.91	47.93	48.24	49.98	51.28	47.68	47.67	47.47	47.31	47.33	0.31	1.74	3.04	-0.56	-0.57	-0.77	-0.93	-0.91
10561.45	47.90	48.22	49.99	51.29	47.64	47.63	47.43	47.26	47.29	0.32	1.77	3.07	-0.58	-0.59	-0.79	-0.96	-0.93
10511.71	47.94	48.25	50.00	51.29	47.69	47.68	47.48	47.31	47.34	0.31	1.75	3.04	-0.56	-0.57	-0.77	-0.94	-0.91
10500	Bridge Walkway									Bridge Walkway							
10463.42	47.78	48.12	49.91	51.26	47.51	47.50	47.28	47.10	47.13	0.34	1.79	3.14	-0.61	-0.62	-0.84	-1.02	-0.99
10368.23	47.62	47.99	49.89	51.27	47.32	47.31	47.06	46.84	46.88	0.37	1.90	3.28	-0.67	-0.68	-0.93	-1.15	-1.11
10280.76	47.59	47.97	49.87	51.23	47.27	47.26	46.99	46.76	46.80	0.38	1.90	3.26	-0.70	-0.71	-0.98	-1.21	-1.17
10225.63	47.58	47.96	49.83	51.21	47.25	47.24	46.97	46.73	46.77	0.38	1.87	3.25	-0.71	-0.72	-0.99	-1.23	-1.19
10200	Bridge Walkway									Bridge Walkway							
10164.78	47.55	47.93	49.82	51.20	47.21	47.10	46.82	46.56	46.60	0.38	1.89	3.27	-0.72	-0.83	-1.11	-1.37	-1.33
10069.75	47.53	47.92	49.83	51.20	47.17	47.05	46.76	46.51	46.54	0.39	1.91	3.28	-0.75	-0.87	-1.16	-1.41	-1.38
9511.942	47.10	47.58	49.75	51.19	46.62	46.44	45.97	45.53	45.58	0.48	2.17	3.61	-0.96	-1.14	-1.61	-2.05	-2.00
9463.775	47.03	47.53	49.75	51.19	46.54	46.37	45.90	45.46	45.51	0.50	2.22	3.66	-0.99	-1.16	-1.63	-2.07	-2.02
9450	Bridge Rice Boulevard									Bridge Rice Boulevard							
9411.652	47.00	47.52	49.70	51.17	46.43	46.25	45.76	45.27	45.33	0.52	2.18	3.65	-1.09	-1.27	-1.76	-2.25	-2.19
9307.397	46.95	47.48	49.69	51.17	46.37	46.18	45.63	44.46	44.98	0.53	2.21	3.69	-1.11	-1.30	-1.85	-2.32	-2.50
8805.521	46.87	47.34	49.64	51.17	46.34	46.16	45.60	44.32	44.91	0.47	2.30	3.83	-1.00	-1.18	-1.74	-2.32	-2.43
8752.369	46.90	47.36	49.63	51.16	46.37	46.19	45.65	44.42	44.98	0.46	2.27	3.80	-0.99	-1.17	-1.71	-2.24	-2.38
8677	Bridge University Boulevard									Bridge University Boulevard							
8674.259	46.88	47.24	49.65	51.16	46.27	46.09	45.53	44.23	44.83	0.36	2.41	3.92	-0.97	-1.15	-1.71	-2.31	-2.41
8645.981	46.88	47.19	49.61	51.12	46.20	46.01	45.44	44.08	44.72	0.31	2.42	3.93	-0.99	-1.18	-1.75	-2.31	-2.47
8523.372	46.72	46.99	49.32	50.97	45.74	45.57	45.11	44.07	44.52	0.27	2.33	3.98	-1.25	-1.42	-1.88	-2.42	-2.47
8421.371	46.58	46.97	49.22	50.80	45.70	45.54	45.07	44.05	44.49	0.39	2.25	3.83	-1.27	-1.43	-1.90	-2.42	-2.48
7730.22	45.66	46.57	48.51	50.03	45.04	44.91	44.54	43.79	44.09	0.91	1.94	3.46	-1.53	-1.66	-2.03	-2.78	-2.48
6656.935	44.79	44.81	46.60	47.87	43.85	43.79	43.70	43.48	43.57	0.02	1.79	3.06	-0.96	-1.02	-1.11	-1.33	-1.24
5717.684	44.04	44.01	42.93	42.91	42.96	42.98	43.15	43.32	43.30	-0.03	-1.08	-1.10	-1.05	-1.03	-0.86	-0.69	-0.71
5619.191	43.96	43.13	43.18	43.25	43.14	43.14	43.19	43.21	43.13	-0.83	0.05	0.12	0.01	0.01	0.06	0.08	0.00
5588.431	43.94	43.20	43.23	43.27	43.20	43.20	43.23	43.25	43.20	-0.74	0.03	0.07	0.01	0.01	0.04	0.05	0.00
5540.284	43.73	43.30	43.30	43.30	43.30	43.30	43.30	43.30	43.30	-0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5430	Bridge Bellaire Boulevard									Bridge Bellaire Boulevard							
5426.389	42.98	43.19	43.19	43.19	43.19	43.19	43.19	43.19	43.19	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5414.522	43.00	43.18	43.18	43.18	43.18	43.18	43.18	43.18	43.18	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5319.974	43.16	43.16	43.16	43.16	43.16	43.16	43.16	43.16	43.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Absolute Decrease in WSE  
 Absolute Increase in WSE  
 Increase and Decrease in WSE  
 Interpolated Result

Proposed Typical Section

XS	50 Year WSE									Corrected Effective-Effective	WSE Difference from Corrected Effective						
	Effective	Corrected Effective	Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B		Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B
12411.01	50.59	50.60	51.84	52.59	50.55	50.45	50.02	49.68	49.82	0.01	1.24	1.99	-0.05	-0.15	-0.58	-0.92	-0.78
12357.62	50.57	50.58	51.83	52.54	50.53	50.43	50.00	49.65	49.80	0.01	1.25	1.96	-0.05	-0.15	-0.58	-0.93	-0.78
12215.95	50.55	50.56	51.83	52.54	50.52	50.41	49.97	49.62	49.77	0.01	1.27	1.98	-0.04	-0.15	-0.59	-0.94	-0.79
12173.38	50.54	50.55	51.81	52.53	50.50	50.40	49.96	49.60	49.75	0.01	1.26	1.98	-0.05	-0.15	-0.59	-0.95	-0.80
11661.96	50.39	50.40	51.74	52.47	50.35	50.23	49.75	49.34	49.52	0.01	1.34	2.07	-0.05	-0.17	-0.65	-1.06	-0.88
11626.6	50.38	50.39	51.72	52.51	50.34	50.23	49.75	49.34	49.51	0.01	1.33	2.12	-0.05	-0.16	-0.64	-1.05	-0.88
11600	Bridge Sunset Boulevard									Bridge Sunset Boulevard							
11574.81	50.06	50.07	51.72	52.36	50.02	49.91	49.61	49.09	49.24	0.01	1.65	2.29	-0.05	-0.16	-0.46	-0.98	-0.83
11466.71	50.05	50.06	51.69	52.33	50.01	49.89	49.59	49.06	49.22	0.01	1.63	2.27	-0.05	-0.17	-0.47	-1.00	-0.84
10989.81	49.93	49.94	51.68	52.34	49.87	49.74	49.34	48.70	48.90	0.01	1.74	2.40	-0.07	-0.20	-0.60	-1.24	-1.04
10924.99	49.84	49.86	51.68	52.33	49.80	49.68	49.32	48.68	48.88	0.02	1.82	2.47	-0.06	-0.18	-0.54	-1.18	-0.98
10900	Bridge Walkway									Bridge Walkway							
10871.51	49.77	49.78	51.52	52.33	49.73	49.61	49.30	48.64	48.86	0.01	1.74	2.55	-0.05	-0.17	-0.48	-1.14	-0.92
10748.91	49.77	49.78	51.47	52.32	49.73	49.61	49.29	48.61	48.83	0.01	1.69	2.54	-0.05	-0.17	-0.49	-1.17	-0.95
10561.45	49.78	49.79	51.51	52.32	49.74	49.60	49.28	48.57	48.81	0.01	1.72	2.53	-0.05	-0.19	-0.51	-1.22	-0.98
10511.71	49.80	49.81	51.51	52.32	49.76	49.63	49.32	48.63	48.86	0.01	1.70	2.51	-0.05	-0.18	-0.49	-1.18	-0.95
10500	Bridge Walkway									Bridge Walkway							
10463.42	49.67	49.68	51.50	52.31	49.62	49.48	49.13	48.37	48.63	0.01	1.82	2.63	-0.06	-0.20	-0.55	-1.31	-1.05
10368.23	49.59	49.60	51.49	52.31	49.53	49.37	48.94	48.08	48.38	0.01	1.89	2.71	-0.07	-0.23	-0.66	-1.52	-1.22
10280.76	49.56	49.58	51.48	52.31	49.51	49.35	48.92	48.01	48.34	0.02	1.90	2.73	-0.07	-0.23	-0.66	-1.57	-1.24
10225.63	49.49	49.50	51.48	52.31	49.44	49.29	48.90	47.98	48.32	0.01	1.98	2.81	-0.06	-0.21	-0.60	-1.52	-1.18
10200	Bridge Walkway									Bridge Walkway							
10164.78	49.47	49.49	51.34	52.30	49.42	49.27	48.86	47.94	48.28	0.02	1.85	2.81	-0.07	-0.22	-0.63	-1.55	-1.21
10069.75	49.48	49.49	51.37	52.30	49.42	49.26	48.84	47.89	48.24	0.01	1.88	2.81	-0.07	-0.23	-0.65	-1.60	-1.25
9511.942	49.16	49.18	51.32	52.30	49.10	48.91	48.37	46.93	47.53	0.02	2.14	3.12	-0.08	-0.27	-0.81	-2.25	-1.65
9463.775	49.14	49.16	51.33	52.30	49.07	48.87	48.30	46.71	47.39	0.02	2.17	3.14	-0.09	-0.29	-0.86	-2.45	-1.77
9450	Bridge Rice Boulevard									Bridge Rice Boulevard							
9411.652	49.10	49.12	51.30	52.29	49.03	48.83	48.28	46.61	47.35	0.02	2.18	3.17	-0.09	-0.29	-0.84	-2.51	-1.77
9307.397	49.09	49.11	51.29	52.29	49.02	48.82	48.24	46.35	47.22	0.02	2.18	3.18	-0.09	-0.29	-0.87	-2.76	-1.89
8805.521	48.85	48.87	51.29	52.29	48.77	48.55	47.93	46.29	46.97	0.02	2.42	3.42	-0.10	-0.32	-0.94	-2.58	-1.90
8752.369	48.91	48.88	51.29	52.29	48.79	48.56	47.95	46.36	47.01	-0.03	2.41	3.41	-0.09	-0.32	-0.93	-2.52	-1.87
8677	Bridge University Boulevard									Bridge University Boulevard							
8674.259	48.70	48.90	51.29	52.29	48.80	48.56	47.79	46.15	46.78	0.20	2.39	3.39	-0.10	-0.34	-1.11	-2.75	-2.12
8645.981	48.65	48.79	51.23	52.29	48.68	48.44	47.66	45.98	46.65	0.14	2.44	3.50	-0.11	-0.35	-1.13	-2.81	-2.14
8523.372	48.52	48.58	51.03	52.29	48.07	47.86	47.25	45.97	46.45	0.06	2.45	3.71	-0.51	-0.72	-1.33	-2.61	-2.13
8421.371	48.41	48.53	50.85	52.29	48.01	47.82	47.21	45.96	46.43	0.12	2.32	3.76	-0.52	-0.71	-1.32	-2.57	-2.10
7730.22	47.66	48.06	50.20	52.02	47.22	47.06	46.61	45.69	46.03	0.40	2.14	3.96	-0.84	-1.00	-1.45	-2.37	-2.03
6656.935	47.12	46.30	48.59	50.27	45.77	45.71	45.60	45.36	45.47	-0.82	2.29	3.97	-0.53	-0.59	-0.70	-0.94	-0.83
5717.684	46.66	45.79	44.48	44.21	44.63	44.68	44.92	45.19	45.19	-0.87	-1.31	-1.58	-1.16	-1.11	-0.87	-0.60	-0.60
5619.191	46.61	45.03	44.97	45.07	44.91	44.92	44.98	45.03	44.92	-1.58	-0.06	0.04	-0.12	-0.11	-0.05	0.00	-0.11
5588.431	46.60	45.08	45.04	45.11	45.01	45.01	45.05	45.08	45.01	-1.52	-0.04	0.02	-0.07	-0.07	-0.03	0.00	-0.07
5540.284	46.14	45.16	45.16	45.16	45.16	45.16	45.16	45.16	45.16	-0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5430	Bridge Bellaire Boulevard									Bridge Bellaire Boulevard							
5426.389	44.39	44.73	44.73	44.73	44.73	44.73	44.73	44.73	44.73	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5414.522	44.42	44.68	44.68	44.68	44.68	44.68	44.68	44.68	44.68	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5319.974	44.69	44.69	44.69	44.69	44.69	44.69	44.69	44.69	44.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Absolute Decrease in WSE  
 Absolute Increase in WSE  
 Increase and Decrease in WSE  
 Interpolated Result

Proposed Typical Section

XS	100 Year WSE									Corrected Effective-Effective	WSE Difference from Corrected Effective						
	Effective	Corrected Effective	Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B		Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B
12411.01	51.25	51.37	52.17	53.14	51.40	51.28	50.94	50.54	50.70	0.12	0.80	1.77	0.03	-0.09	-0.43	-0.83	-0.67
12357.62	51.24	51.36	52.10	53.13	51.39	51.26	50.93	50.52	50.68	0.12	0.74	1.77	0.03	-0.10	-0.43	-0.84	-0.68
12215.95	51.22	51.35	52.09	53.13	51.38	51.25	50.90	50.50	50.66	0.13	0.74	1.78	0.03	-0.10	-0.45	-0.85	-0.69
12173.38	51.20	51.32	52.06	53.12	51.35	51.22	50.88	50.48	50.64	0.12	0.74	1.80	0.03	-0.10	-0.44	-0.84	-0.68
11661.96	51.06	51.19	51.98	53.12	51.23	51.09	50.70	50.26	50.44	0.13	0.79	1.93	0.04	-0.10	-0.49	-0.93	-0.75
11626.6	51.04	51.17	51.96	53.12	51.20	51.07	50.69	50.25	50.43	0.13	0.79	1.95	0.03	-0.10	-0.48	-0.92	-0.74
11600	Bridge Sunset Boulevard									Bridge Sunset Boulevard							
11574.81	50.74	50.91	52.02	53.09	50.95	50.78	50.44	49.84	50.01	0.17	1.11	2.18	0.04	-0.13	-0.47	-1.07	-0.90
11466.71	50.75	50.92	51.97	53.06	50.97	50.79	50.44	49.82	49.99	0.17	1.05	2.14	0.05	-0.13	-0.48	-1.10	-0.93
10989.81	50.71	50.88	51.97	53.07	50.93	50.75	50.35	49.53	49.78	0.17	1.09	2.19	0.05	-0.13	-0.53	-1.35	-1.10
10924.99	50.52	50.84	51.97	53.07	50.89	50.56	50.19	49.49	49.70	0.32	1.13	2.23	0.05	-0.28	-0.65	-1.35	-1.14
10900	Bridge Walkway									Bridge Walkway							
10871.51	50.38	50.53	51.92	53.07	50.57	50.41	50.07	49.42	49.62	0.15	1.39	2.54	0.04	-0.12	-0.46	-1.11	-0.91
10748.91	50.39	50.53	51.91	53.07	50.57	50.42	50.08	49.40	49.61	0.14	1.38	2.54	0.04	-0.11	-0.45	-1.13	-0.92
10561.45	50.40	50.54	51.91	53.07	50.58	50.43	50.08	49.39	49.61	0.14	1.37	2.53	0.04	-0.11	-0.46	-1.15	-0.93
10511.71	50.43	50.57	51.90	53.06	50.61	50.46	50.11	49.44	49.65	0.14	1.33	2.49	0.04	-0.11	-0.46	-1.13	-0.92
10500	Bridge Walkway									Bridge Walkway							
10463.42	50.26	50.38	51.88	53.06	50.41	50.28	49.92	49.20	49.44	0.12	1.50	2.68	0.03	-0.10	-0.46	-1.18	-0.94
10368.23	50.25	50.37	51.87	53.06	50.41	50.28	49.88	48.93	49.24	0.12	1.50	2.69	0.04	-0.09	-0.49	-1.44	-1.13
10280.76	50.20	50.32	51.86	53.06	50.36	50.23	49.84	48.90	49.21	0.12	1.54	2.74	0.04	-0.09	-0.48	-1.42	-1.11
10225.63	50.07	50.19	51.86	53.06	50.23	50.10	49.72	48.87	49.14	0.12	1.67	2.87	0.04	-0.09	-0.47	-1.32	-1.05
10200	Bridge Walkway									Bridge Walkway							
10164.78	50.03	50.15	51.85	53.06	50.19	50.06	49.69	48.82	49.10	0.12	1.70	2.91	0.04	-0.09	-0.46	-1.33	-1.05
10069.75	50.07	50.19	51.84	53.06	50.23	50.10	49.71	48.79	49.08	0.12	1.65	2.87	0.04	-0.09	-0.48	-1.40	-1.11
9511.942	49.83	49.98	51.84	53.06	50.03	49.87	49.36	48.06	48.51	0.15	1.86	3.08	0.05	-0.11	-0.62	-1.92	-1.47
9463.775	49.84	49.99	51.84	53.06	50.04	49.87	49.36	47.93	48.42	0.15	1.85	3.07	0.05	-0.12	-0.63	-2.06	-1.57
9450	Bridge Rice Boulevard									Bridge Rice Boulevard							
9411.652	49.66	49.82	51.83	53.05	49.87	49.70	49.17	47.90	48.40	0.16	2.01	3.23	0.05	-0.12	-0.65	-1.92	-1.42
9307.397	49.64	49.78	51.83	53.05	49.84	49.67	49.16	47.79	48.35	0.14	2.05	3.27	0.06	-0.11	-0.62	-1.99	-1.43
8805.521	49.47	49.64	51.83	53.05	49.70	49.51	48.84	47.34	47.94	0.17	2.19	3.41	0.06	-0.13	-0.80	-2.30	-1.70
8752.369	49.51	49.63	51.83	53.05	49.69	49.50	48.86	47.38	47.97	0.12	2.20	3.42	0.06	-0.13	-0.77	-2.25	-1.66
8677	Bridge University Boulevard									Bridge University Boulevard							
8674.259	49.39	49.67	51.83	53.05	49.73	49.54	48.88	47.08	47.76	0.28	2.16	3.38	0.06	-0.13	-0.79	-2.59	-1.91
8645.981	49.35	49.56	51.77	53.05	49.62	49.42	48.72	46.90	47.58	0.21	2.21	3.49	0.06	-0.14	-0.84	-2.66	-1.98
8523.372	49.23	49.32	51.60	53.05	48.90	48.74	48.22	46.90	47.38	0.09	2.28	3.73	-0.42	-0.58	-1.10	-2.42	-1.94
8421.371	49.13	49.25	51.44	53.05	48.84	48.68	48.18	46.89	47.35	0.12	2.19	3.80	-0.41	-0.57	-1.07	-2.36	-1.90
7730.22	48.44	48.77	50.76	52.89	48.14	48.00	47.57	46.62	46.95	0.33	1.99	4.12	-0.63	-0.77	-1.20	-2.15	-1.82
6656.935	47.95	47.04	49.02	51.22	46.64	46.59	46.49	46.28	46.39	-0.91	1.98	4.18	-0.40	-0.45	-0.55	-0.76	-0.65
5717.684	47.55	46.64	45.75	46.30	45.71	45.75	45.92	46.12	46.14	-0.91	-0.89	-0.34	-0.93	-0.89	-0.72	-0.52	-0.50
5619.191	47.51	45.97	45.87	45.97	45.80	45.81	45.88	45.94	45.81	-1.54	-0.10	0.00	-0.17	-0.16	-0.09	-0.03	-0.16
5588.431	47.50	46.01	45.95	46.01	45.91	45.91	45.95	45.99	45.91	-1.49	-0.06	0.00	-0.10	-0.10	-0.05	-0.02	-0.10
5540.284	47.49	46.07	46.07	46.07	46.07	46.07	46.07	46.07	46.07	-1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5430	Bridge Bellaire Boulevard									Bridge Bellaire Boulevard							
5426.389	45.04	45.45	45.45	45.45	45.45	45.45	45.45	45.45	45.45	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5414.522	45.08	45.39	45.39	45.39	45.39	45.39	45.39	45.39	45.39	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5319.974	45.40	45.4	45.4	45.4	45.4	45.4	45.4	45.4	45.4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

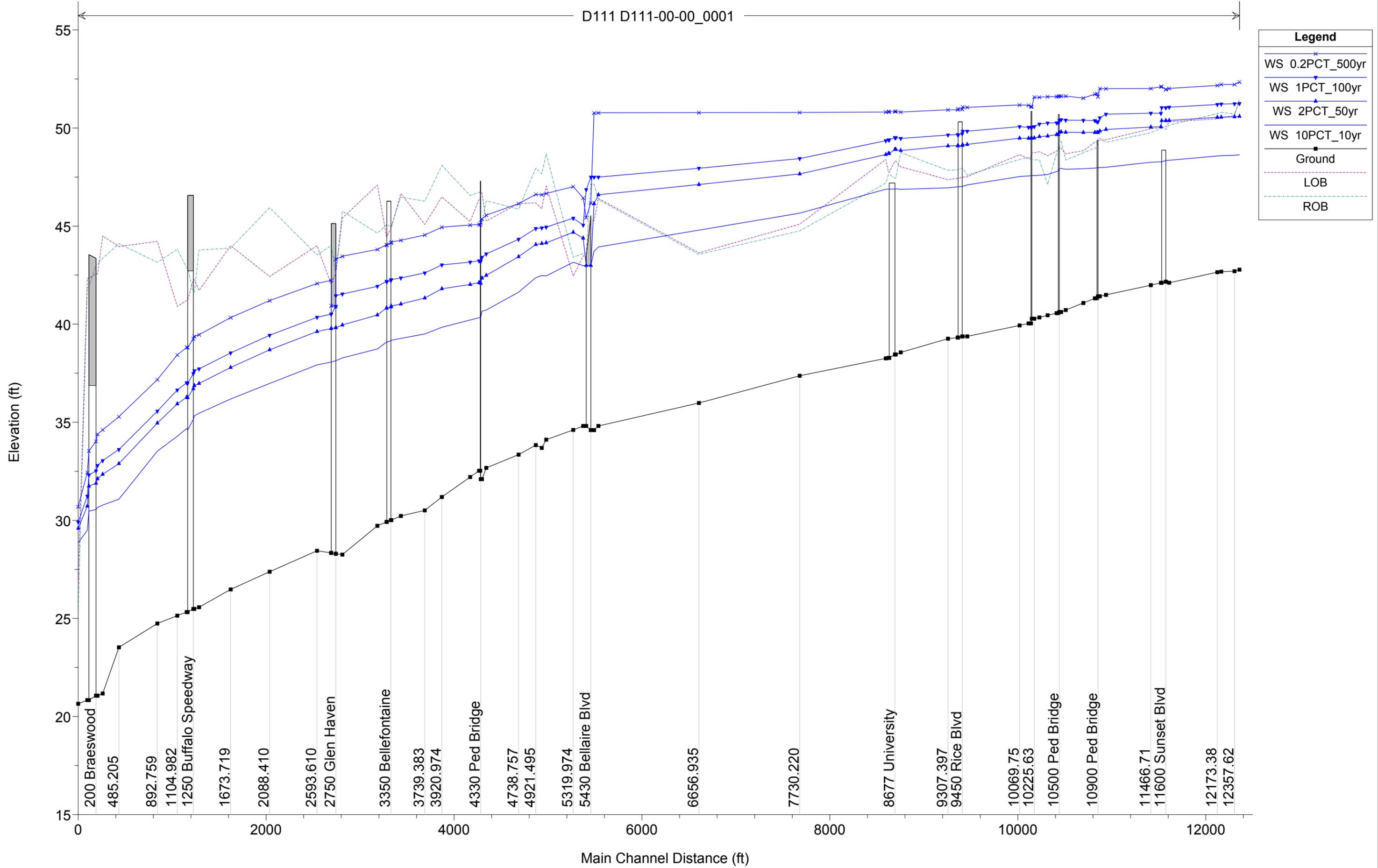
Absolute Decrease in WSE  
 Absolute Increase in WSE  
 Increase and Decrease in WSE  
 Interpolated Result  
 Bray's Bayou Backwater Limits

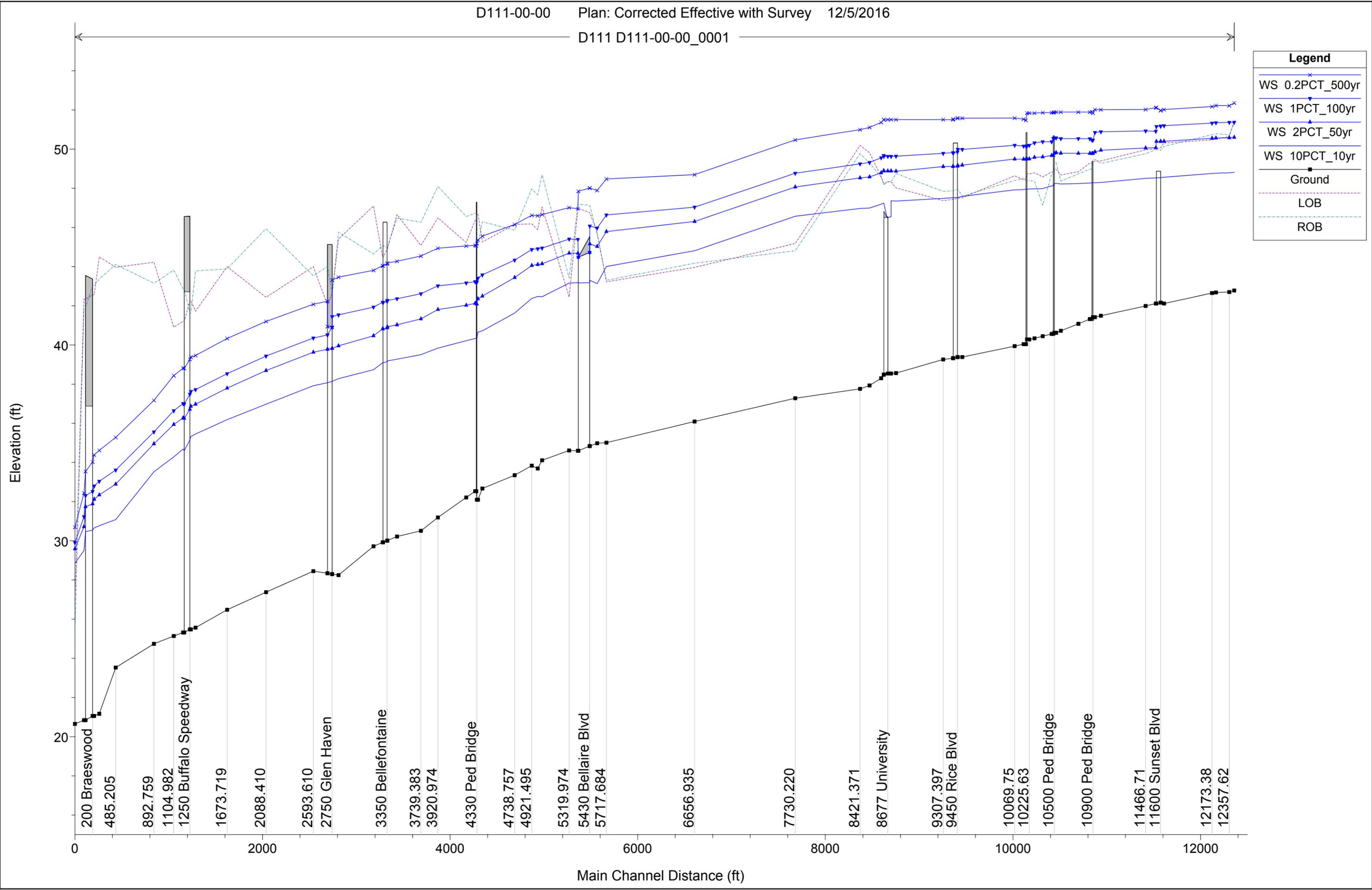
Proposed Typical Section

XS	500 Year WSE									Corrected Effective-Effective	WSE Difference from Corrected Effective						
	Effective	Corrected Effective	Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B		Alt 1A	Alt 1B	Alt 2A	Alt 2B	Alt 2C	Alt3A	Alt3B
12411.01	52.35	52.35	52.96	52.93	52.34	52.35	52.72	52.24	52.30	0.00	0.61	0.58	-0.01	0.00	0.37	-0.11	-0.05
12357.62	52.21	52.22	52.95	52.92	52.20	52.22	52.60	52.09	52.16	0.01	0.73	0.70	-0.02	0.00	0.38	-0.13	-0.06
12215.95	52.22	52.22	52.96	52.93	52.21	52.22	52.60	52.10	52.17	0.00	0.74	0.71	-0.01	0.00	0.38	-0.12	-0.05
12173.38	52.17	52.18	52.88	52.85	52.16	52.18	52.59	52.05	52.12	0.01	0.70	0.67	-0.02	0.00	0.41	-0.13	-0.06
11661.96	52.02	52.02	52.75	52.72	52.00	52.02	52.44	51.88	51.96	0.00	0.73	0.70	-0.02	0.00	0.42	-0.14	-0.06
11626.6	51.97	51.97	52.82	52.79	51.96	51.97	52.43	51.83	51.91	0.00	0.85	0.82	-0.01	0.00	0.46	-0.14	-0.06
11600	Bridge Sunset Boulevard									Bridge Sunset Boulevard							
11574.81	52.11	52.11	52.79	52.76	52.09	52.12	52.11	51.91	52.03	0.00	0.68	0.65	-0.02	0.01	0.00	-0.20	-0.08
11466.71	52.01	52.02	52.73	52.69	51.99	52.02	52.02	51.81	51.93	0.01	0.71	0.67	-0.03	0.00	0.00	-0.21	-0.09
10989.81	52.01	52.01	52.76	52.72	51.98	52.02	52.01	51.80	51.92	0.00	0.75	0.71	-0.03	0.01	0.00	-0.21	-0.09
10924.99	52.01	52.02	52.75	52.71	51.99	52.03	52.02	51.81	51.92	0.01	0.73	0.69	-0.03	0.01	0.00	-0.21	-0.10
10900	Bridge Walkway									Bridge Walkway							
10871.51	51.73	51.89	52.74	52.70	51.83	51.90	51.74	51.23	51.39	0.16	0.85	0.81	-0.06	0.01	-0.15	-0.66	-0.50
10748.91	51.53	51.89	52.73	52.69	51.82	51.89	51.54	51.09	51.25	0.36	0.84	0.80	-0.07	0.00	-0.35	-0.80	-0.64
10561.45	51.63	51.89	52.73	52.68	51.83	51.89	51.64	51.10	51.37	0.26	0.84	0.79	-0.06	0.00	-0.25	-0.79	-0.52
10511.71	51.63	51.89	52.73	52.68	51.83	51.89	51.64	51.17	51.37	0.26	0.84	0.79	-0.06	0.00	-0.25	-0.72	-0.52
10500	Bridge Walkway									Bridge Walkway							
10463.42	51.60	51.86	52.72	52.66	51.81	51.87	51.61	50.85	51.09	0.26	0.86	0.80	-0.05	0.01	-0.25	-1.01	-0.77
10368.23	51.60	51.86	52.72	52.65	51.80	51.86	51.61	50.84	51.09	0.26	0.86	0.79	-0.06	0.00	-0.25	-1.02	-0.77
10280.76	51.57	51.84	52.71	52.65	51.78	51.85	51.58	50.73	51.00	0.27	0.87	0.81	-0.06	0.01	-0.26	-1.11	-0.84
10225.63	51.58	51.84	52.71	52.64	51.78	51.85	51.59	50.47	50.77	0.26	0.87	0.80	-0.06	0.01	-0.25	-1.37	-1.07
10200	Bridge Walkway									Bridge Walkway							
10164.78	51.16	51.53	52.70	52.63	51.60	51.54	51.18	50.46	50.74	0.37	1.17	1.10	0.07	0.01	-0.35	-1.07	-0.79
10069.75	51.18	51.59	52.70	52.62	51.65	51.60	51.19	50.47	50.75	0.41	1.11	1.03	0.06	0.01	-0.40	-1.12	-0.84
9511.942	51.05	51.58	52.70	52.61	51.65	51.50	51.07	50.08	50.49	0.53	1.12	1.03	0.07	-0.08	-0.51	-1.50	-1.09
9463.775	51.07	51.58	52.70	52.61	51.65	51.52	51.09	50.10	50.51	0.51	1.12	1.03	0.07	-0.06	-0.49	-1.48	-1.07
9450	Bridge Rice Boulevard									Bridge Rice Boulevard							
9411.652	50.93	51.50	52.69	52.59	51.57	51.44	50.95	49.65	50.15	0.57	1.19	1.09	0.07	-0.06	-0.55	-1.85	-1.35
9307.397	50.93	51.51	52.69	52.59	51.58	51.45	50.95	49.59	50.05	0.58	1.18	1.08	0.07	-0.06	-0.56	-1.92	-1.46
8805.521	50.81	51.51	52.69	52.58	51.58	51.45	50.94	49.05	49.81	0.70	1.18	1.07	0.07	-0.06	-0.57	-2.46	-1.70
8752.369	50.85	51.50	52.69	52.57	51.58	51.45	50.75	49.09	49.80	0.65	1.19	1.07	0.08	-0.05	-0.75	-2.41	-1.70
8677	Bridge University Boulevard									Bridge University Boulevard							
8674.259	50.82	51.50	52.69	52.57	51.58	51.44	50.89	49.17	49.88	0.68	1.19	1.07	0.08	-0.06	-0.61	-2.33	-1.62
8645.981	50.81	51.36	52.69	52.57	51.44	51.30	50.70	48.86	49.67	0.55	1.33	1.21	0.08	-0.06	-0.66	-2.50	-1.69
8523.372	50.81	51.11	52.69	52.56	50.59	50.44	49.91	48.83	49.25	0.30	1.58	1.45	-0.52	-0.67	-1.20	-2.28	-1.86
8421.371	50.81	50.99	52.69	52.56	50.41	50.29	49.87	48.82	49.22	0.18	1.70	1.57	-0.58	-0.70	-1.12	-2.17	-1.77
7730.22	50.79	50.47	52.28	52.55	49.82	49.65	49.30	48.55	48.87	-0.32	1.81	2.08	-0.65	-0.82	-1.17	-1.92	-1.60
6656.935	50.78	48.69	50.39	52.03	48.42	48.40	48.33	48.21	48.32	-2.09	1.70	3.34	-0.27	-0.29	-0.36	-0.48	-0.37
5717.684	50.77	48.48	47.87	47.62	47.74	47.76	47.88	48.09	48.13	-2.29	-0.61	-0.86	-0.74	-0.72	-0.60	-0.39	-0.35
5619.191	50.77	47.89	47.77	47.89	47.69	47.70	47.80	47.85	47.71	-2.88	-0.12	0.00	-0.20	-0.19	-0.09	-0.04	-0.18
5588.431	50.77	47.94	47.87	47.94	47.82	47.82	47.89	47.92	47.83	-2.83	-0.07	0.00	-0.12	-0.12	-0.05	-0.02	-0.11
5540.284	50.77	48.02	48.02	48.02	48.02	48.02	48.02	48.02	48.02	-2.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5430	Bridge Bellaire Boulevard									Bridge Bellaire Boulevard							
5426.389	46.44	47.06	47.06	47.06	47.06	47.06	47.06	47.06	47.06	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5414.522	46.50	46.96	46.96	46.96	46.96	46.96	46.96	46.96	46.96	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5319.974	47.01	47.01	47.01	47.01	47.01	47.01	47.01	47.01	47.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Absolute Decrease in WSE  
 Absolute Increase in WSE  
 Increase and Decrease in WSE  
 Interpolated Result

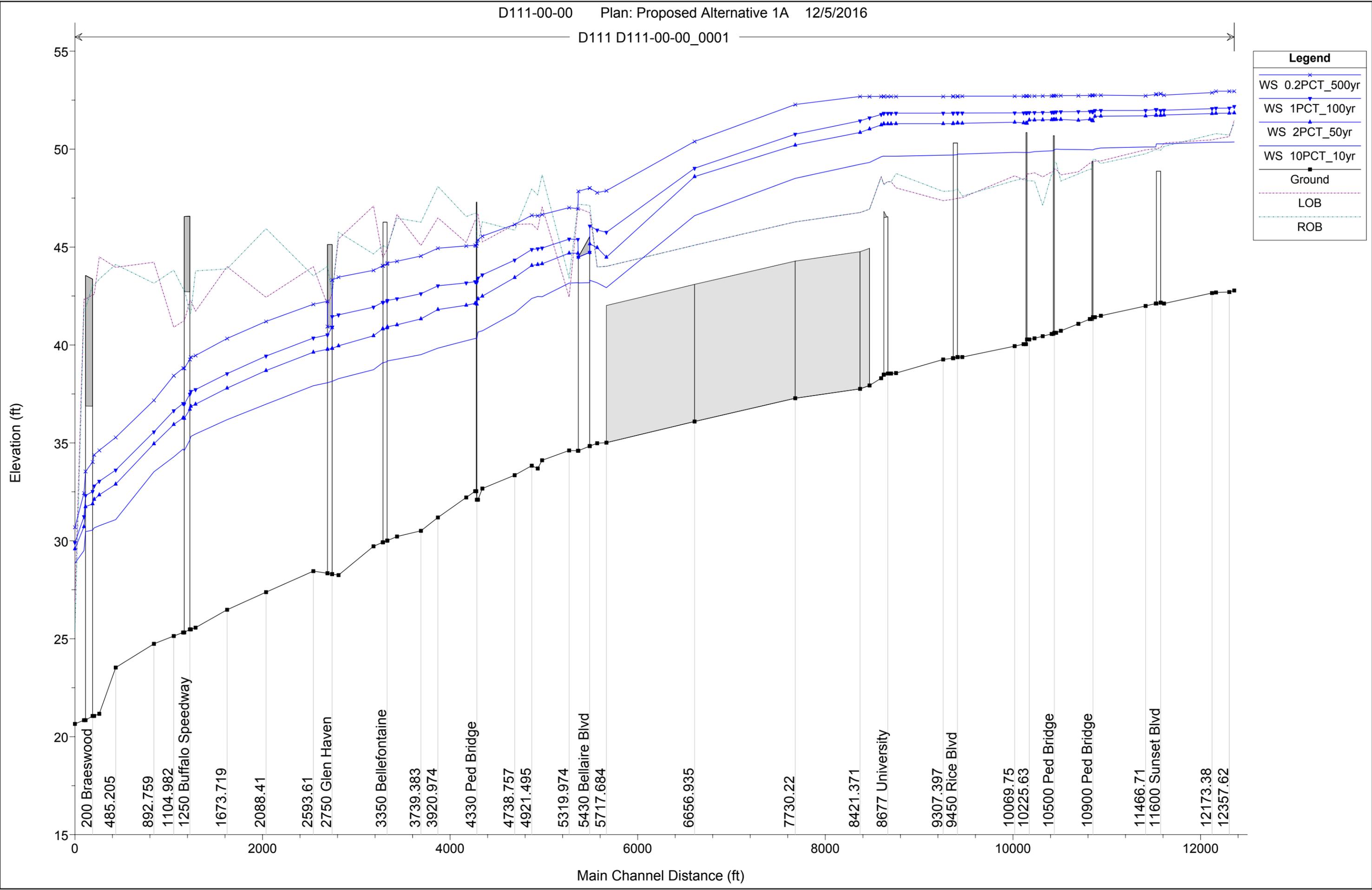
Proposed Typical Section





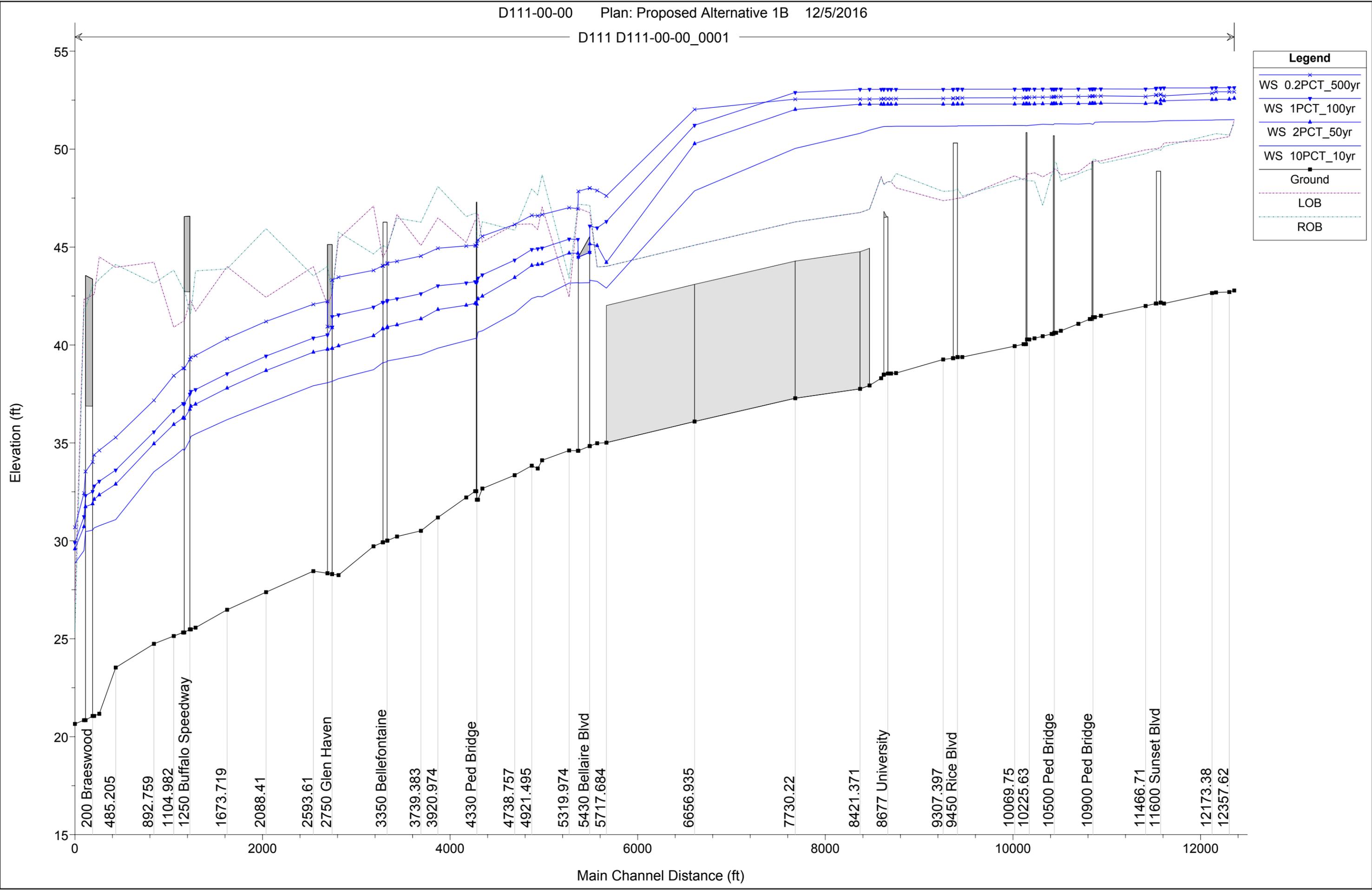
Legend	
WS 0.2PCT_500yr	(Blue line with 'x' markers)
WS 1PCT_100yr	(Blue line with downward-pointing triangle markers)
WS 2PCT_50yr	(Blue line with upward-pointing triangle markers)
WS 10PCT_10yr	(Blue line with no markers)
Ground	(Black line with square markers)
LOB	(Dashed pink line)
ROB	(Dashed green line)

D111 D111-00-00\_0001



Legend	
WS 0.2PCT_500yr	(Blue line with 'x' markers)
WS 1PCT_100yr	(Blue line with downward-pointing triangle markers)
WS 2PCT_50yr	(Blue line with upward-pointing triangle markers)
WS 10PCT_10yr	(Blue line with square markers)
Ground	(Solid black line with square markers)
LOB	(Dashed magenta line)
ROB	(Dashed green line)

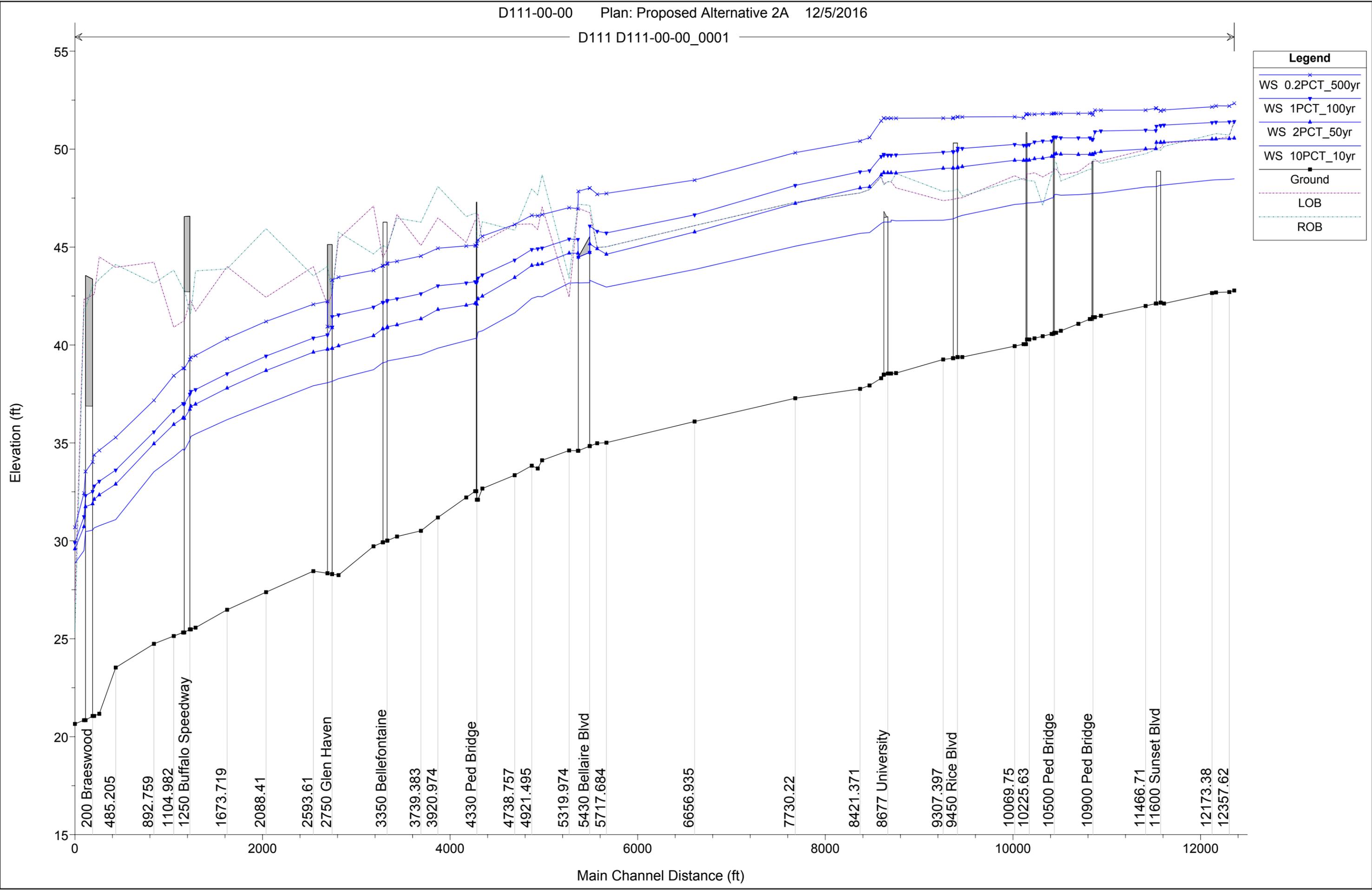
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Legend	
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WS 1PCT_100yr	(Blue line with downward triangle markers)
WS 2PCT_50yr	(Blue line with upward triangle markers)
WS 10PCT_10yr	(Blue line with no markers)
Ground	(Black line with square markers)
LOB	(Magenta dashed line)
ROB	(Green dashed line)

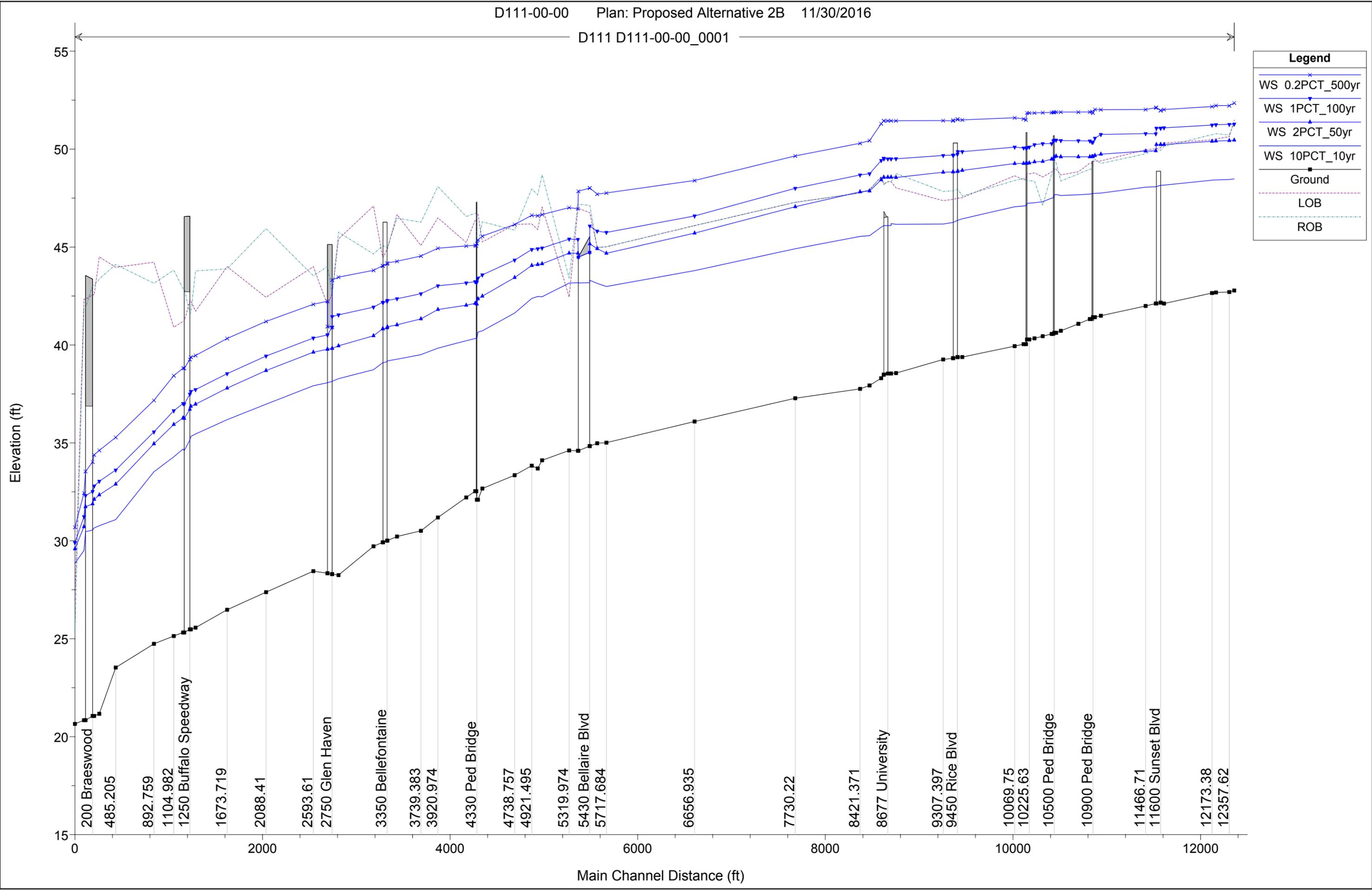
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- 485.205
- 892.759
- 1104.982
- 1250 Buffalo Speedway
- 1673.719
- 2088.41
- 2593.61
- 2750 Glen Haven
- 3350 Bellefontaine
- 3739.383
- 3920.974
- 4330 Ped Bridge
- 4738.757
- 4921.495
- 5319.974
- 5430 Bellaire Blvd
- 5717.684
- 6656.935
- 7730.22
- 8421.371
- 8677 University
- 9307.397
- 9450 Rice Blvd
- 10069.75
- 10225.63
- 10500 Ped Bridge
- 10900 Ped Bridge
- 11466.71
- 11600 Sunset Blvd
- 12173.38
- 12357.62

D111 D111-00-00\_0001

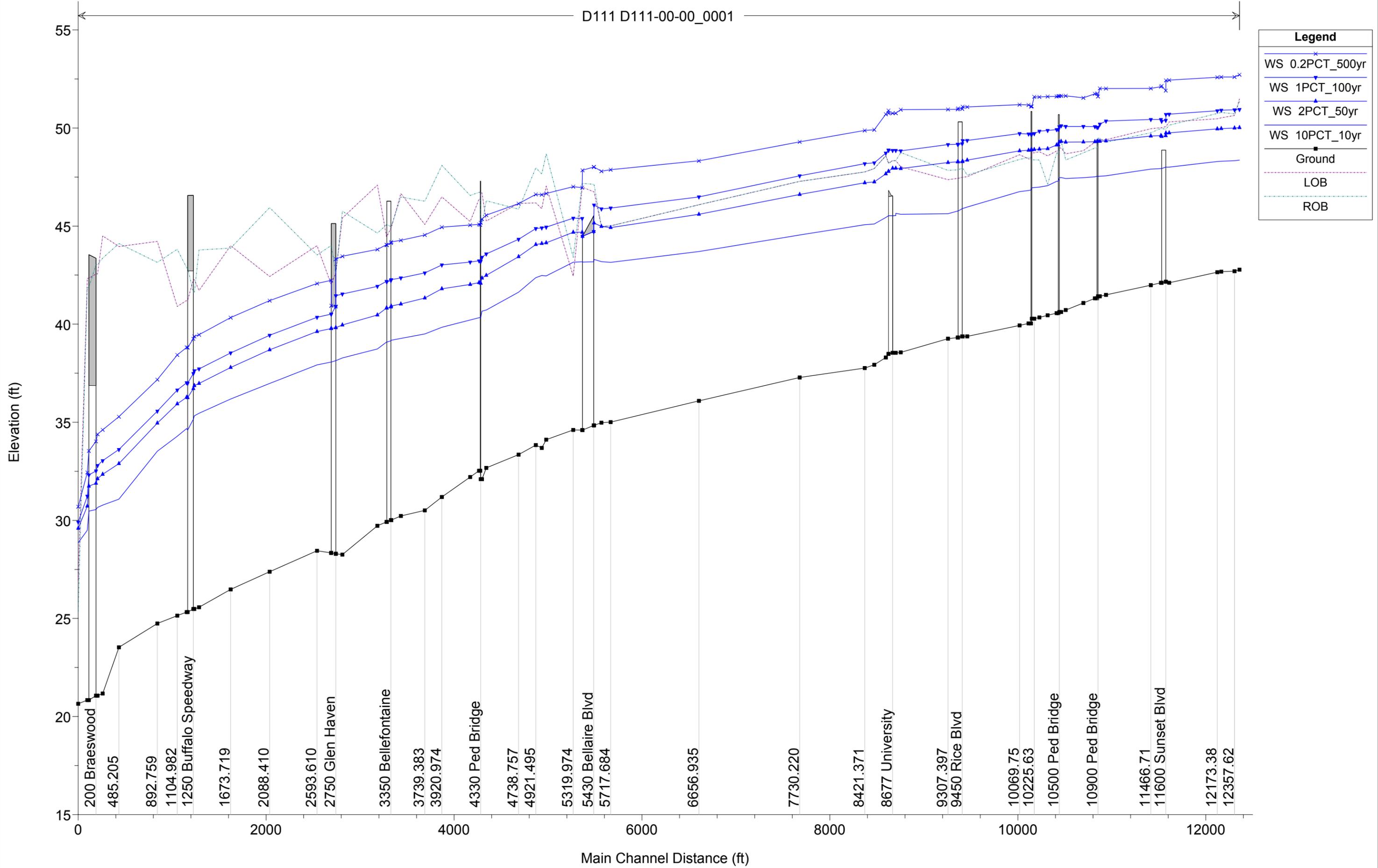


Legend	
WS 0.2PCT_500yr	Blue line with 'x' markers
WS 1PCT_100yr	Blue line with downward-pointing triangle markers
WS 2PCT_50yr	Blue line with upward-pointing triangle markers
WS 10PCT_10yr	Blue line with no markers
Ground	Black line with square markers
LOB	Dashed magenta line
ROB	Dotted green line

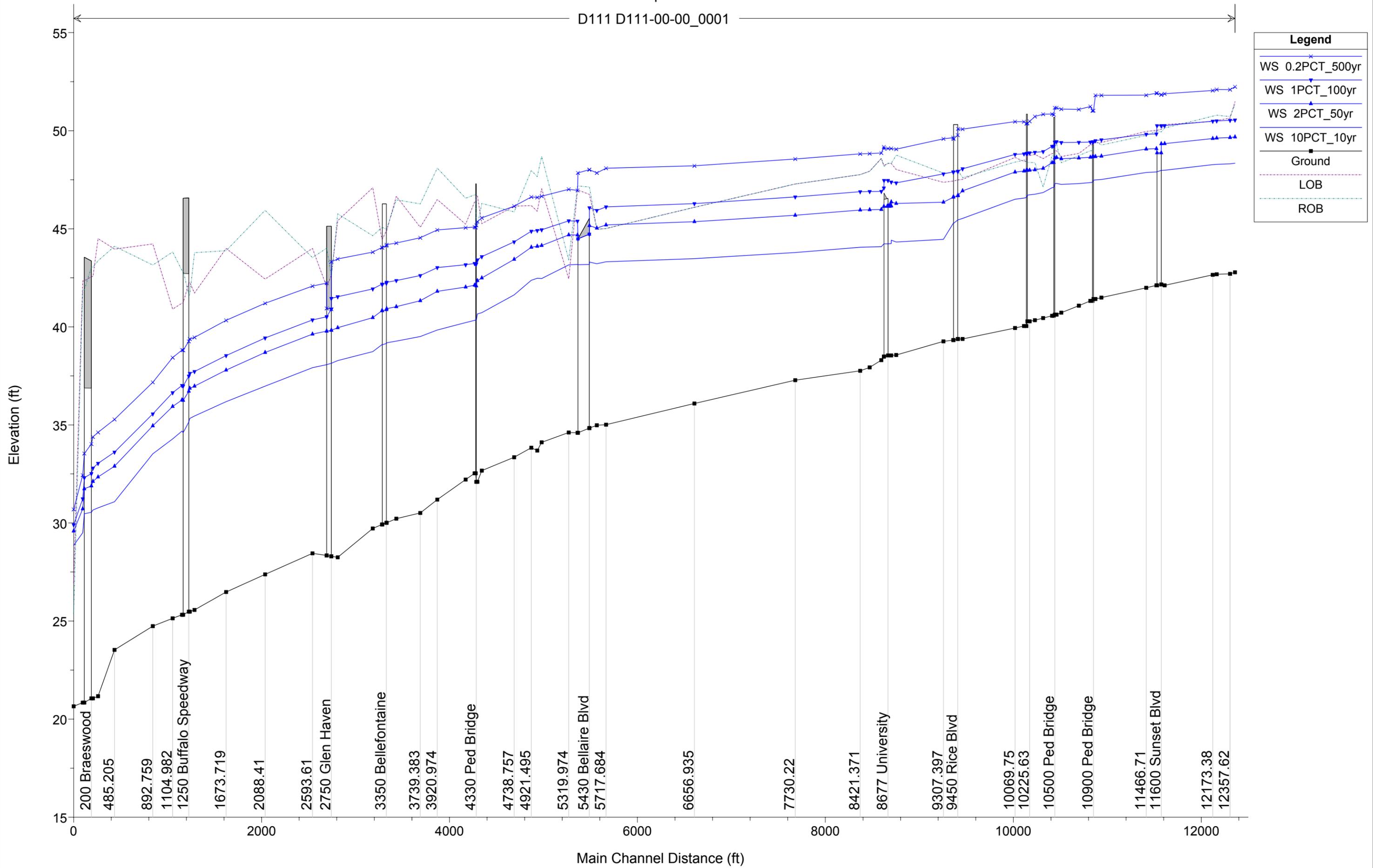
D111 D111-00-00\_0001



Legend	
WS 0.2PCT_500yr	(Blue line with 'x' markers)
WS 1PCT_100yr	(Blue line with downward-pointing triangle markers)
WS 2PCT_50yr	(Blue line with upward-pointing triangle markers)
WS 10PCT_10yr	(Blue line with square markers)
Ground	(Solid black line)
LOB	(Dashed magenta line)
ROB	(Dashed green line)

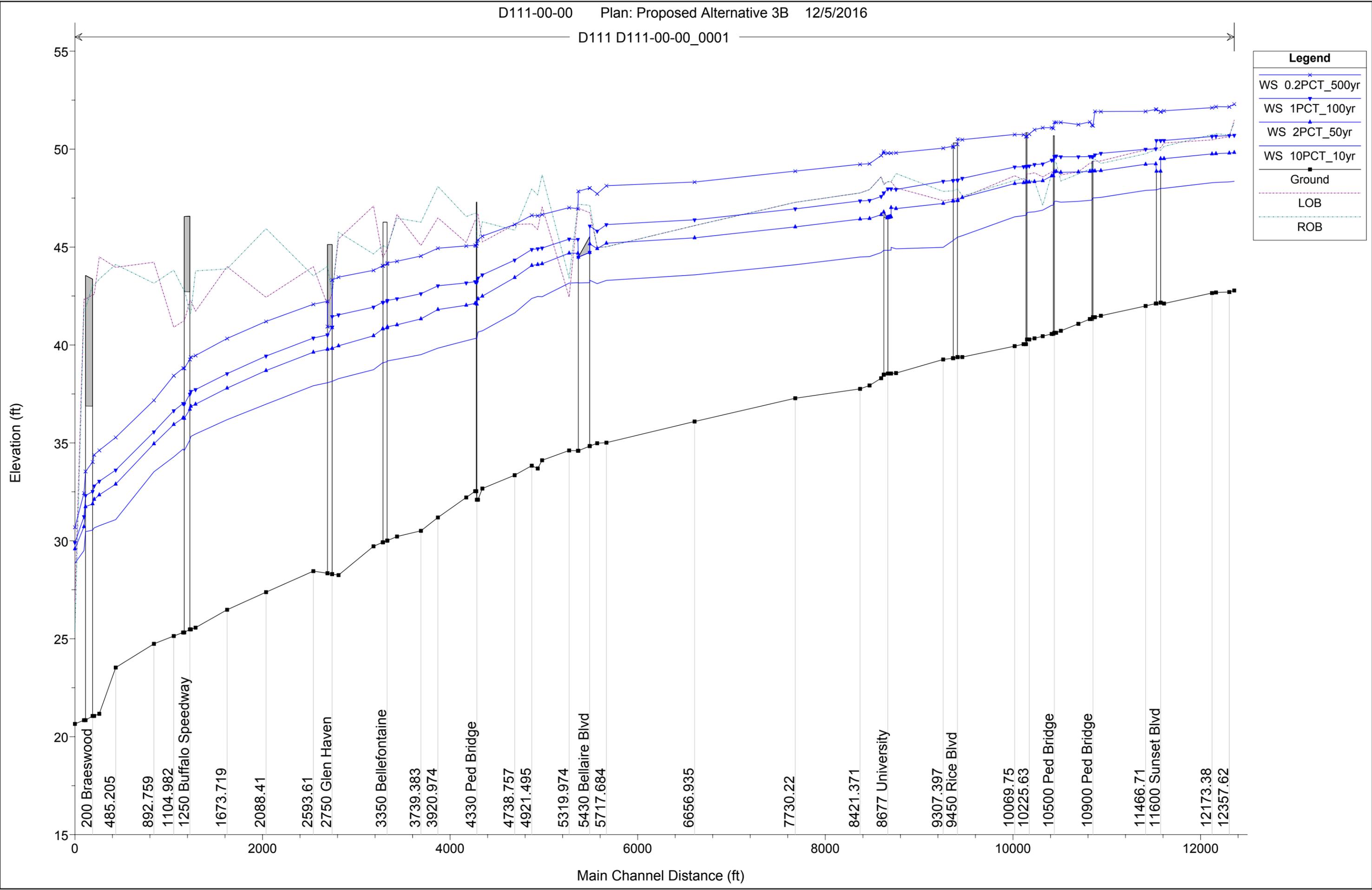


Legend	
WS 0.2PCT_500yr	x
WS 1PCT_100yr	▼
WS 2PCT_50yr	▲
WS 10PCT_10yr	■
Ground	—
LOB	- - -
ROB	· · ·



Legend	
WS 0.2PCT_500yr	(Blue line with 'x' markers)
WS 1PCT_100yr	(Blue line with downward-pointing triangle markers)
WS 2PCT_50yr	(Blue line with upward-pointing triangle markers)
WS 10PCT_10yr	(Blue line with no markers)
Ground	(Black line with square markers)
LOB	(Dashed red line)
ROB	(Dotted green line)

D111 D111-00-00\_0001

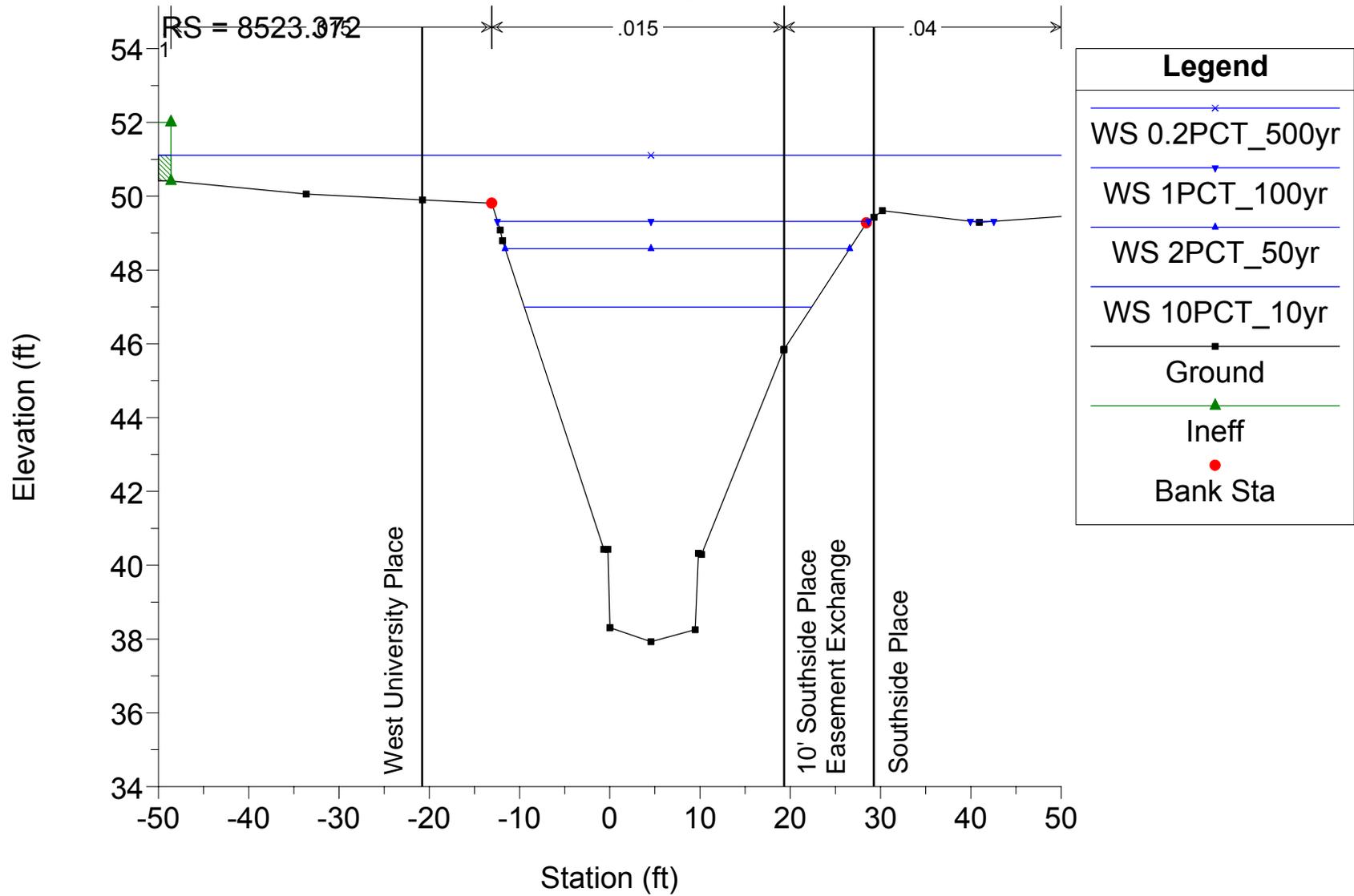


Legend	
WS 0.2PCT_500yr	Blue line with 'x' markers
WS 1PCT_100yr	Blue line with downward triangle markers
WS 2PCT_50yr	Blue line with upward triangle markers
WS 10PCT_10yr	Blue line with square markers
Ground	Black line with square markers
LOB	Red dashed line
ROB	Green dashed line

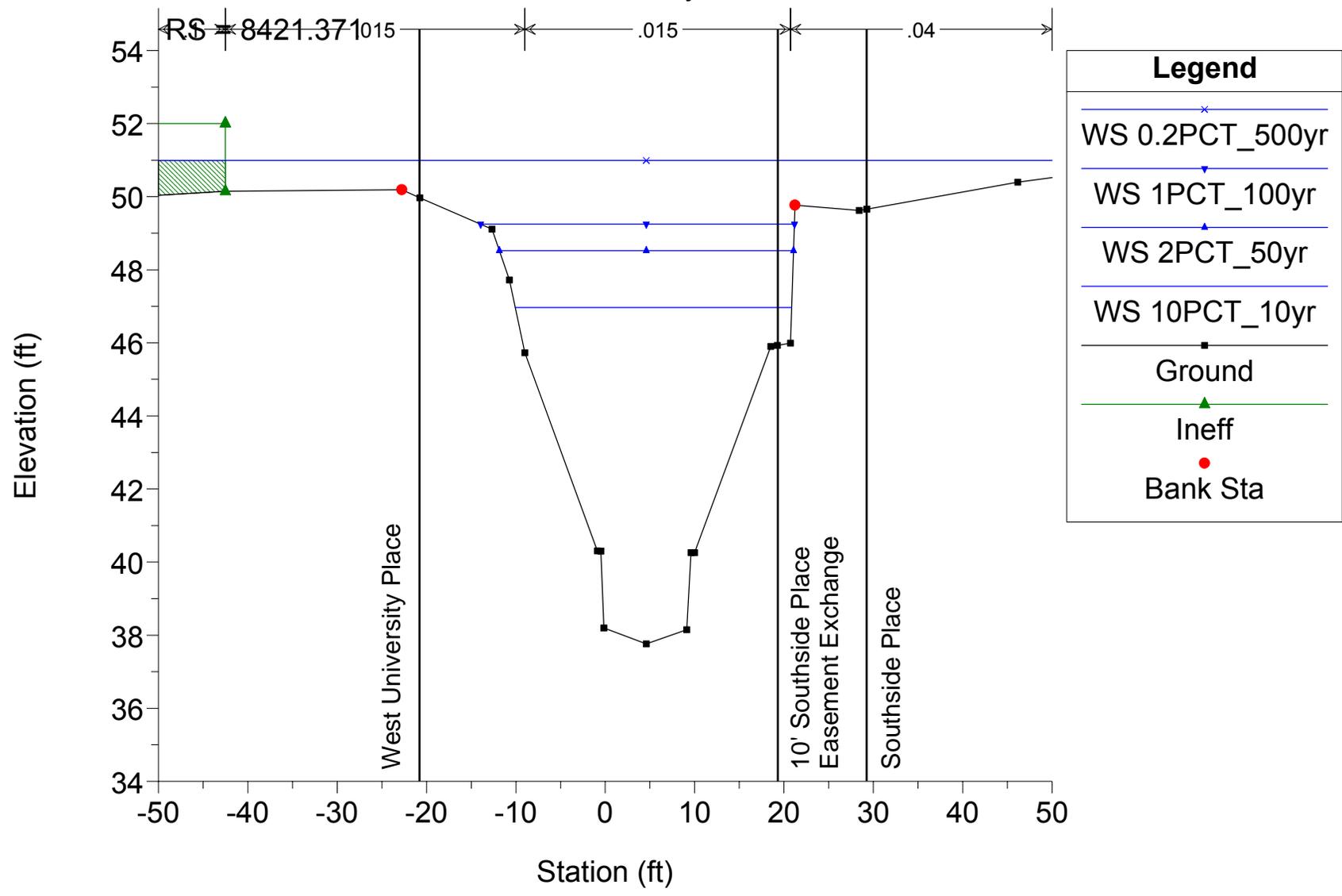
D111-00-00

Plan: Corrected Effective with Survey 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks

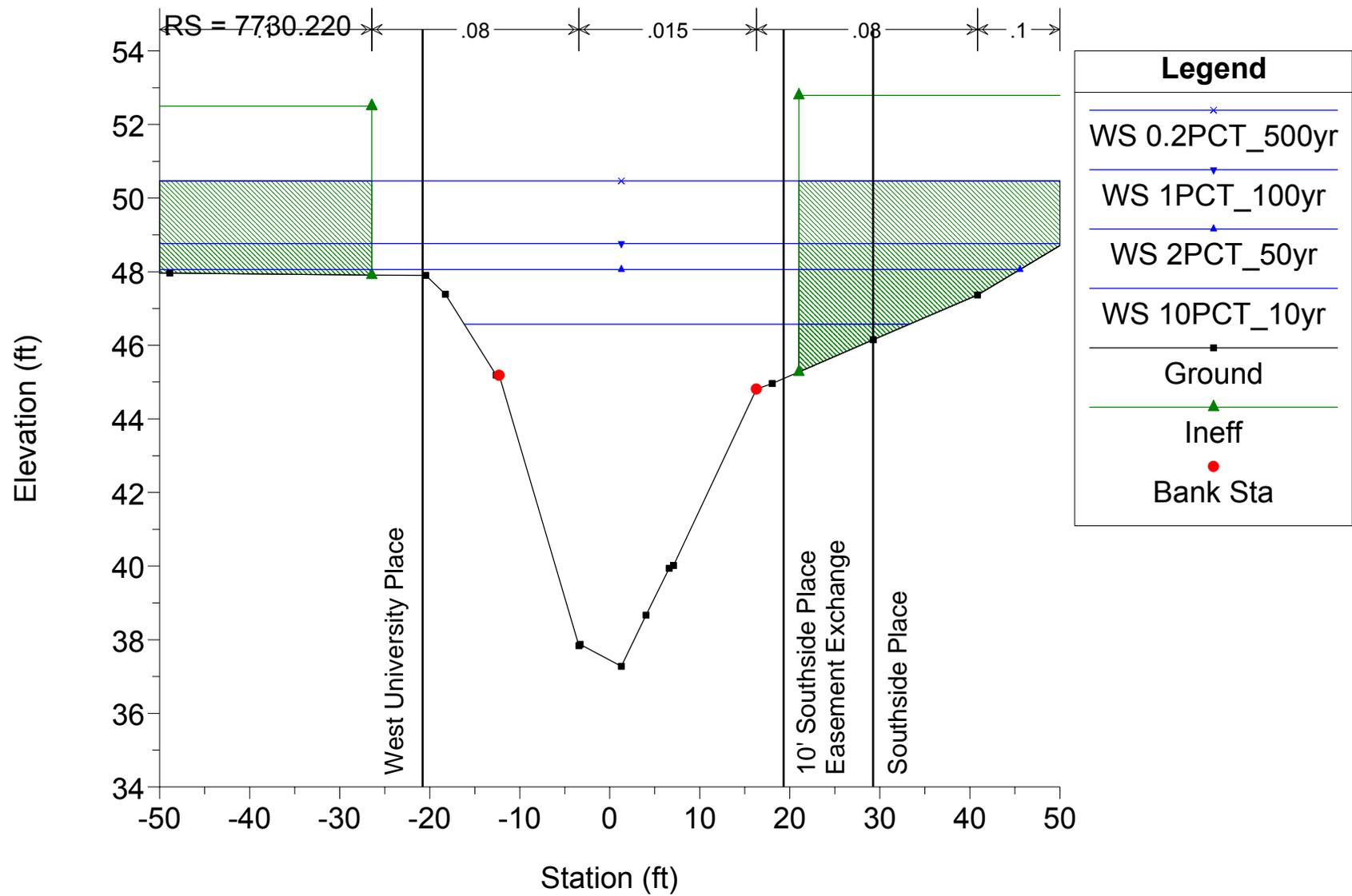


D111-00-00 Plan: Corrected Effective with Survey 12/5/2016  
 FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



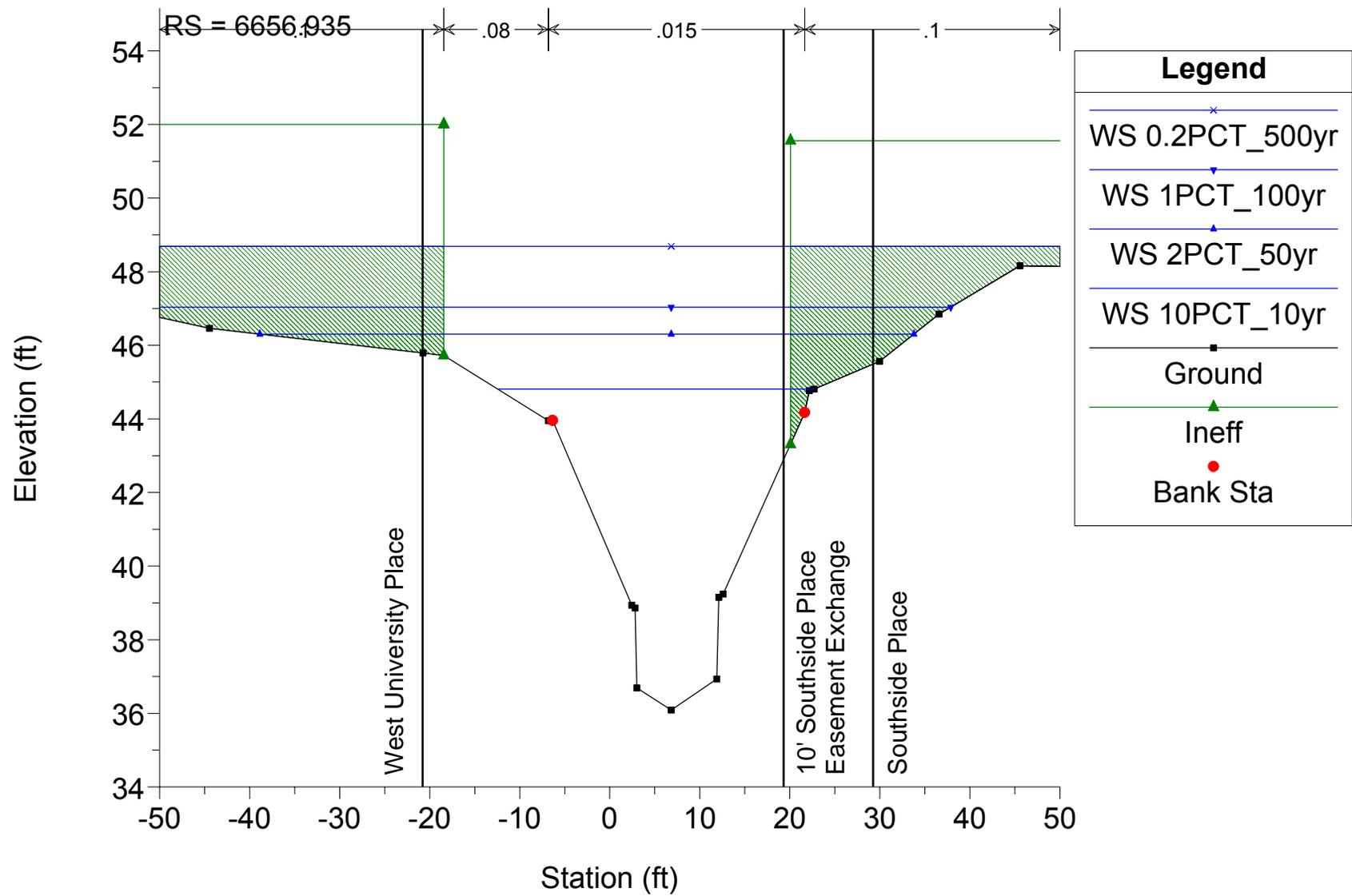
D111-00-00 Plan: Corrected Effective with Survey 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks; FNI

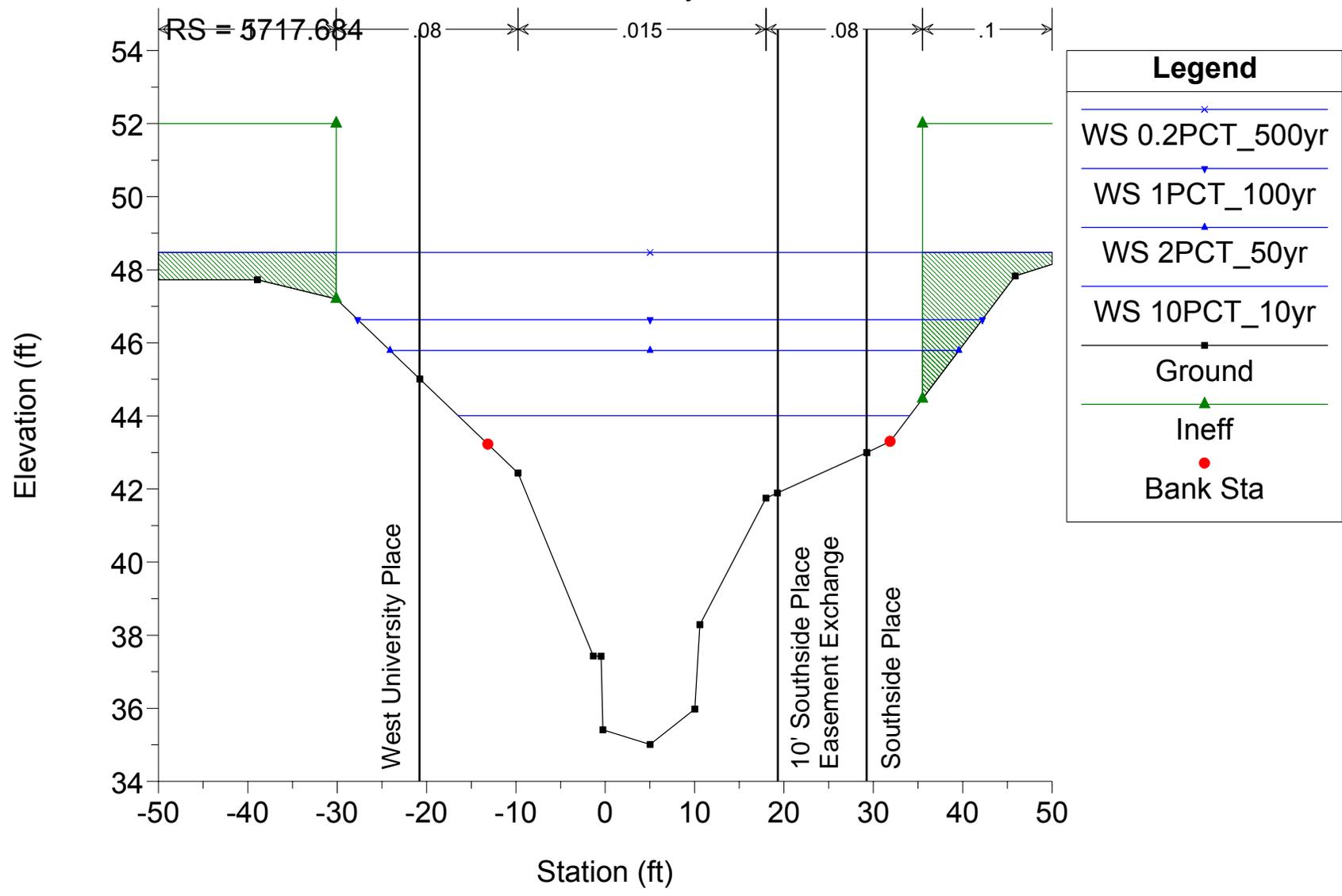


D111-00-00 Plan: Corrected Effective with Survey 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks; FNI



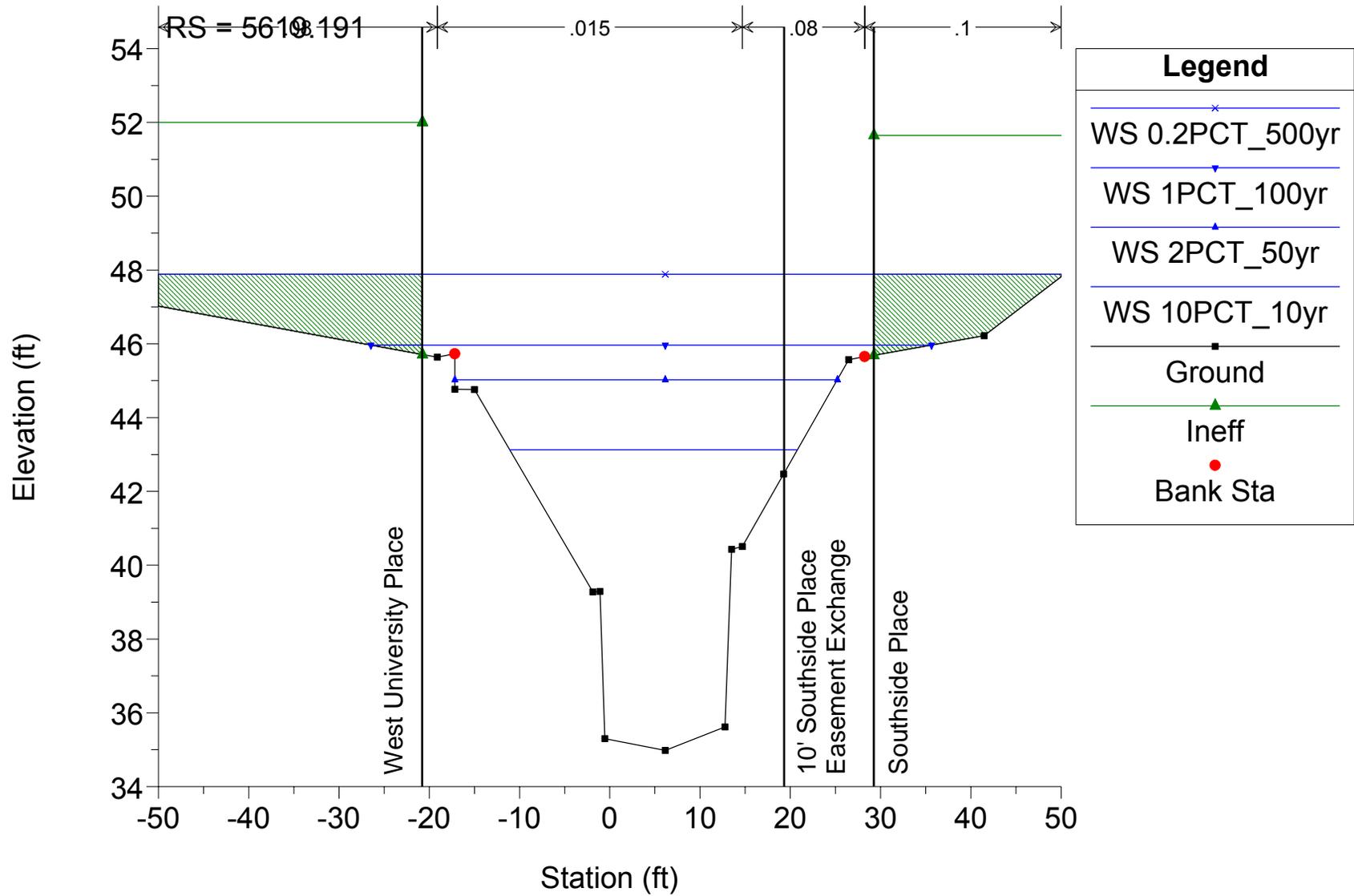
D111-00-00 Plan: Corrected Effective with Survey 12/5/2016  
 FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



D111-00-00

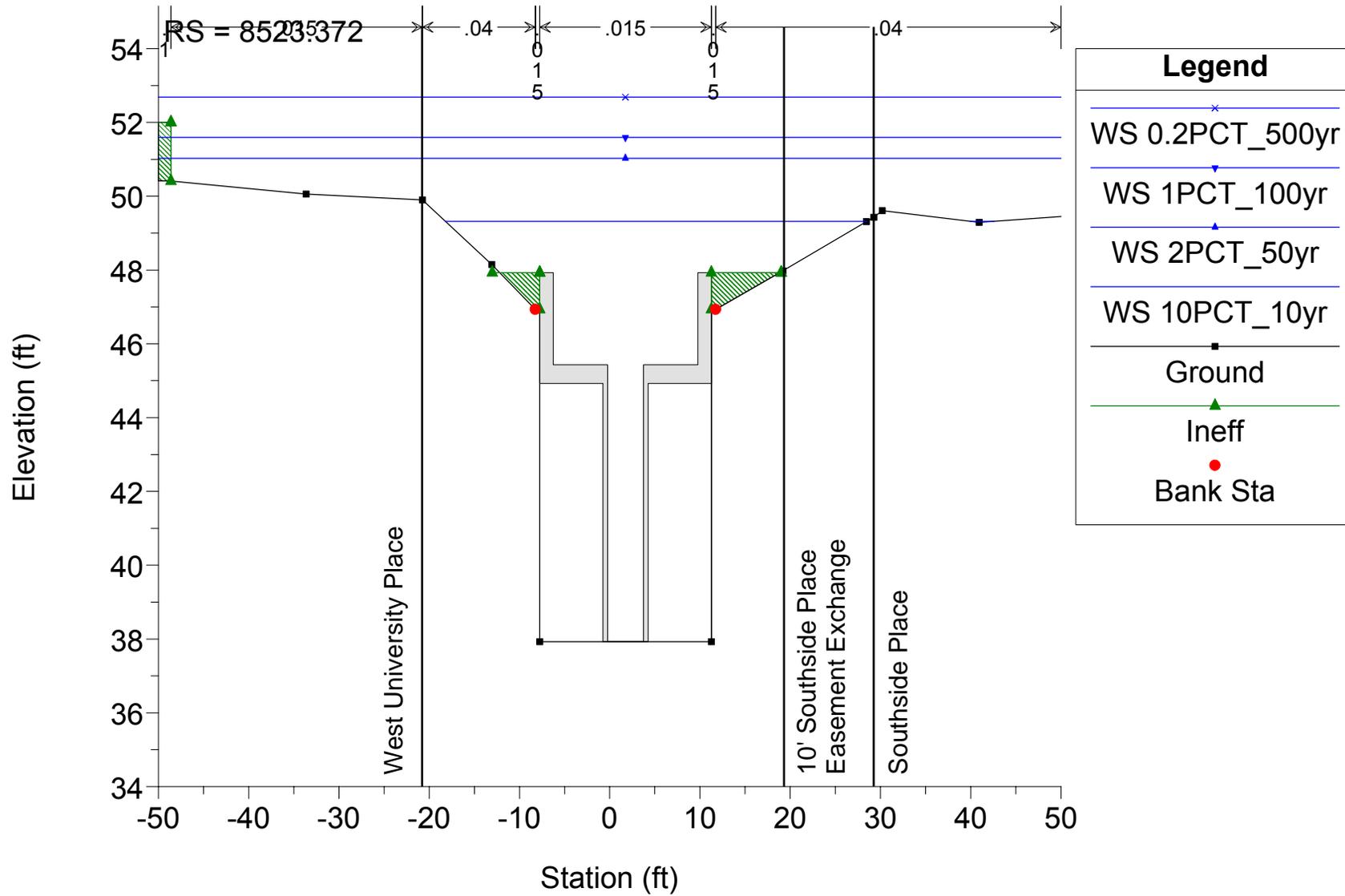
Plan: Corrected Effective with Survey 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



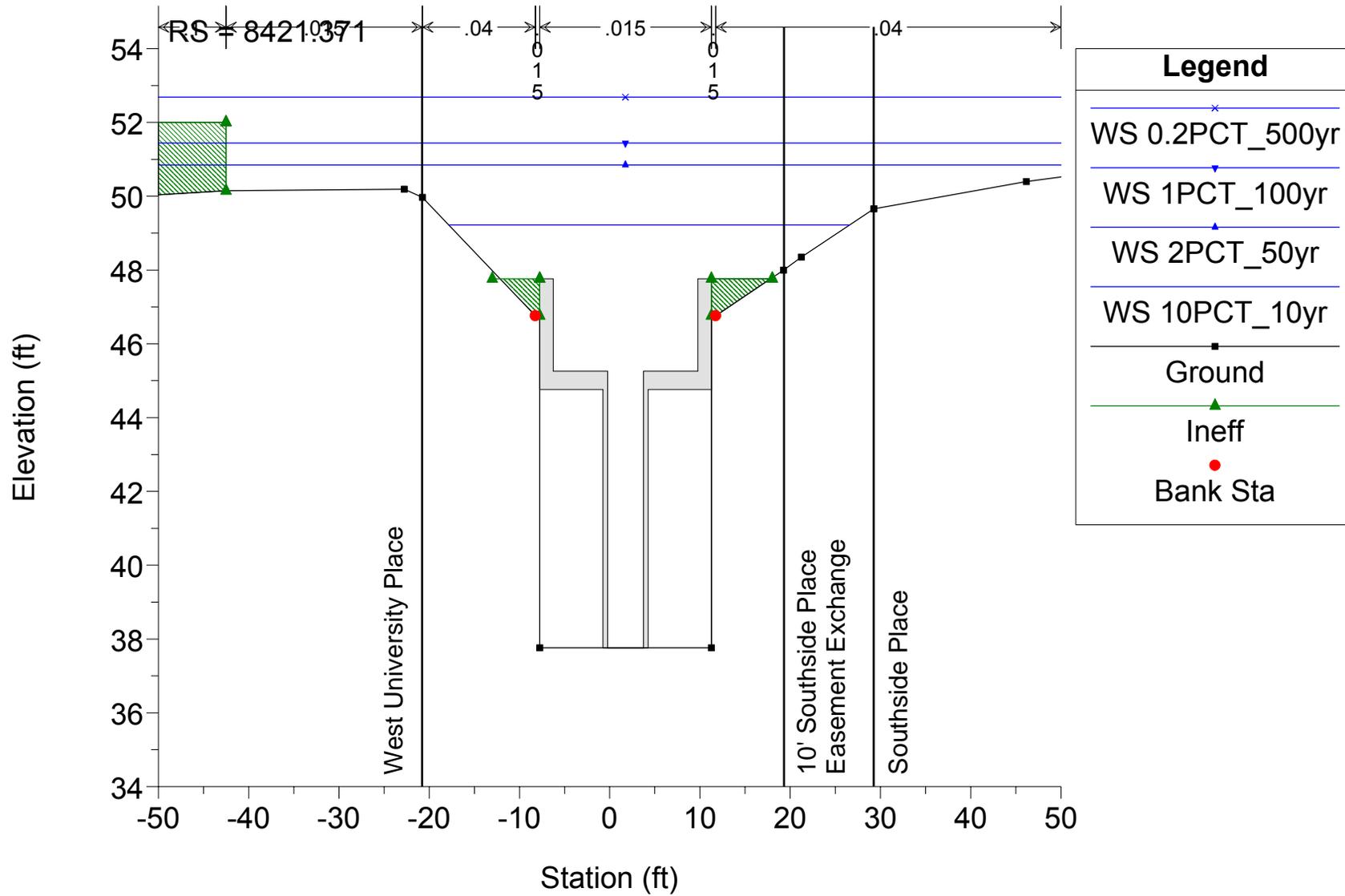
D111-00-00 Plan: Proposed Alternative 1A 12/5/2016

FNI 2016 Alternative 1A Channel; 2001 Lidar for overbanks



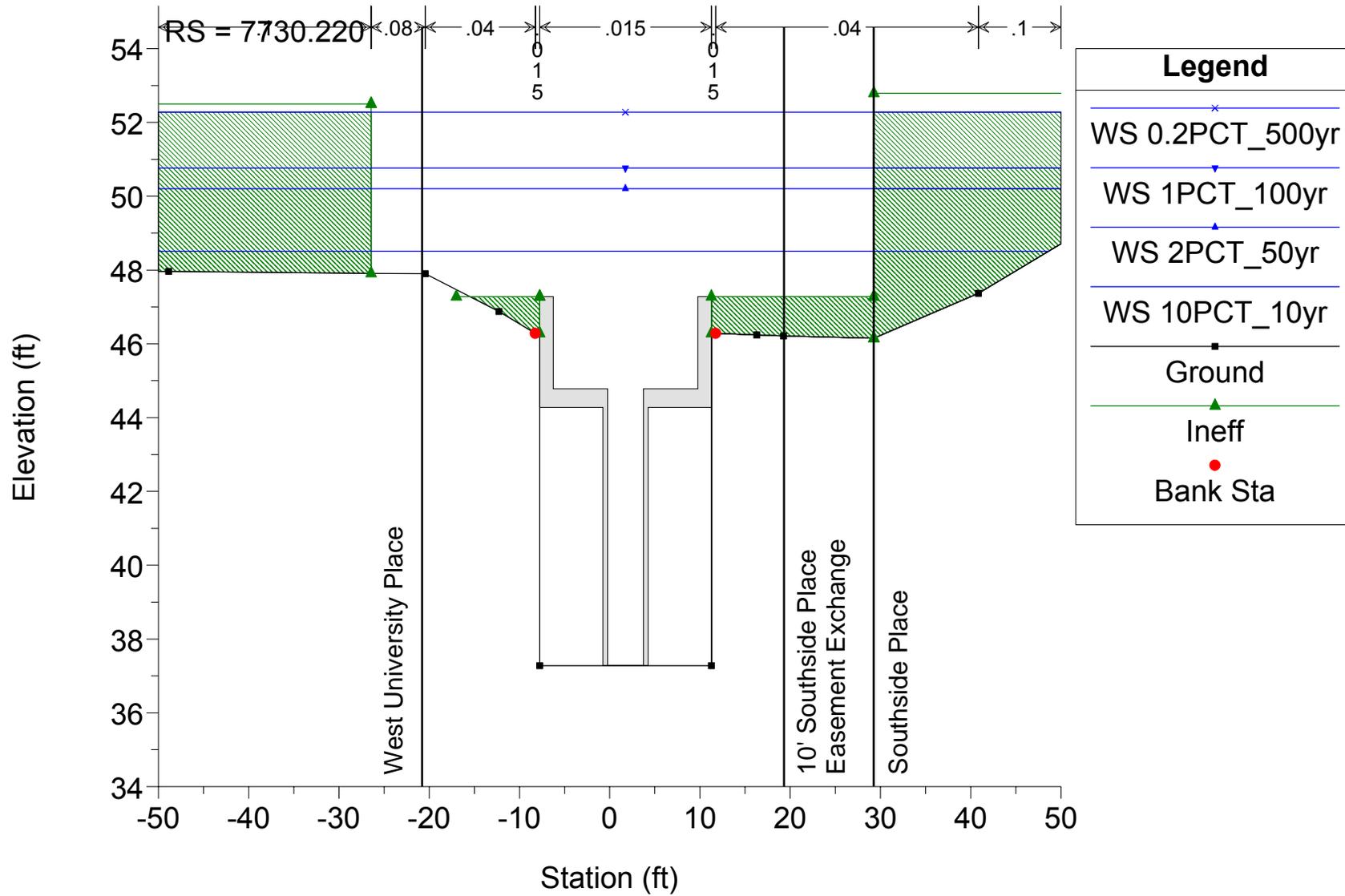
D111-00-00 Plan: Proposed Alternative 1A 12/5/2016

FNI 2016 Alternative 1A Channel; 2001 Lidar for overbanks



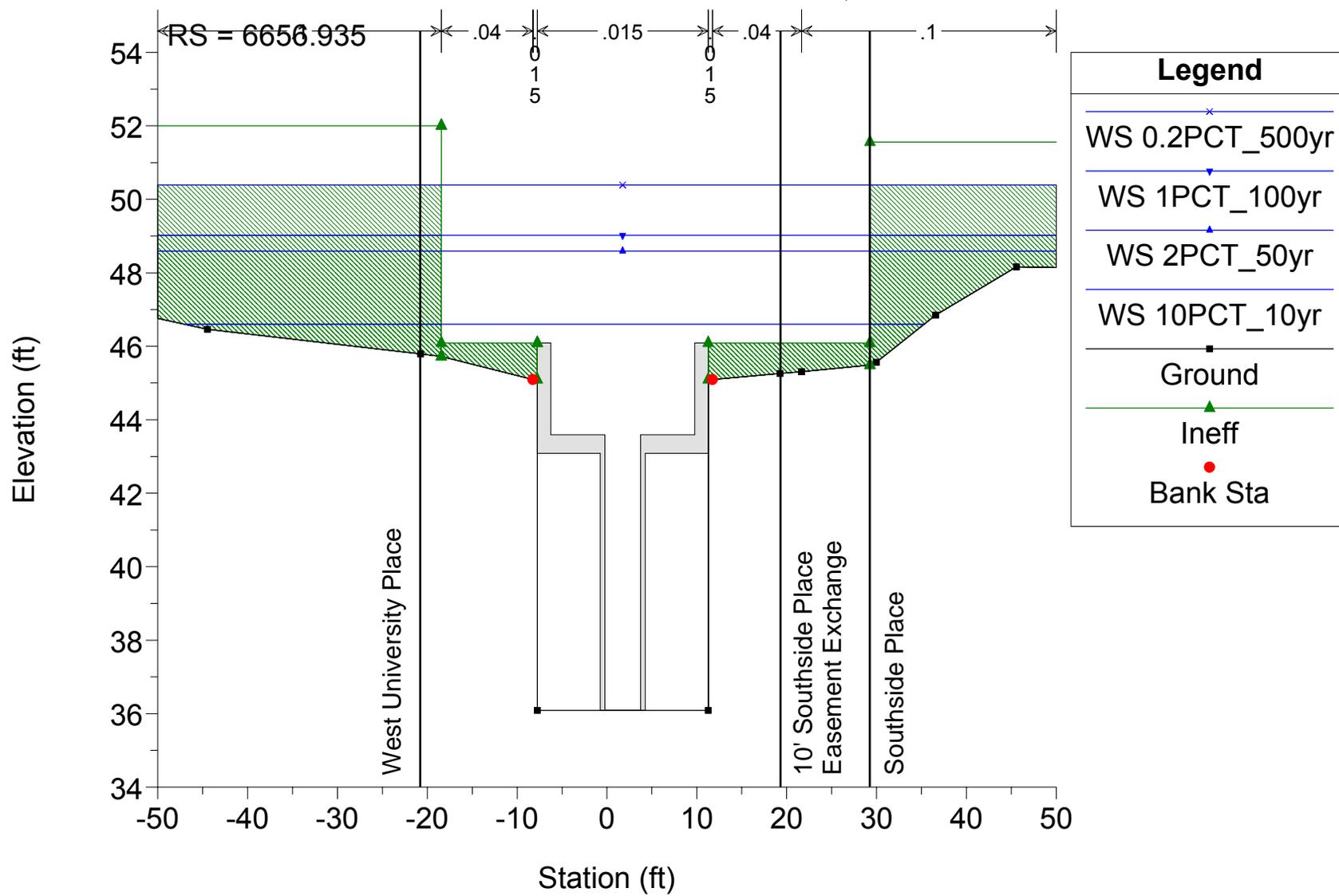
D111-00-00 Plan: Proposed Alternative 1A 12/5/2016

FNI 2016 Alternative 1A Channell; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 1A 12/5/2016

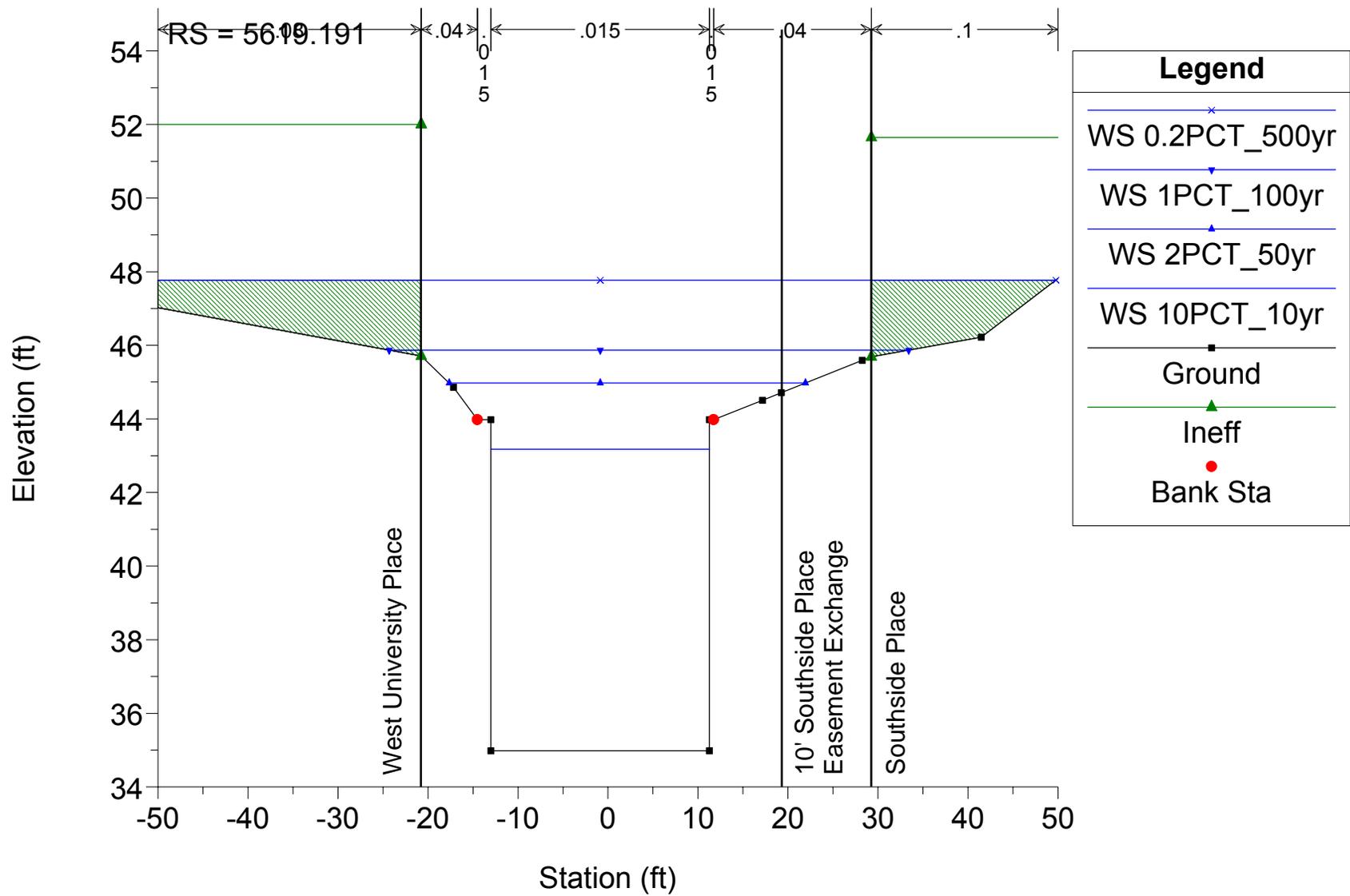
FNI 2016 Alternative 1A Channel; 2001 Lidar for overbanks





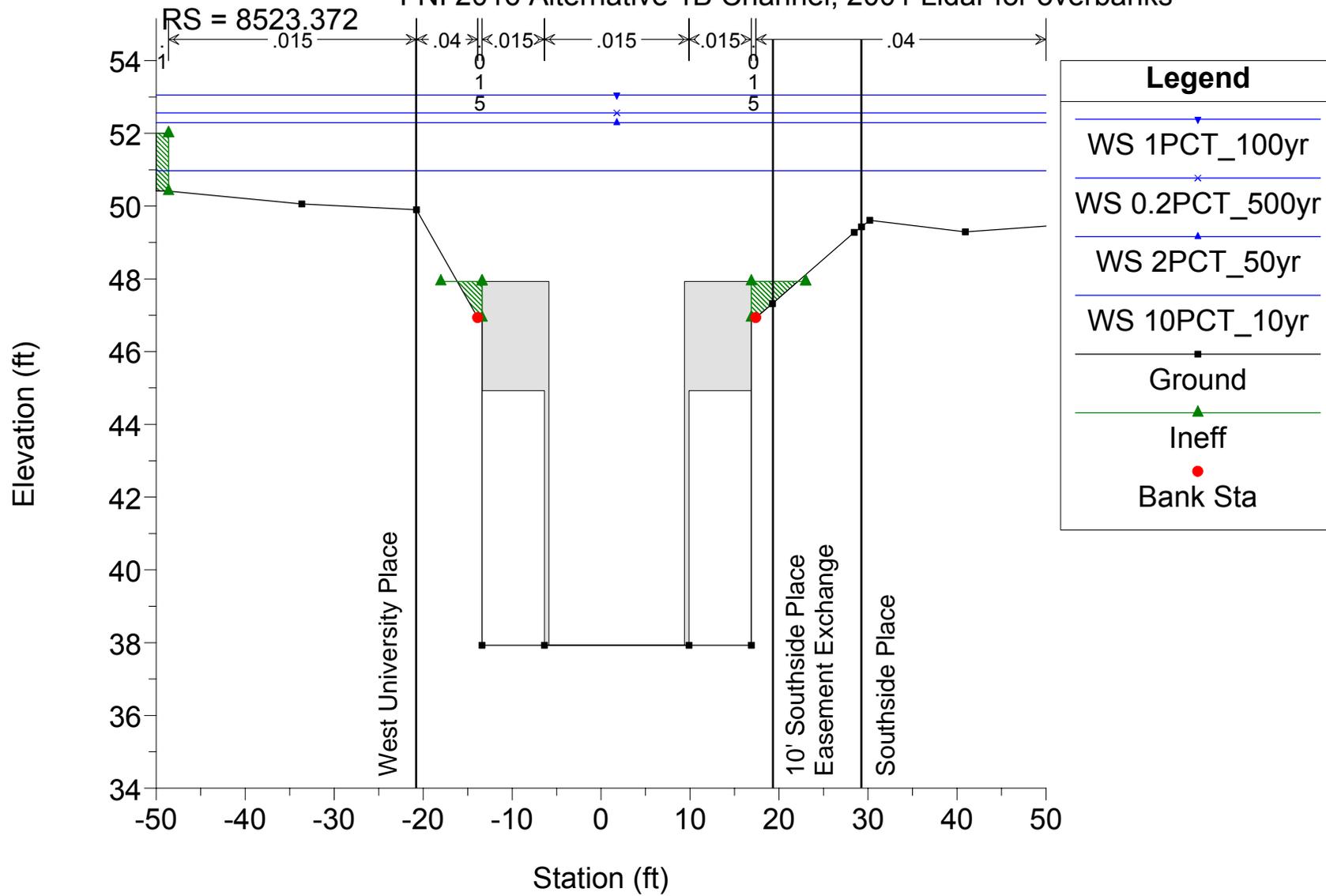
D111-00-00 Plan: Proposed Alternative 1A 12/5/2016

FNI 2016 Alternative 1A Channel; 2001 Lidar for overbanks



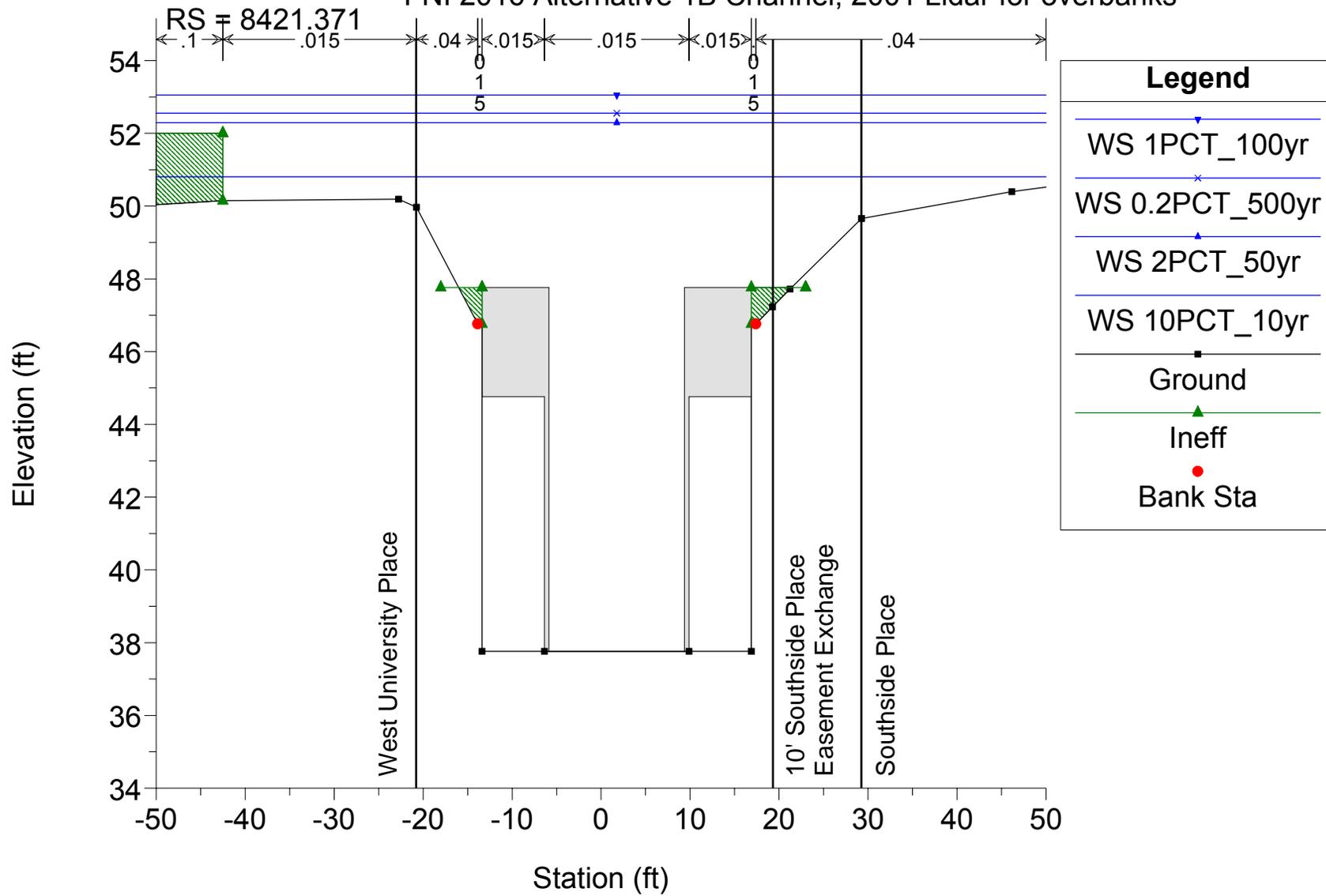
D111-00-00 Plan: Proposed Alternative 1B 12/5/2016

FNI 2016 Alternative 1B Channel; 2001 Lidar for overbanks



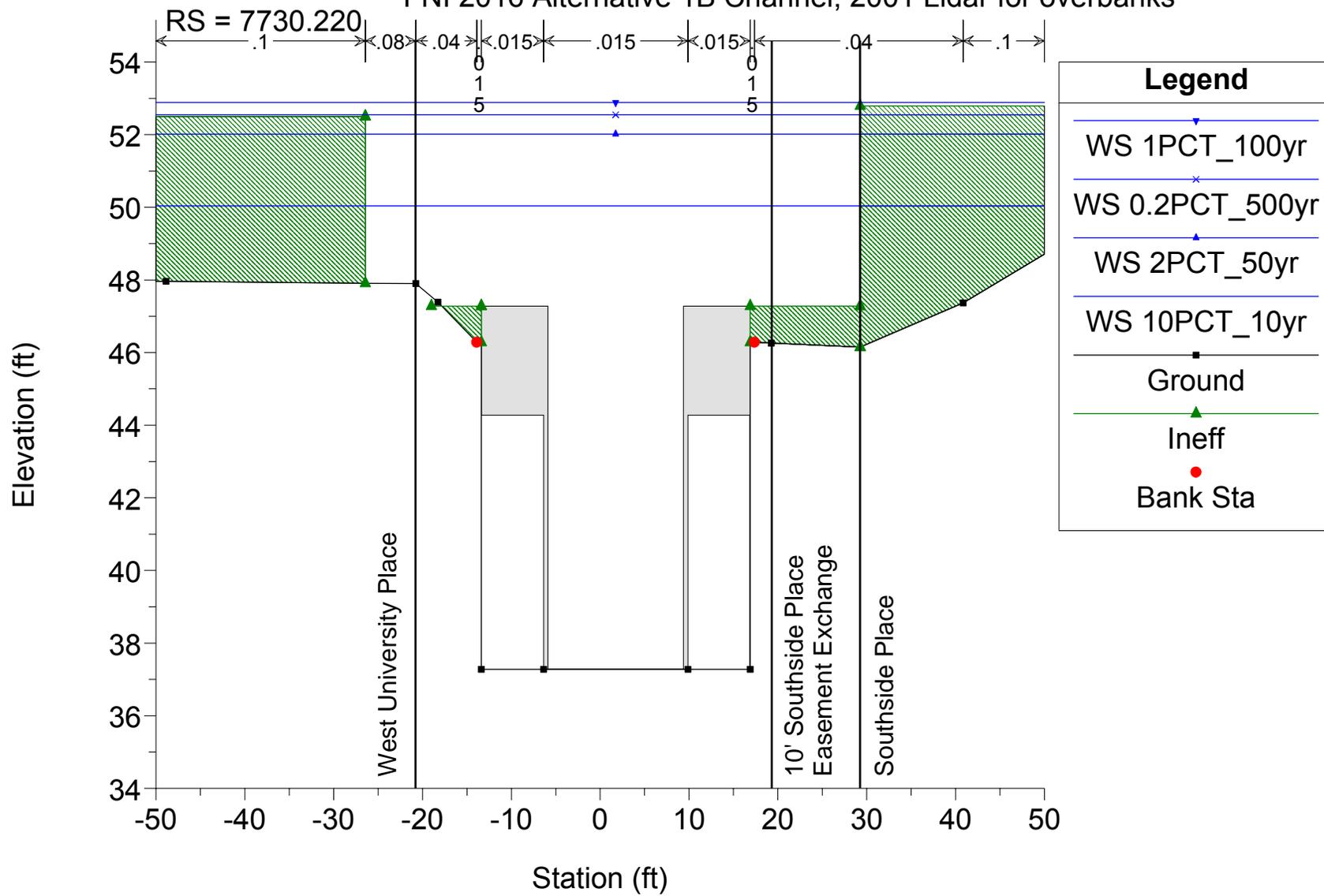
D111-00-00 Plan: Proposed Alternative 1B 12/5/2016

FNI 2016 Alternative 1B Channel; 2001 Lidar for overbanks



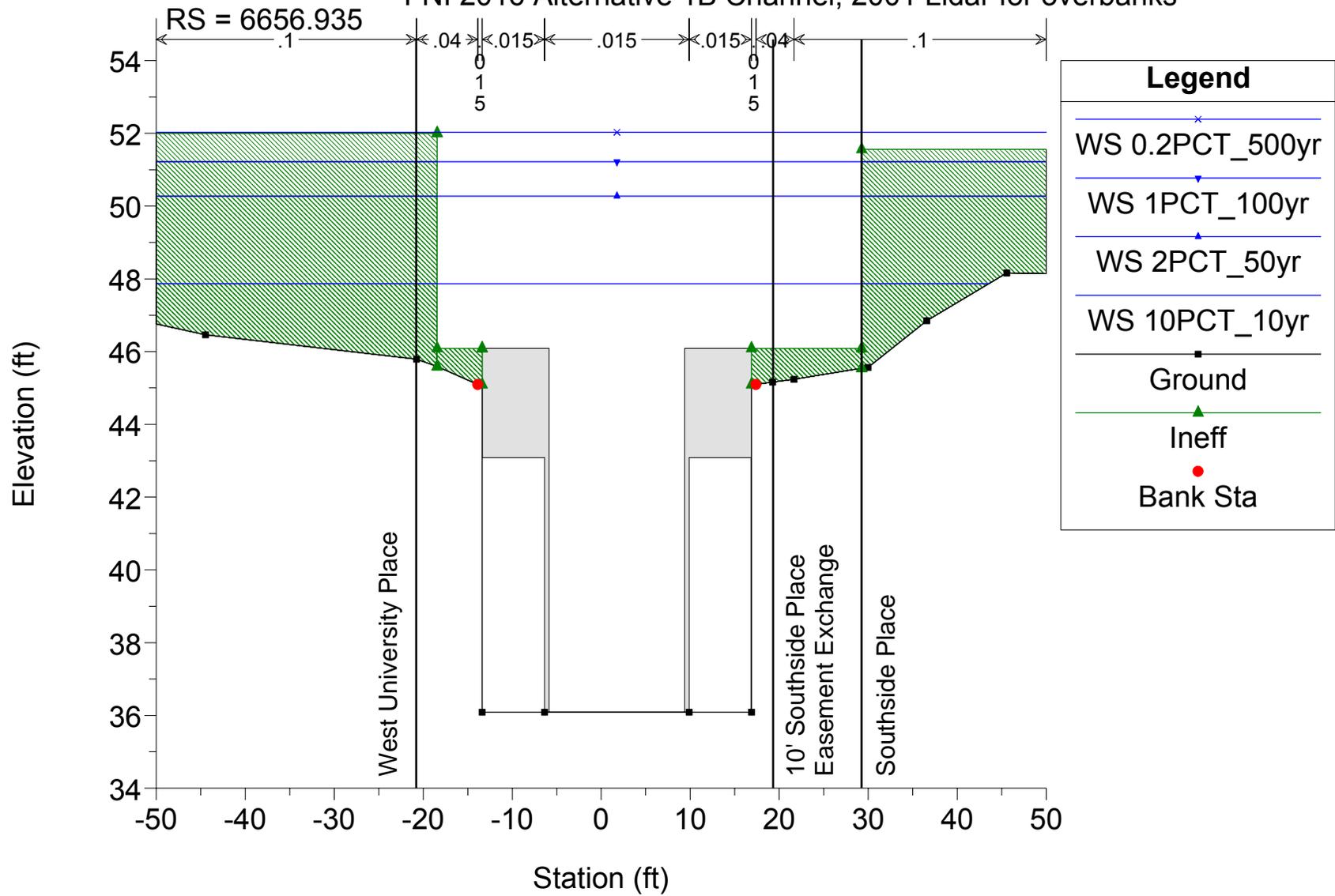
D111-00-00 Plan: Proposed Alternative 1B 12/5/2016

FNI 2016 Alternative 1B Channel; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 1B 12/5/2016

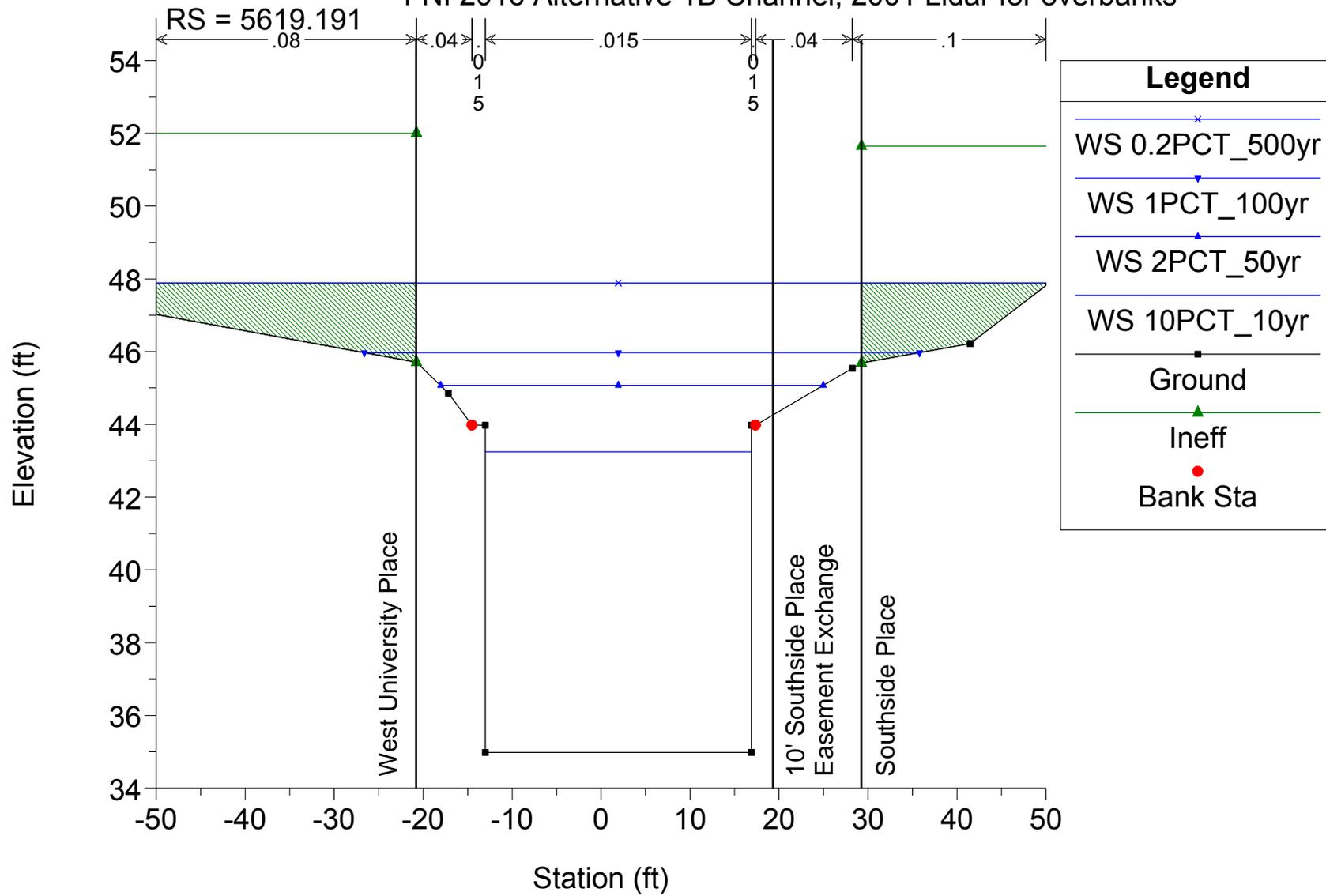
FNI 2016 Alternative 1B Channel; 2001 Lidar for overbanks





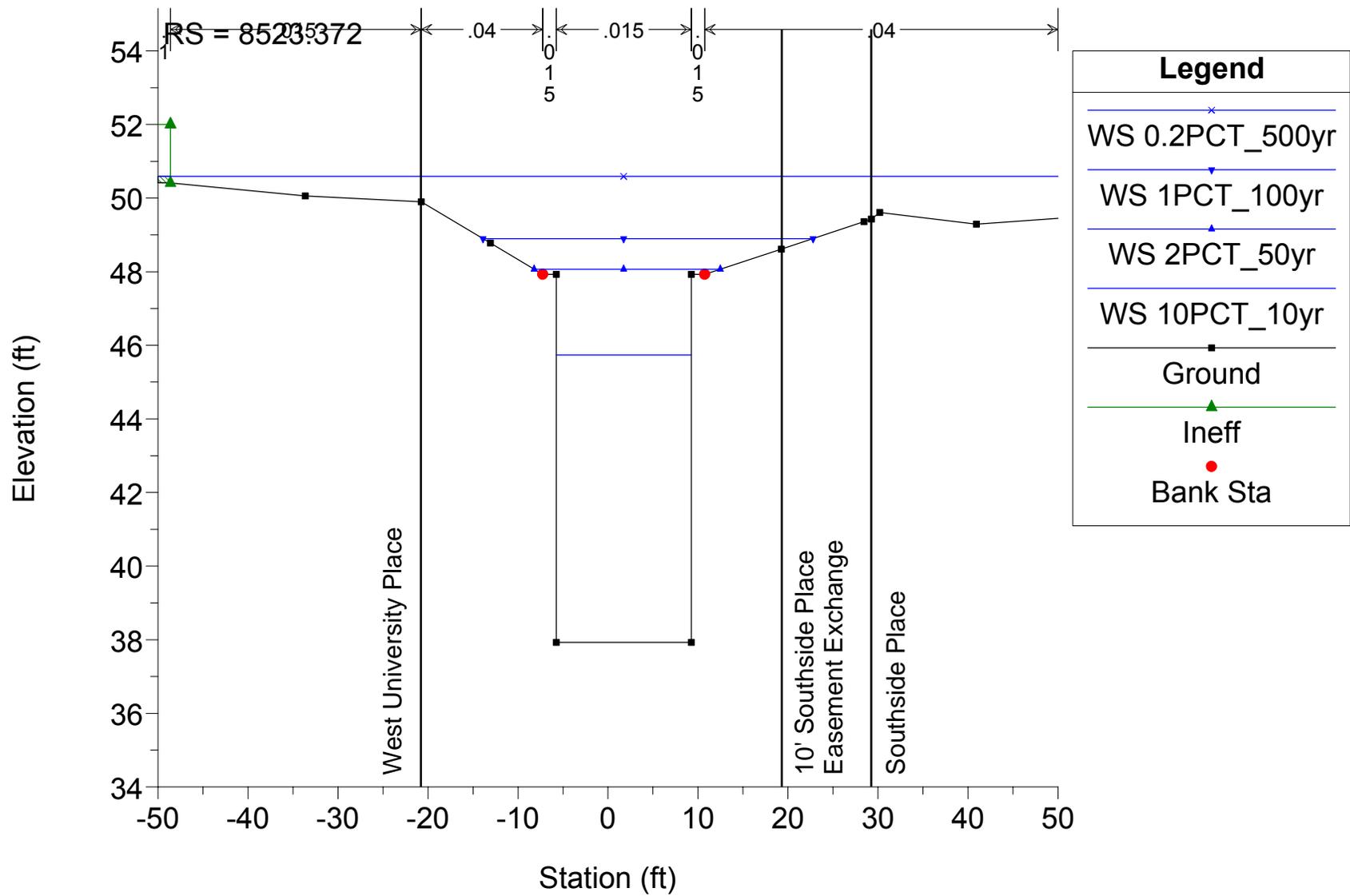
D111-00-00 Plan: Proposed Alternative 1B 12/5/2016

FNI 2016 Alternative 1B Channel; 2001 Lidar for overbanks



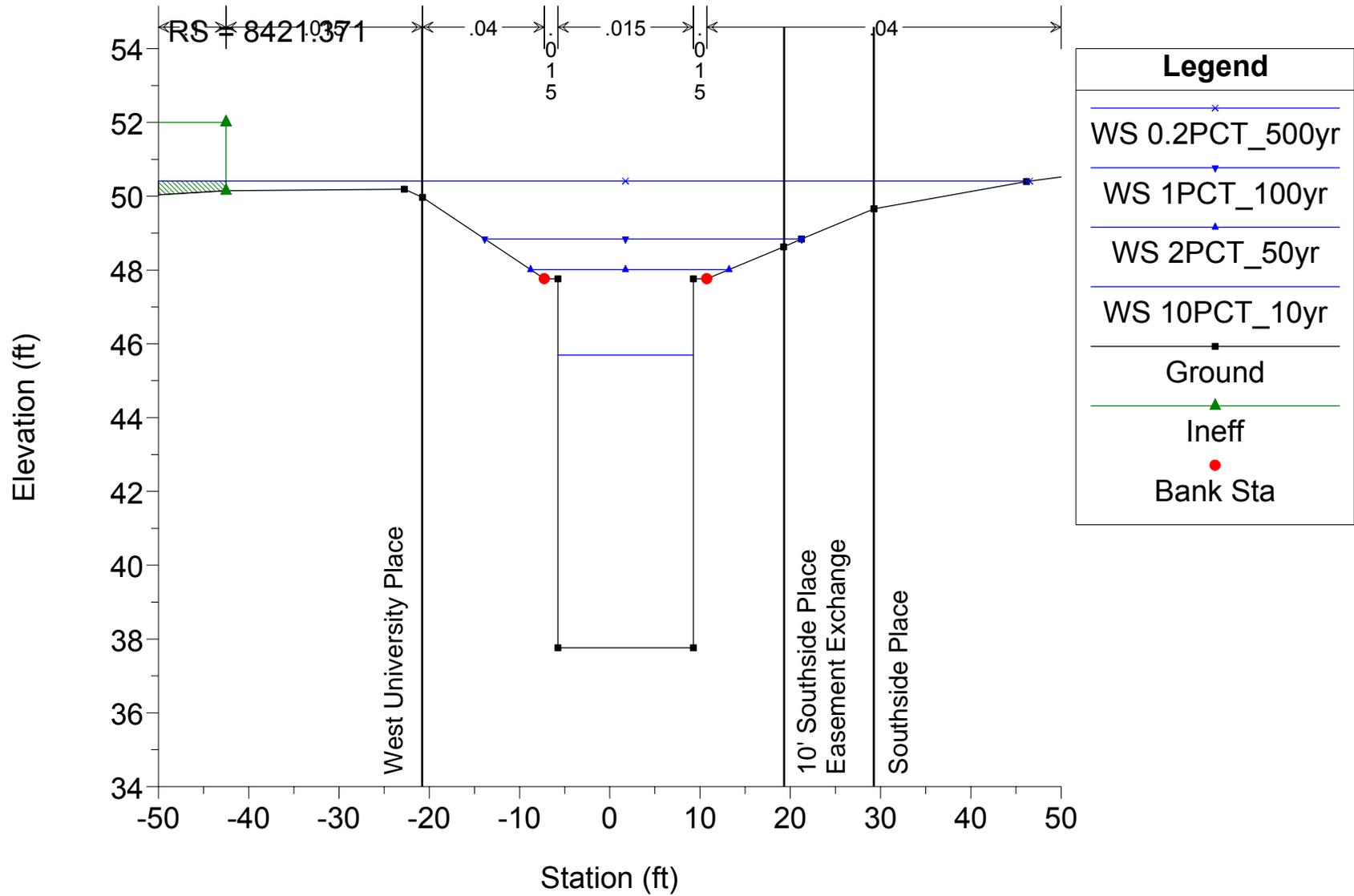
D111-00-00 Plan: Proposed Alternative 2A 12/5/2016

FNI 2016 Alternative 2A Channel; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 2A 12/5/2016

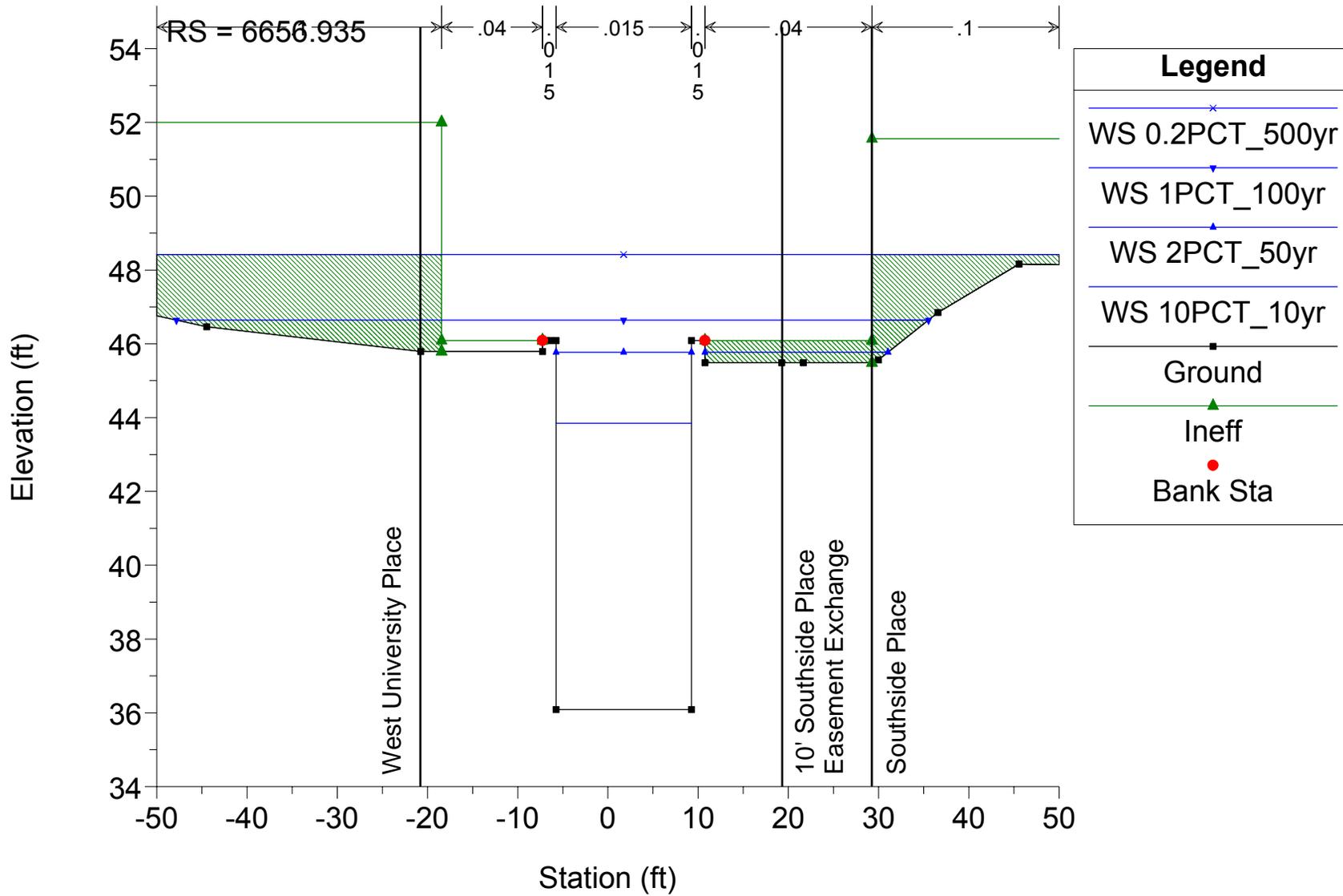
FNI 2016 Alternative 2A Channel; 2001 Lidar for overbanks





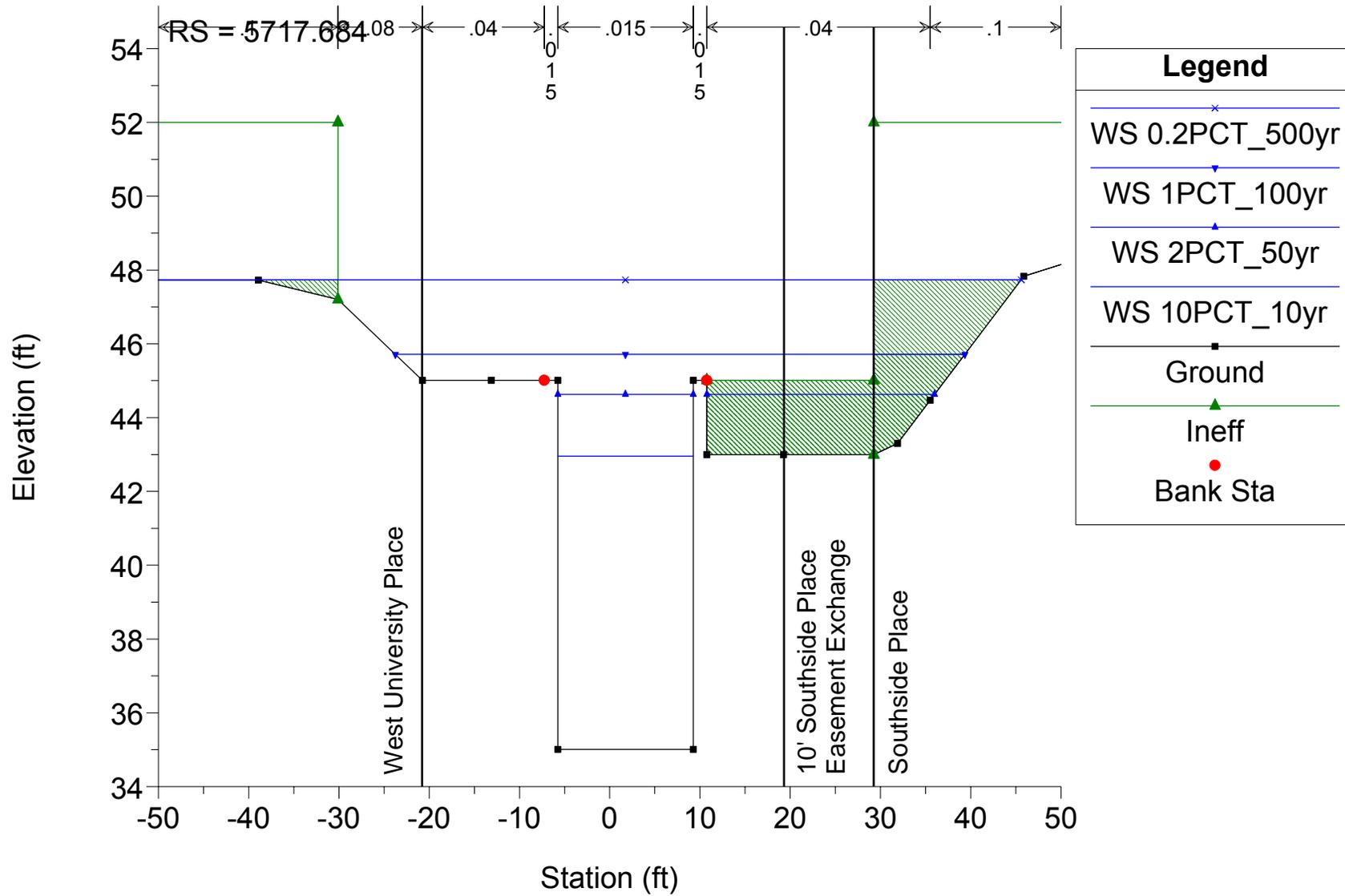
D111-00-00 Plan: Proposed Alternative 2A 12/5/2016

FNI 2016 Alternative 2A Channel; 2001 Lidar for overbanks



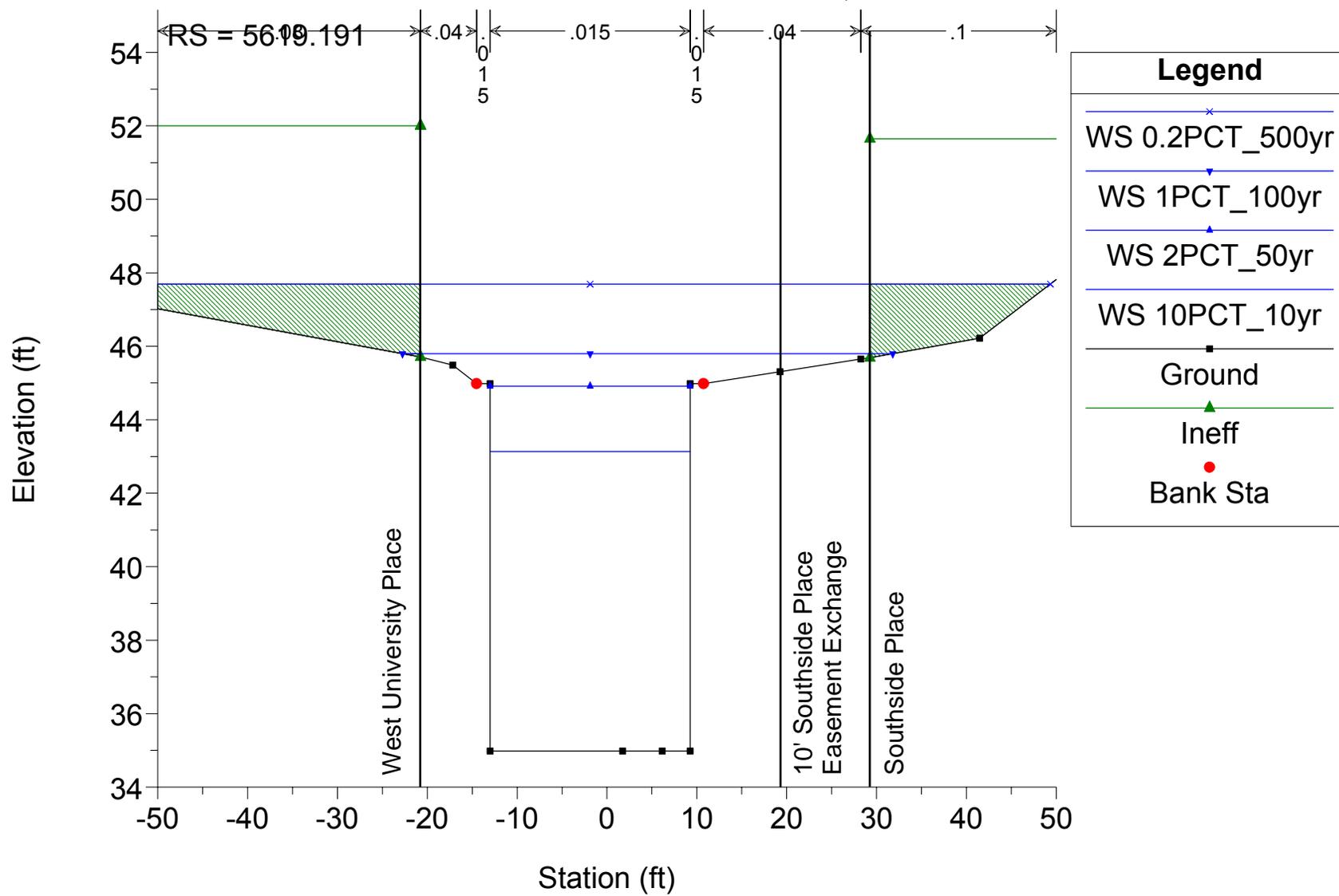
D111-00-00 Plan: Proposed Alternative 2A 12/5/2016

FNI 2016 Alternative 2A Channel; 2001 Lidar for overbanks



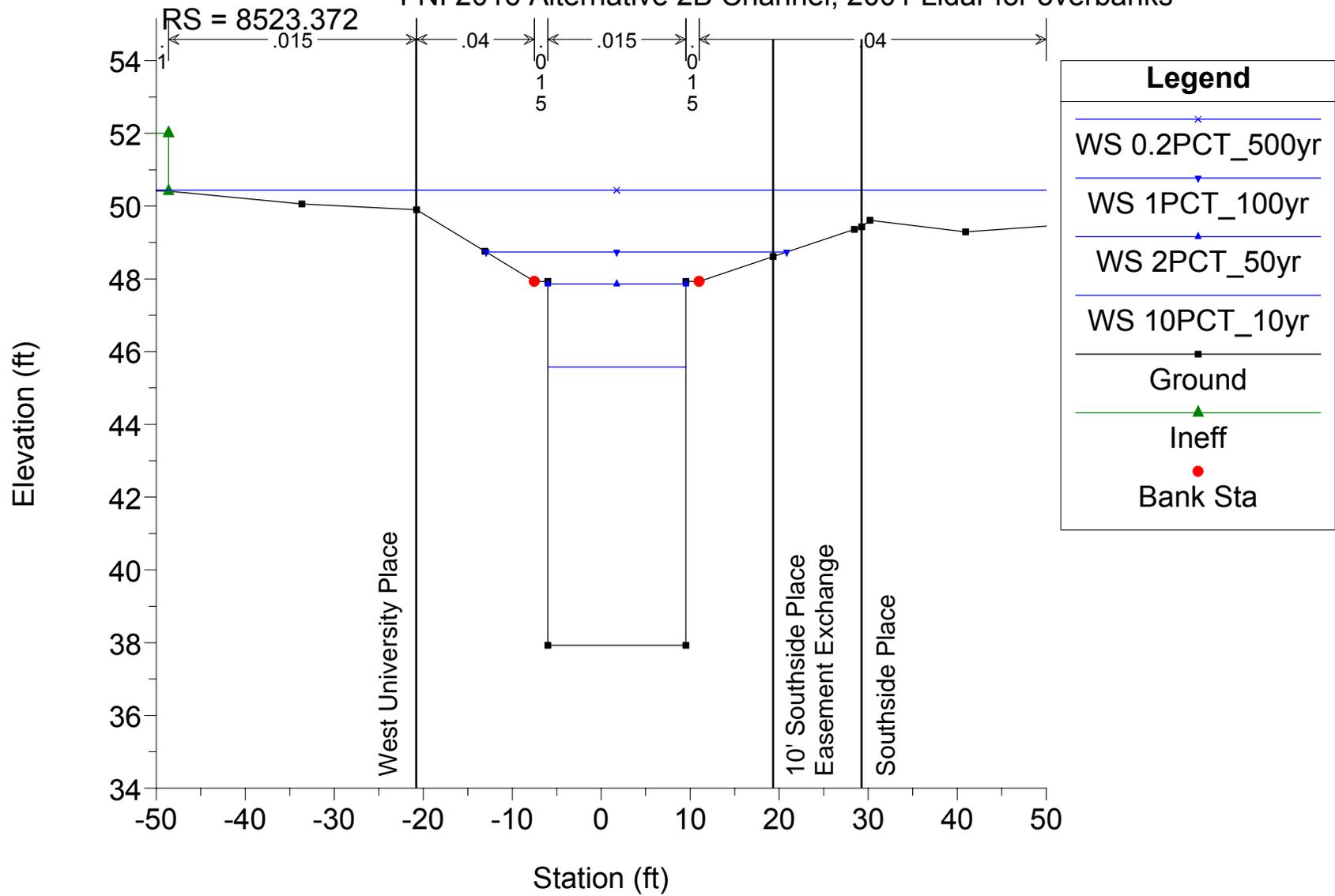
D111-00-00 Plan: Proposed Alternative 2A 12/5/2016

FNI 2016 Alternative 2A Channel; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 2B 11/30/2016

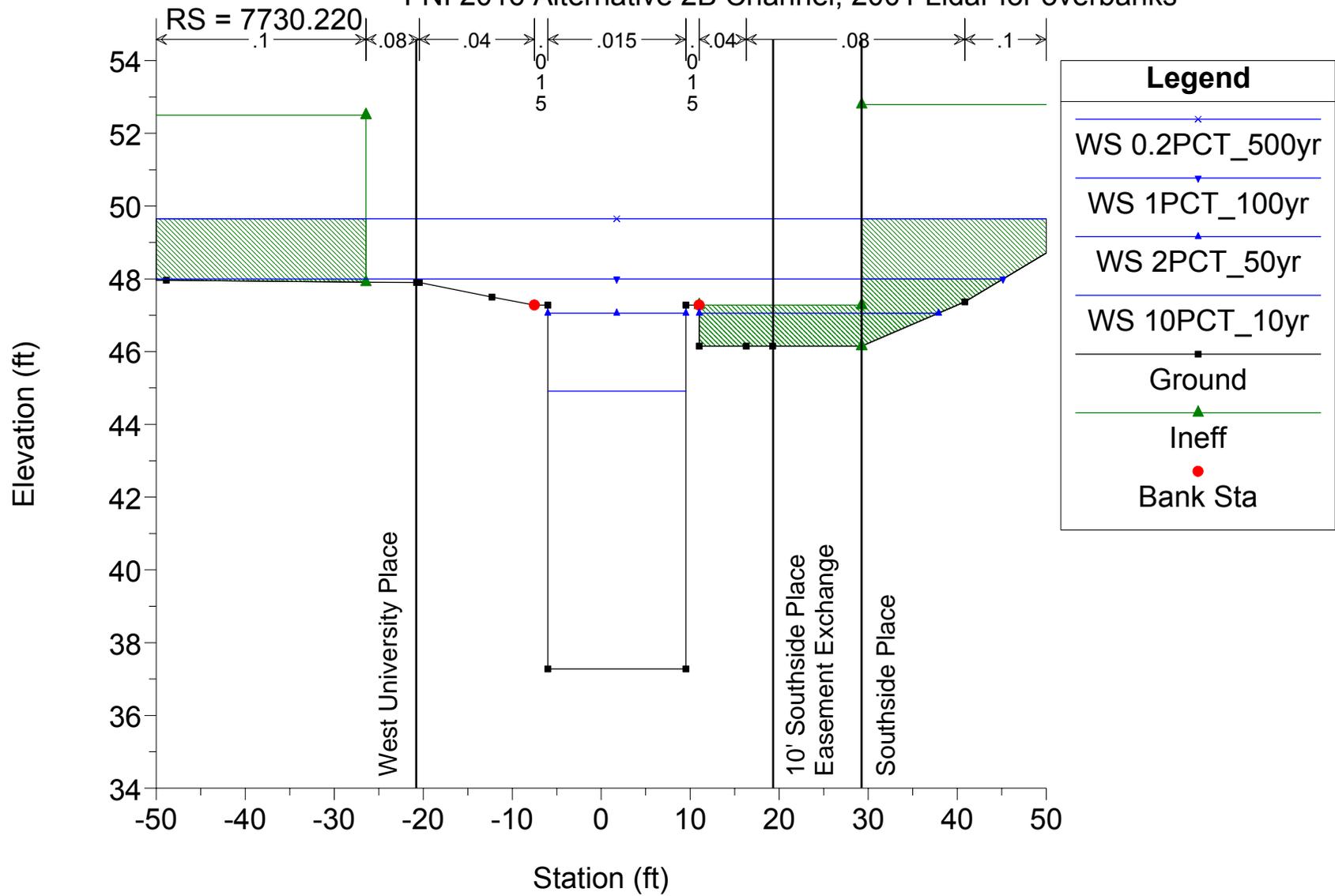
FNI 2016 Alternative 2B Channel; 2001 Lidar for overbanks





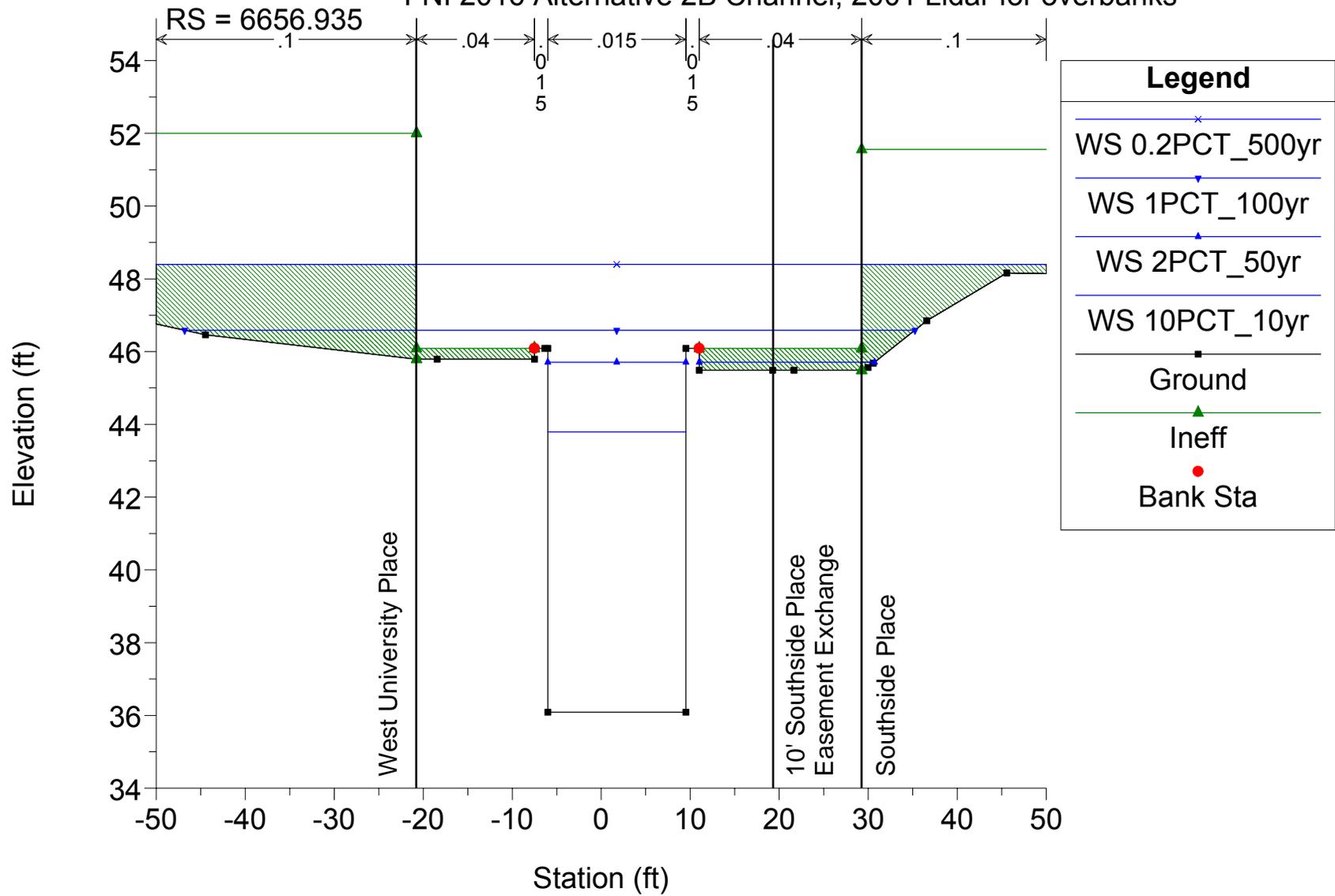
D111-00-00 Plan: Proposed Alternative 2B 11/30/2016

FNI 2016 Alternative 2B Channel; 2001 Lidar for overbanks



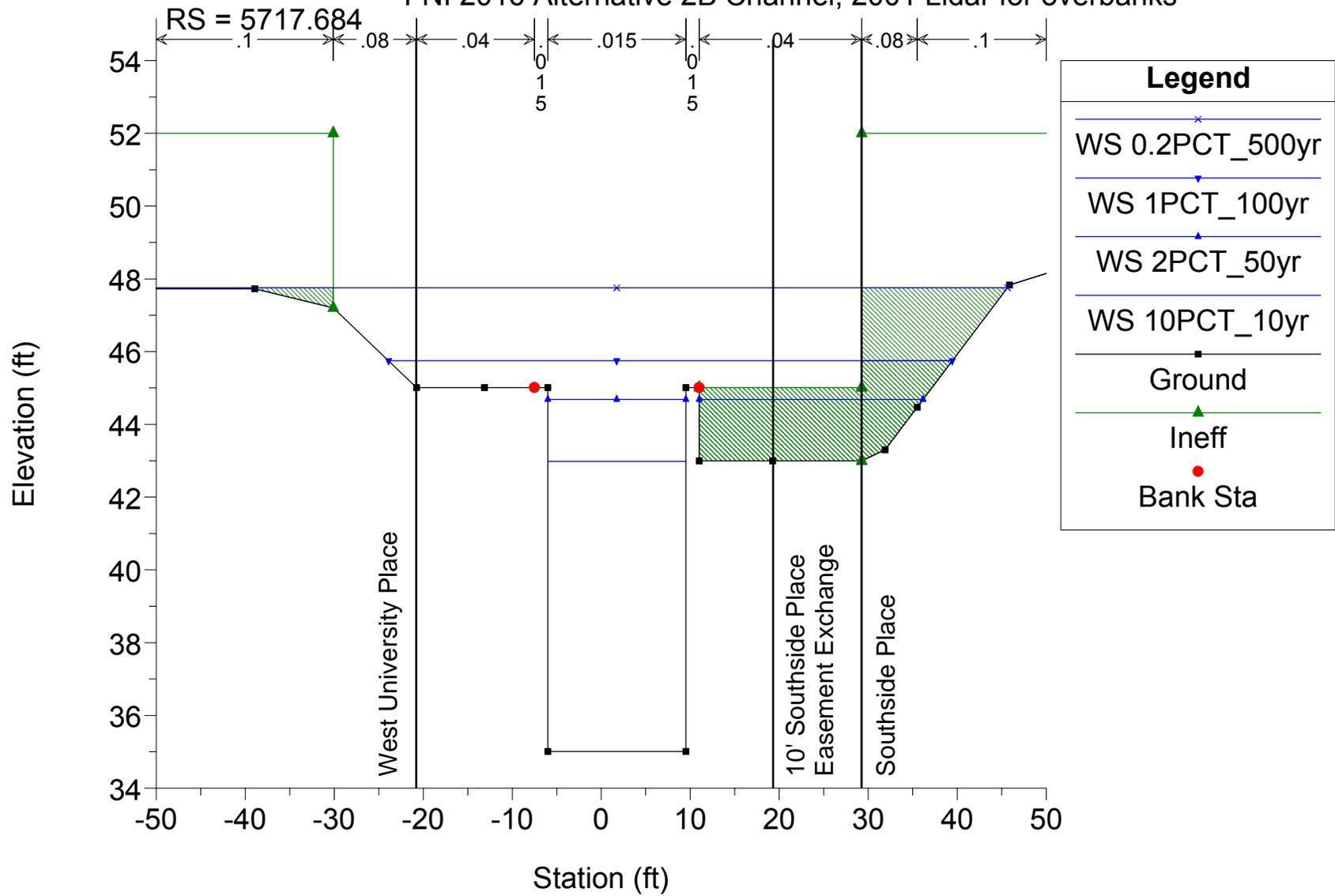
D111-00-00 Plan: Proposed Alternative 2B 11/30/2016

FNI 2016 Alternative 2B Channel; 2001 Lidar for overbanks



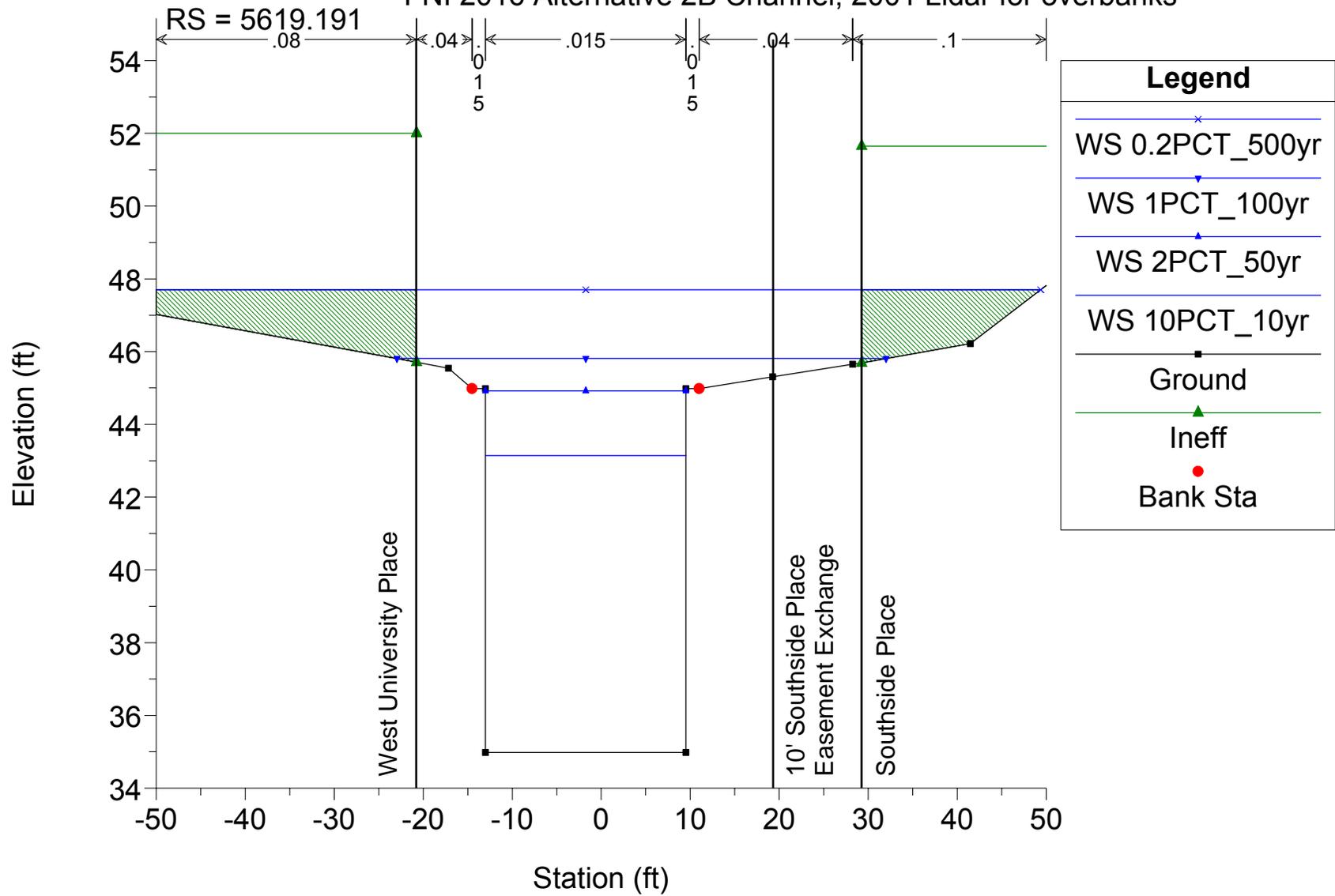
D111-00-00 Plan: Proposed Alternative 2B 11/30/2016

FNI 2016 Alternative 2B Channel; 2001 Lidar for overbanks



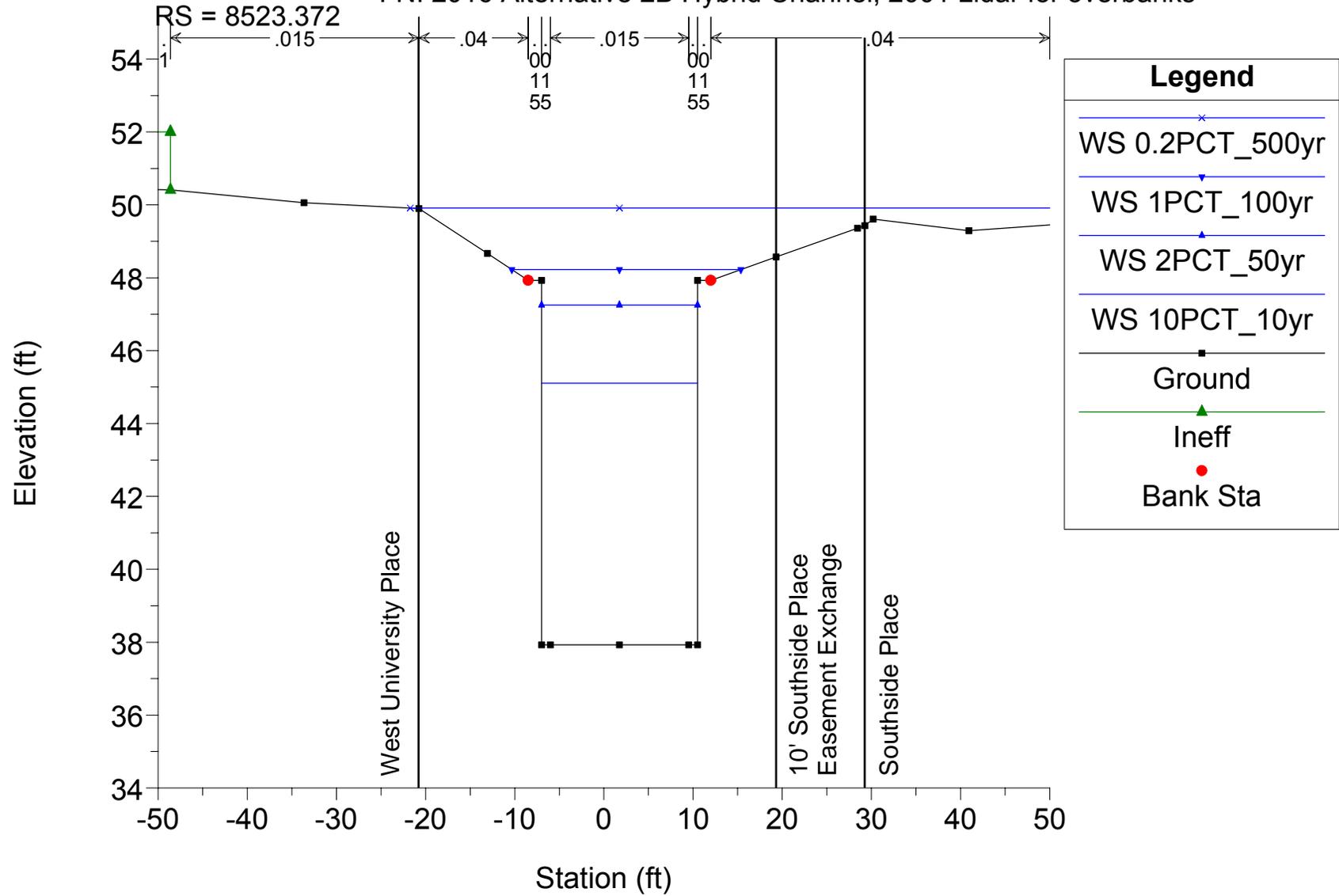
D111-00-00 Plan: Proposed Alternative 2B 11/30/2016

FNI 2016 Alternative 2B Channel; 2001 Lidar for overbanks



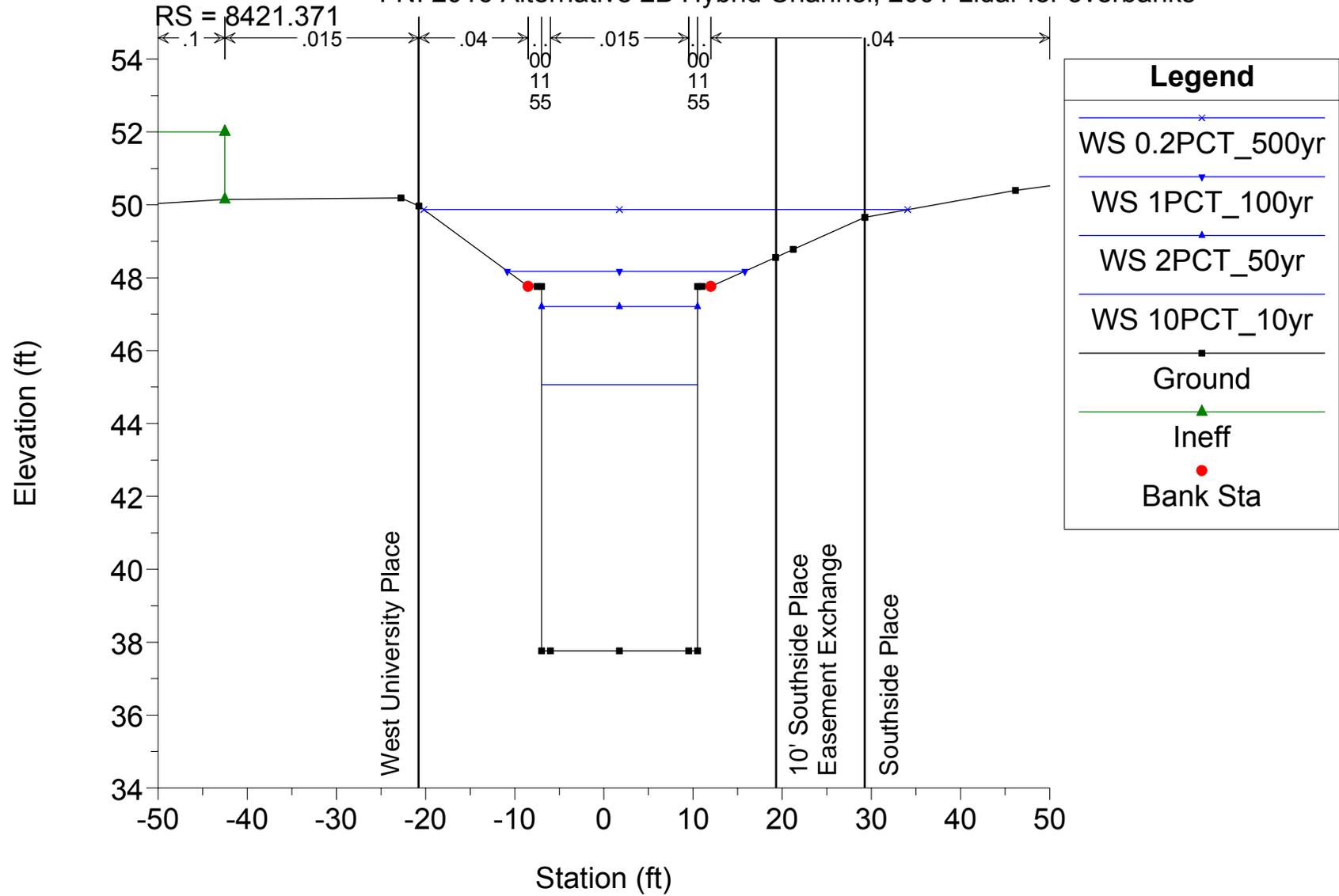
D111-00-00 Plan: Proposed Alternative 2C 12/5/2016

FNI 2016 Alternative 2B Hybrid Channel; 2001 Lidar for overbanks



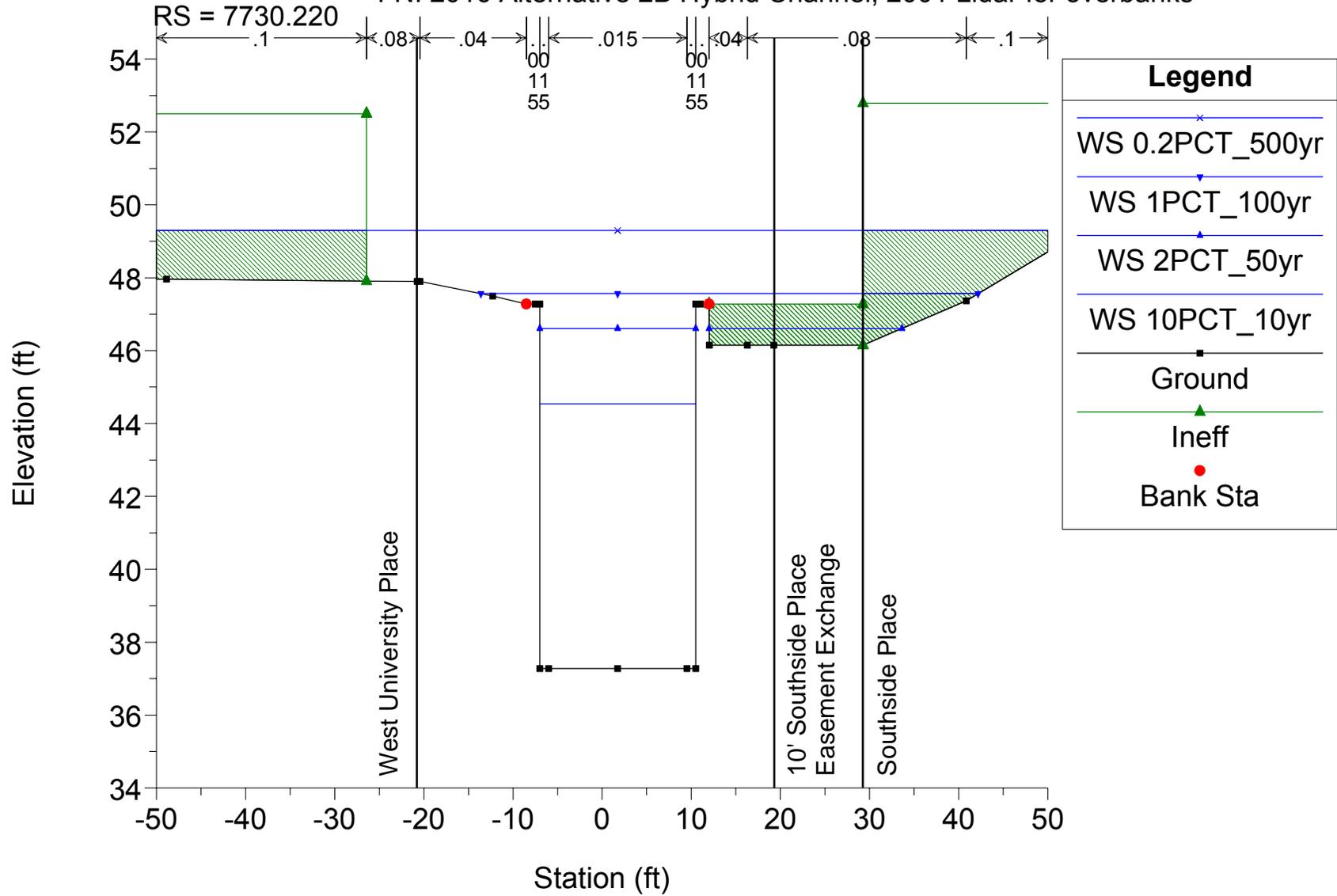
D111-00-00 Plan: Proposed Alternative 2C 12/5/2016

FNI 2016 Alternative 2B Hybrid Channel; 2001 Lidar for overbanks



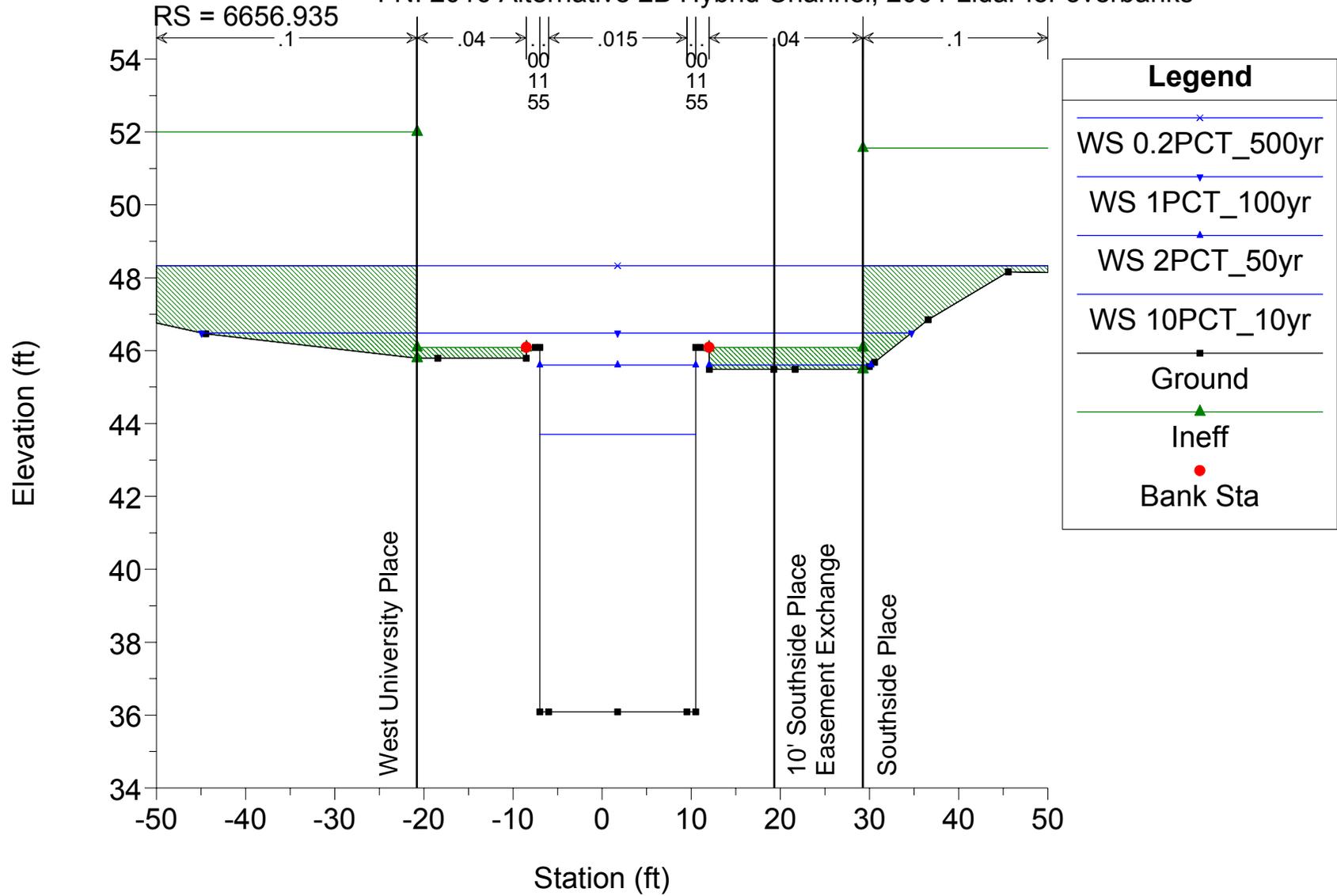
D111-00-00 Plan: Proposed Alternative 2C 12/5/2016

FNI 2016 Alternative 2B Hybrid Channel; 2001 Lidar for overbanks



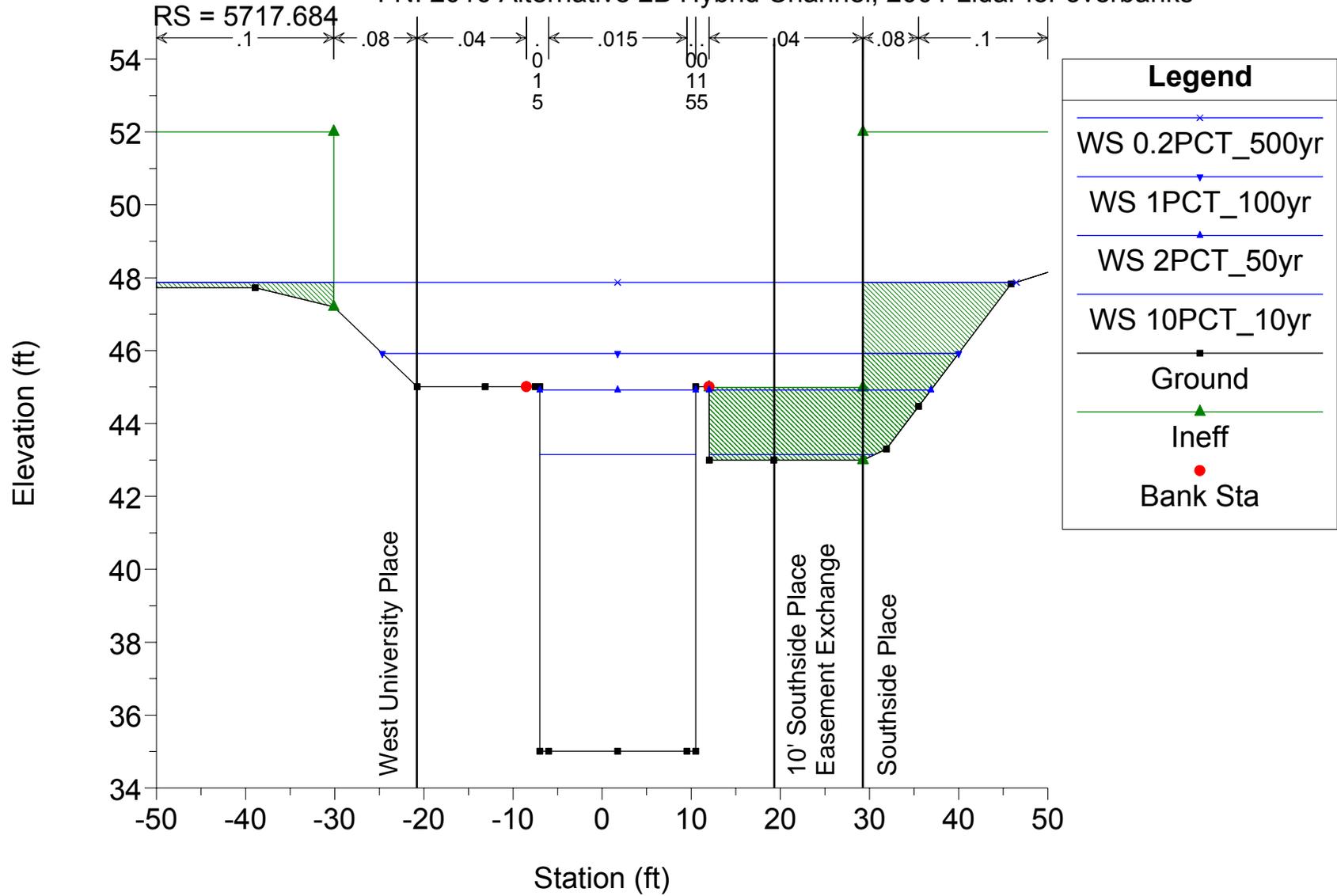
D111-00-00 Plan: Proposed Alternative 2C 12/5/2016

FNI 2016 Alternative 2B Hybrid Channel; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 2C 12/5/2016

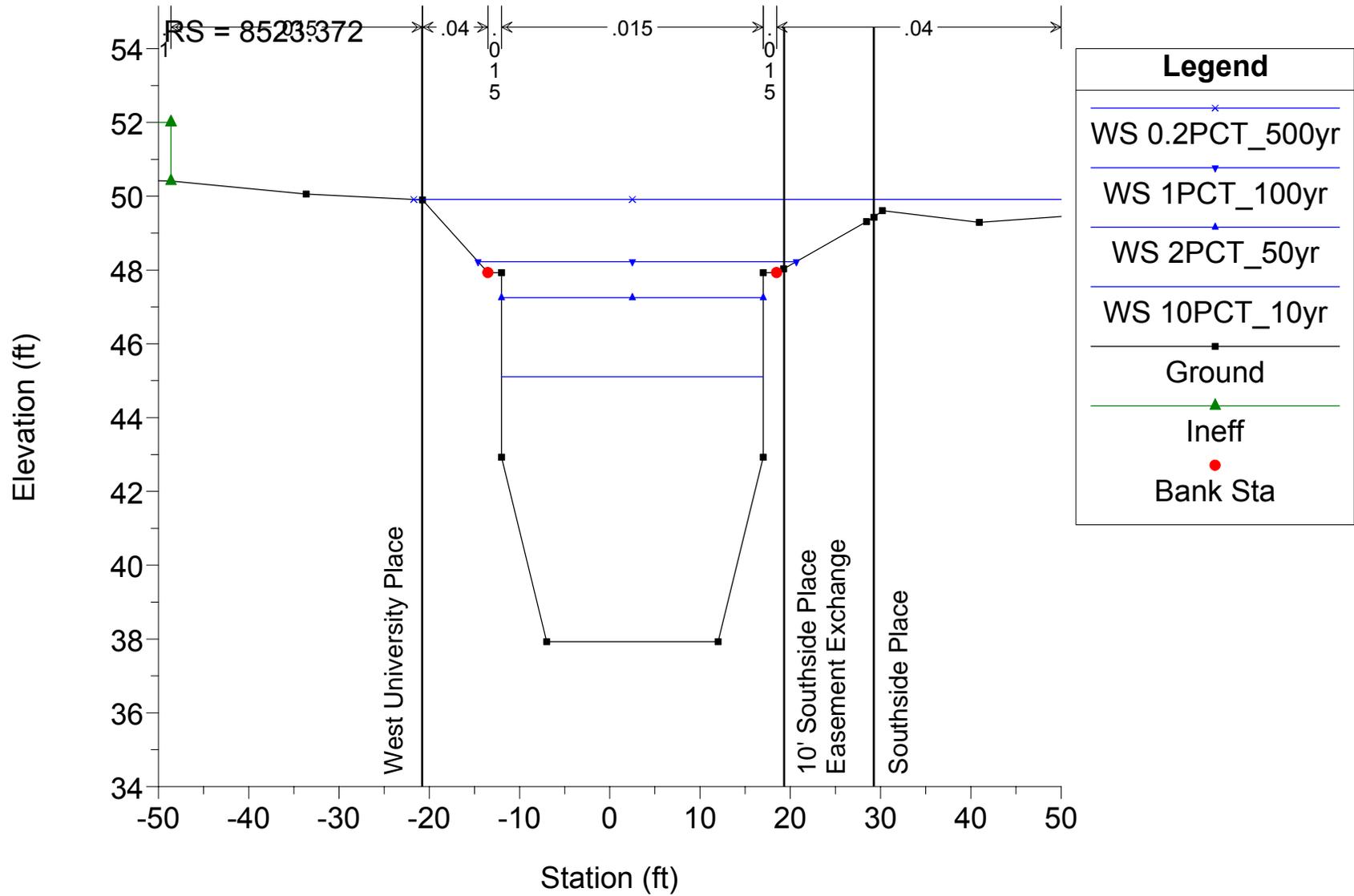
FNI 2016 Alternative 2B Hybrid Channel; 2001 Lidar for overbanks





D111-00-00 Plan: Proposed Alternative 3A 11/30/2016

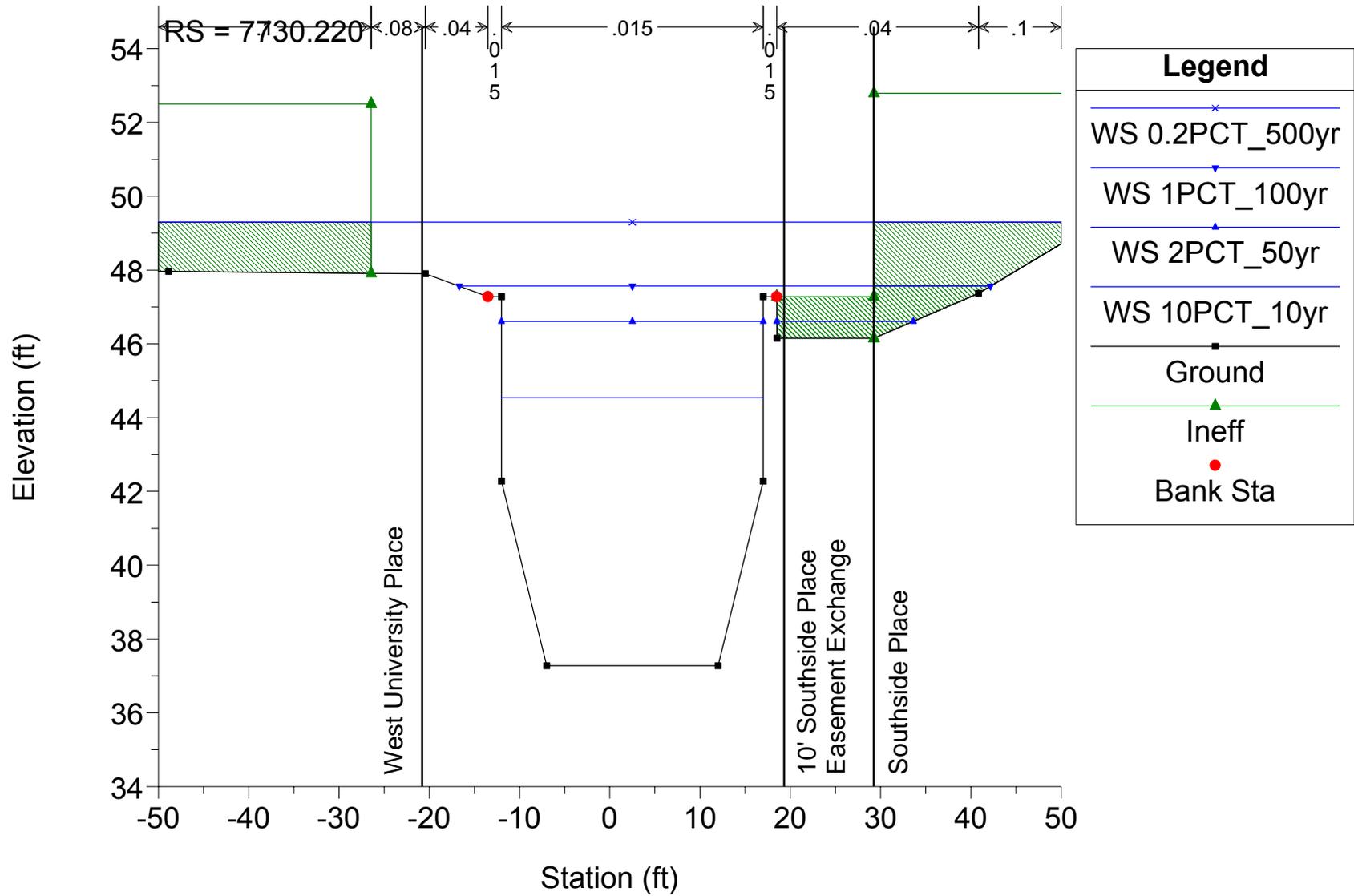
FNI 2016 Alternative 3A Channel; 2001 Lidar for overbanks





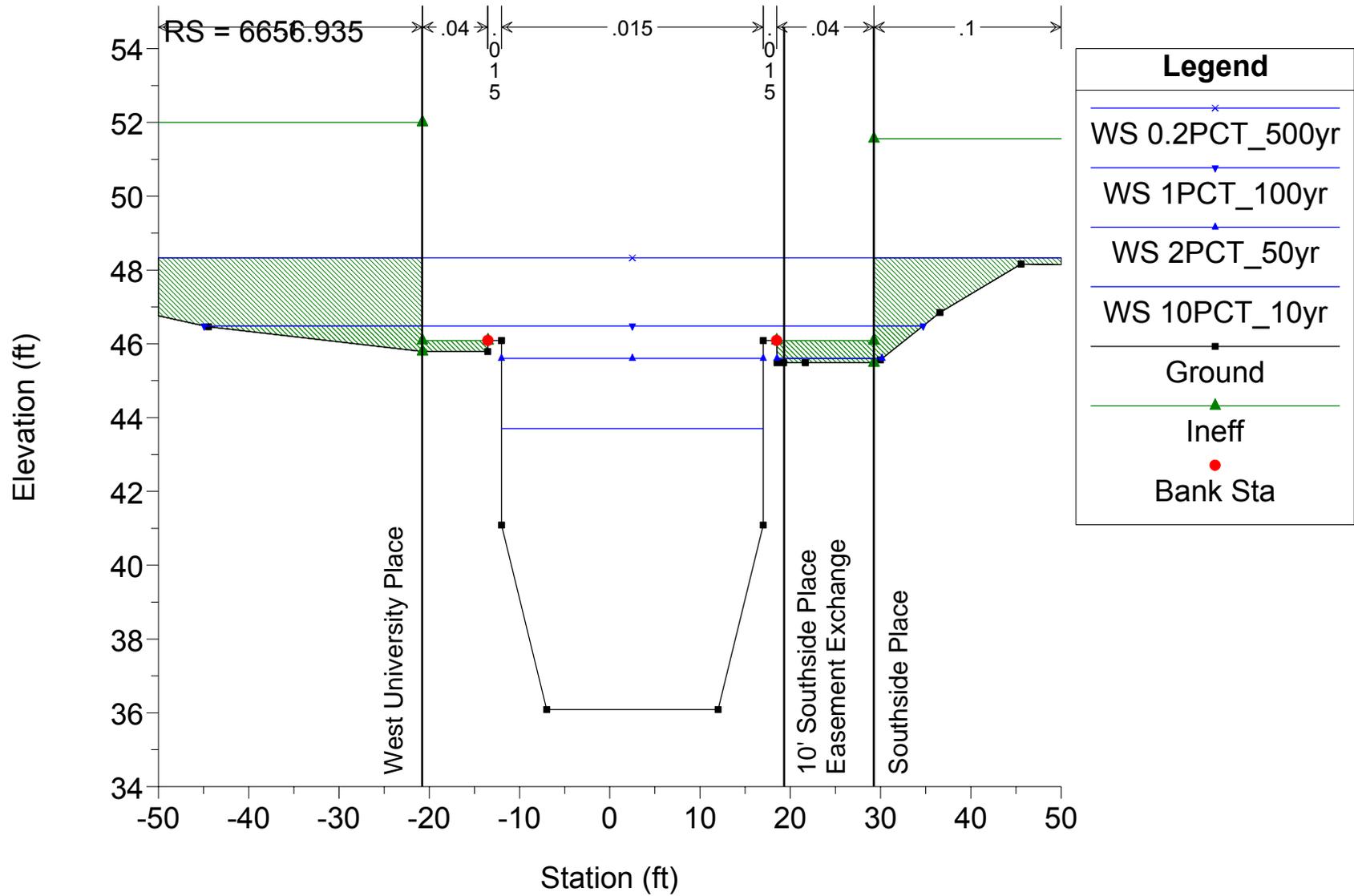
D111-00-00 Plan: Proposed Alternative 3A 11/30/2016

FNI 2016 Alternative 3A Channel; 2001 Lidar for overbanks



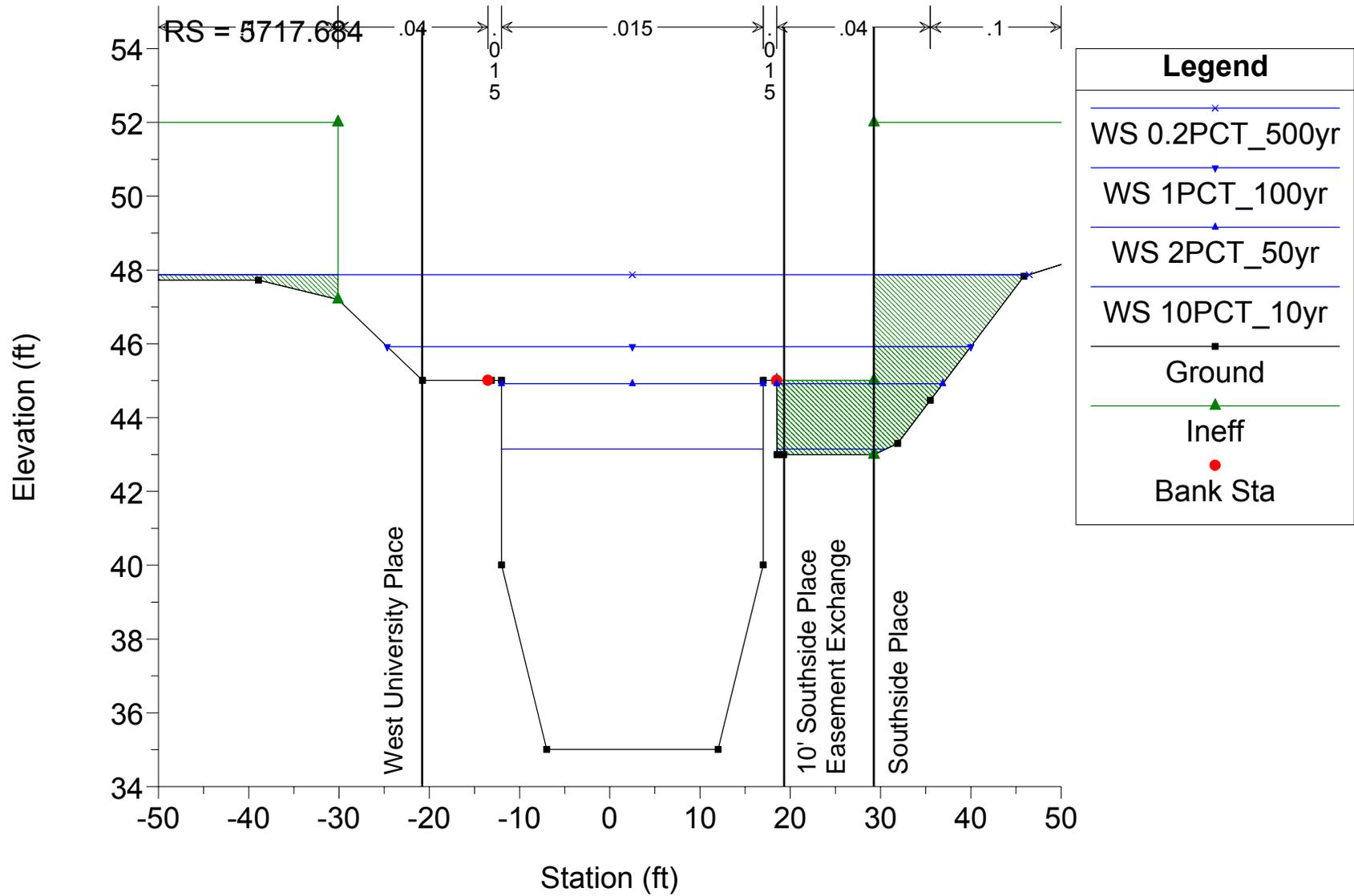
D111-00-00 Plan: Proposed Alternative 3A 11/30/2016

FNI 2016 Alternative 3A Channel; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 3A 11/30/2016

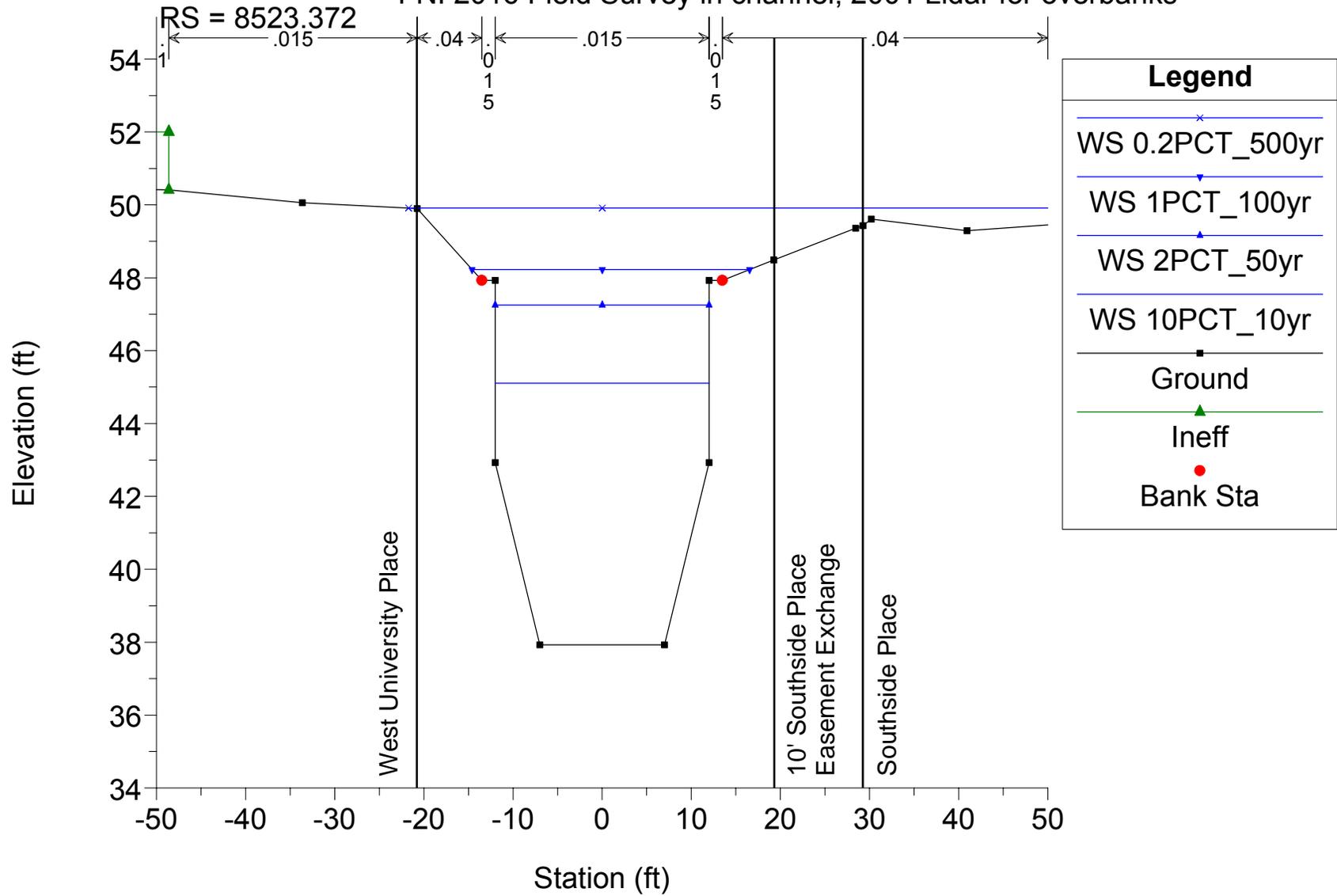
FNI 2016 Alternative 3A Channel; 2001 Lidar for overbanks





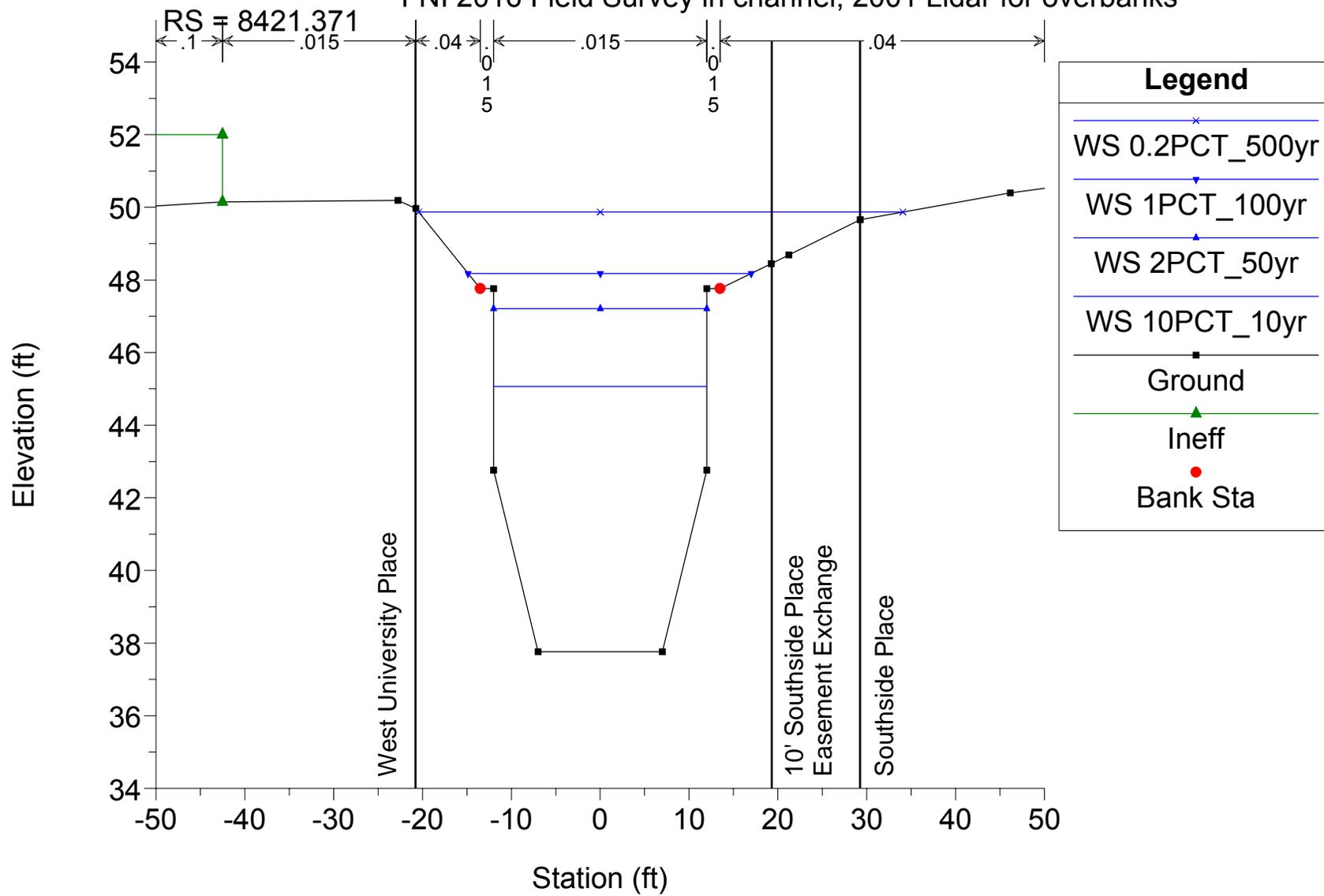
D111-00-00 Plan: Proposed Alternative 3B 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



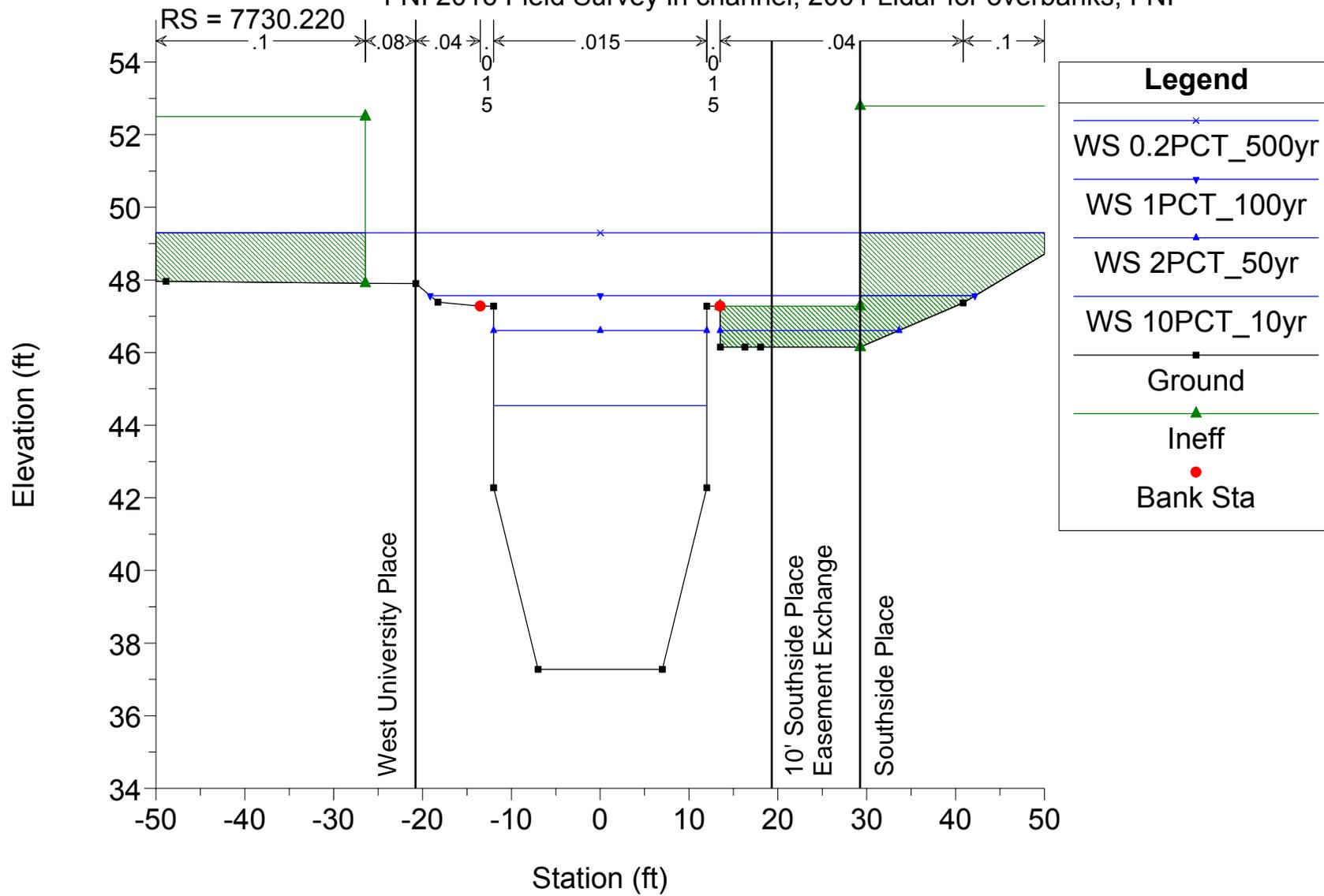
D111-00-00 Plan: Proposed Alternative 3B 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



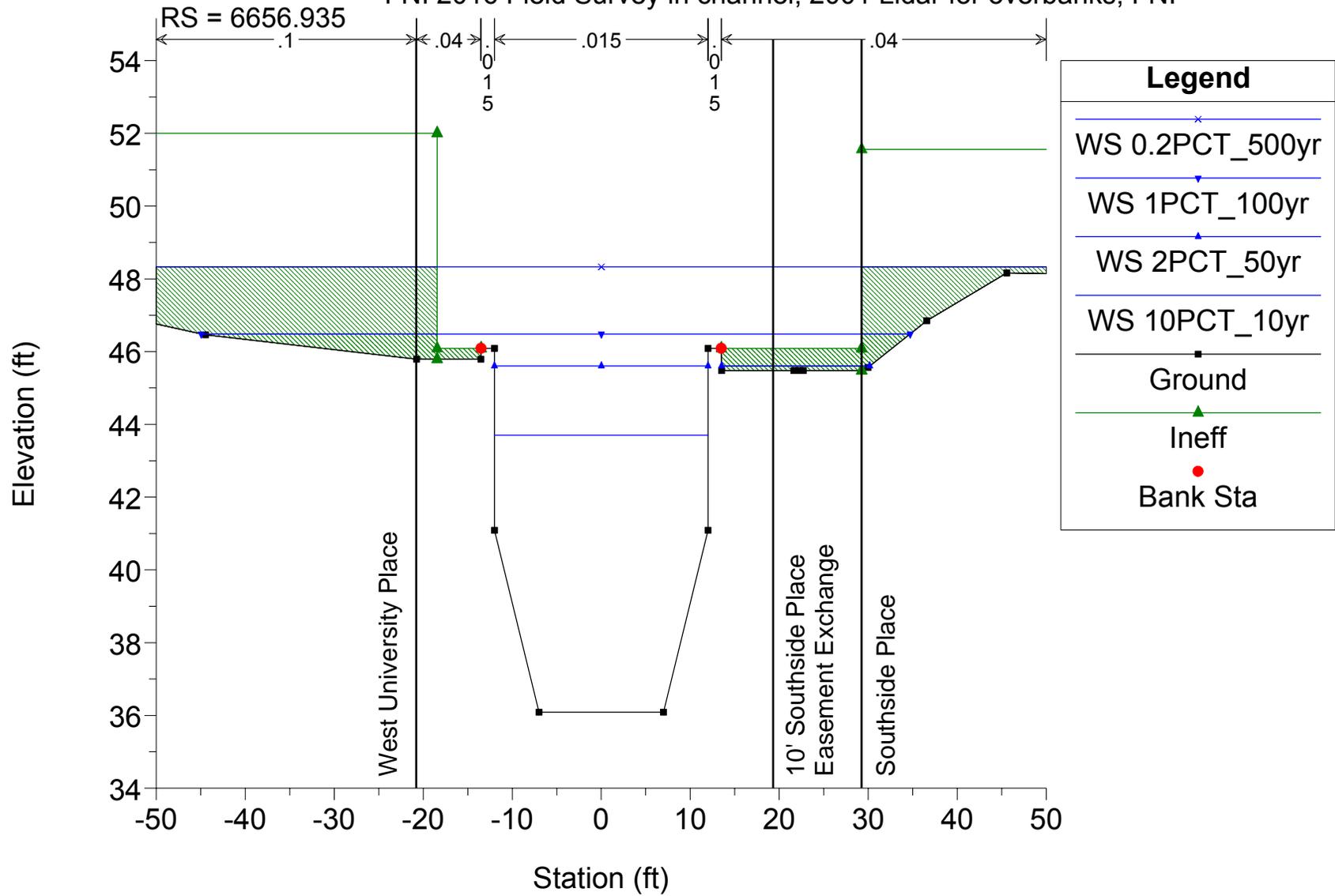
D111-00-00 Plan: Proposed Alternative 3B 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks; FNI



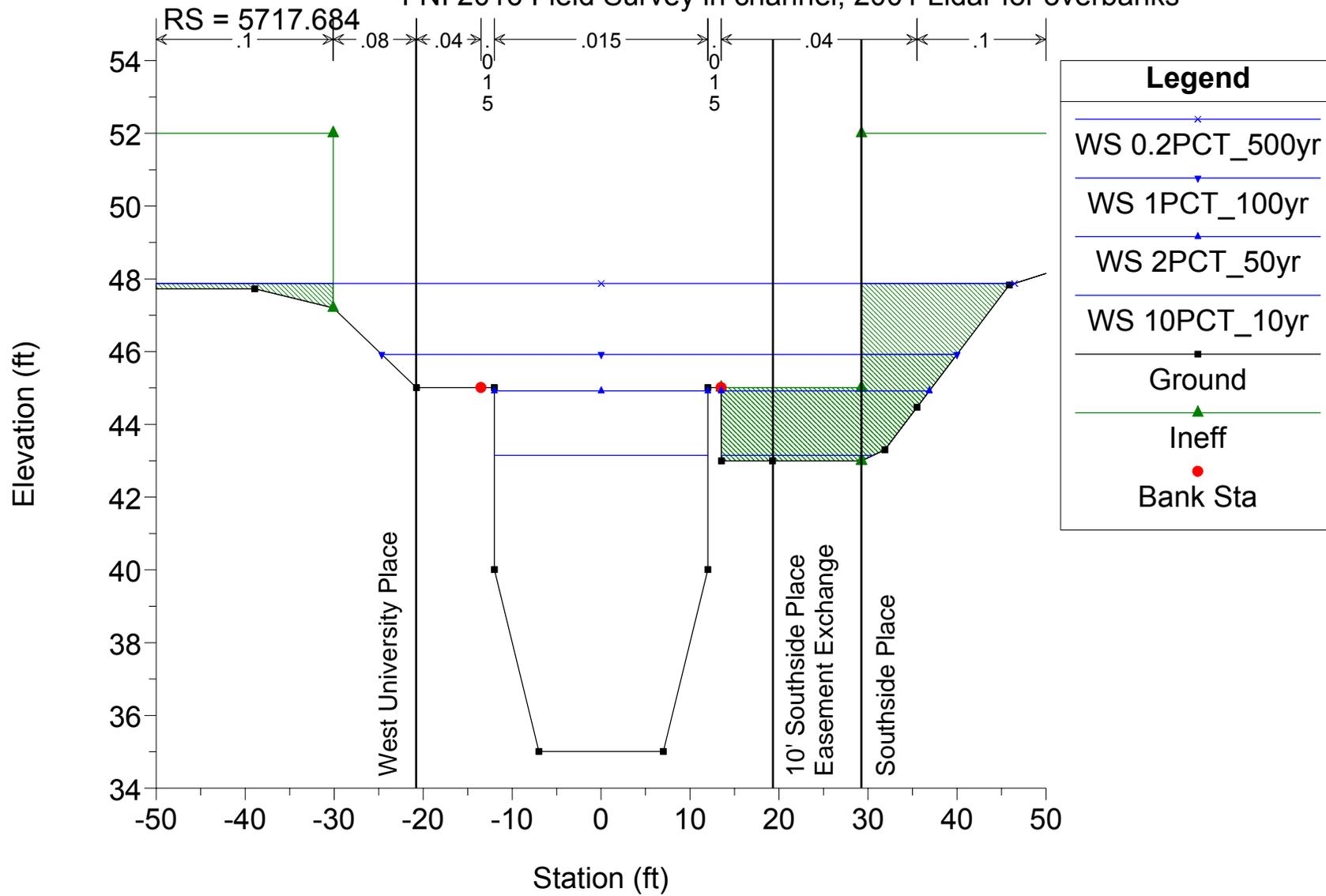
D111-00-00 Plan: Proposed Alternative 3B 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks; FNI



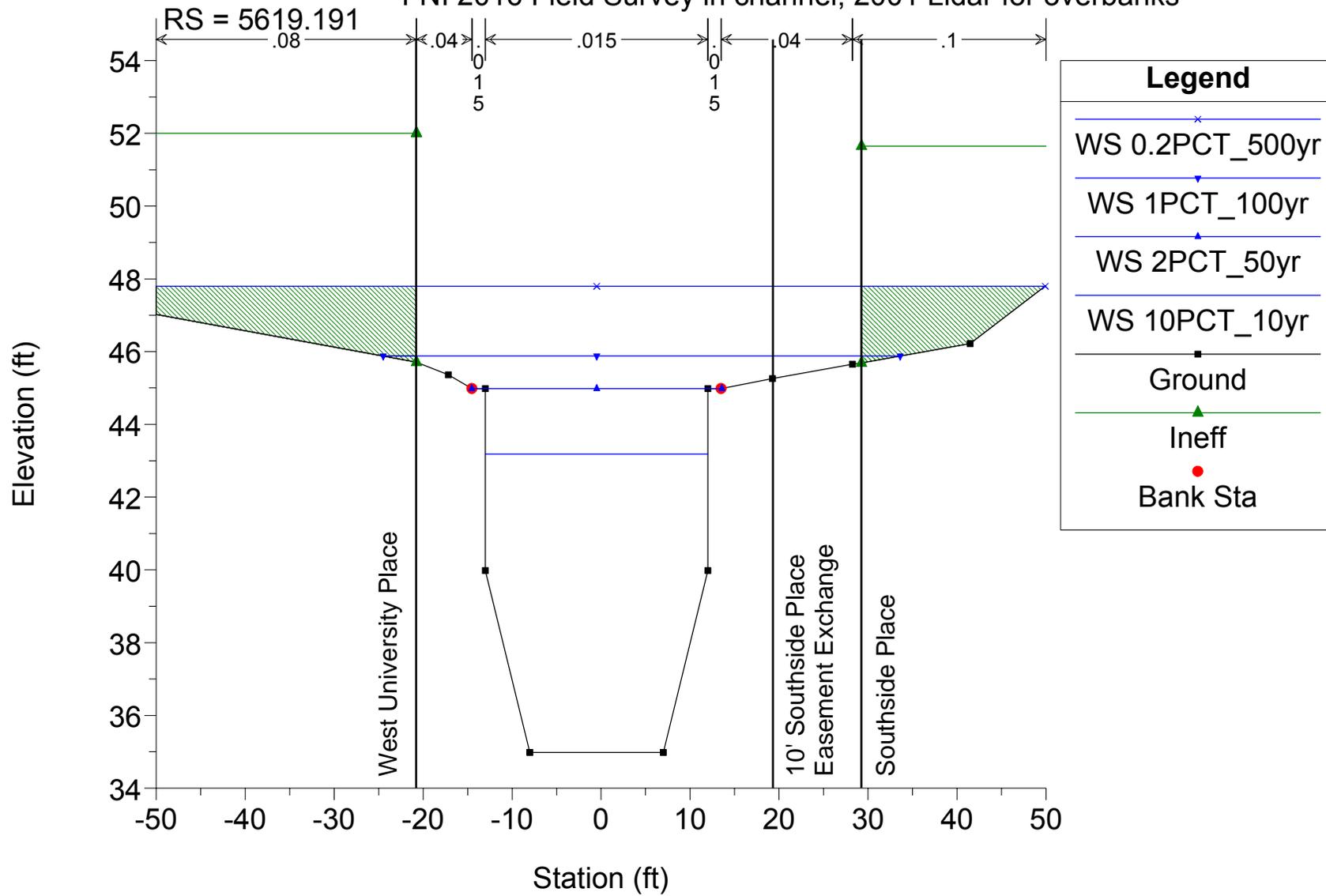
D111-00-00 Plan: Proposed Alternative 3B 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



D111-00-00 Plan: Proposed Alternative 3B 12/5/2016

FNI 2016 Field Survey in channel; 2001 Lidar for overbanks



**APPENDIX F: ESTIMATES OF PROBABLE CONSTRUCTION COST ITEMS (CHANNEL ONLY)**



ESTIMATE OF PROBABLE CONSTRUCTION COST ITEMS (CHANNEL ONLY)

FEBRUARY 21, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 2A

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>TEMPORARY EXCAVATION MEASURES</b>					
1	SOIL ANCHORS	23,100	LF	\$25.00	\$577,500
<b>NEW CONSTRUCTION</b>					
2	EXCAVATION AND OFF-SITE DISPOSAL	19,100	CY	\$25.00	\$477,500
3	IMPORTED FILL	16,710	CY	\$40.00	\$668,400
4	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	5,190	CY	\$1,200.00	\$6,228,000
5	REINFORCED CONCRETE (VERTICAL) - FOR RECTANGULAR CHANNEL WALLS	3,120	CY	\$2,000.00	\$6,240,000
<b>TOTAL</b>					<b>\$14,191,400</b>



ESTIMATE OF PROBABLE CONSTRUCTION COST ITEMS (CHANNEL ONLY)

FEBRUARY 21, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 2B

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>TEMPORARY EXCAVATION MEASURES</b>					
1	SHEET PILING	105,000	SF	\$55.00	\$5,775,000
<b>NEW CONSTRUCTION</b>					
2	EXCAVATION AND OFF-SITE DISPOSAL	22,230	CY	\$25.00	\$555,750
3	IMPORTED FILL	20,350	CY	\$40.00	\$814,000
4	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	5,400	CY	\$1,200.00	\$6,480,000
5	REINFORCED CONCRETE (VERTICAL) - FOR RECTANGULAR CHANNEL WALLS	3,120	CY	\$2,000.00	\$6,240,000
<b>TOTAL</b>					<b>\$19,864,750</b>



HCFC D POOR FARM DITCH CONVEYANCE IMPROVEMENTS PROJECT  
HARRIS COUNTY FLOOD CONTROL DISTRICT

ESTIMATE OF PROBABLE CONSTRUCTION COST ITEMS (CHANNEL ONLY)

FEBRUARY 21, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 2C

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>TEMPORARY EXCAVATION MEASURES</b>					
1	SOIL ANCHORS	23,100	LF	\$25.00	\$577,500
2	SHEET PILING	52,500	SF	\$55.00	\$2,887,500
<b>NEW CONSTRUCTION</b>					
3	EXCAVATION AND OFF-SITE DISPOSAL	22,720	CY	\$25.00	\$568,000
4	IMPORTED FILL	17,210	CY	\$40.00	\$688,400
5	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	5,860	CY	\$1,200.00	\$7,032,000
6	REINFORCED CONCRETE (VERTICAL) - FOR RECTANGULAR CHANNEL WALLS	3,120	CY	\$2,000.00	\$6,240,000
<b>TOTAL</b>					<b>\$17,993,400</b>



ESTIMATE OF PROBABLE CONSTRUCTION COST ITEMS (CHANNEL ONLY)

FEBRUARY 21, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 3A

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>NEW CONSTRUCTION</b>					
1	SOIL ANCHORS	64,400	LF	\$25.00	\$1,610,000
2	EXCAVATION AND OFF-SITE DISPOSAL	16,890	CY	\$25.00	\$422,250
3	IMPORTED FILL	4,530	CY	\$40.00	\$181,200
4	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	3,950	CY	\$1,200.00	\$4,740,000
5	REINFORCED CONCRETE (HORIZONTAL) - FOR SLOPE PAVEMENT COMPRISING TRAPEZOIDAL CHANNEL	1,400	CY	\$1,200.00	\$1,680,000
6	REINFORCED CONCRETE (HORIZONTAL) - FOR RETAINING WALLS	1,200	CY	\$1,200.00	\$1,440,000
7	REINFORCED CONCRETE (VERTICAL) - FOR RETAINING WALLS	1,200	CY	\$2,000.00	\$2,400,000
<b>PROJECT TOTAL</b>					<b>\$12,473,450</b>



ESTIMATE OF PROBABLE CONSTRUCTION COST ITEMS (CHANNEL ONLY)

FEBRUARY 21, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 3B

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>NEW CONSTRUCTION</b>					
1	SOIL ANCHORS	58,800	LF	\$25.00	\$1,470,000
2	EXCAVATION AND OFF-SITE DISPOSAL	12,700	CY	\$25.00	\$317,500
3	IMPORTED FILL	6,810	CY	\$40.00	\$272,400
4	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	2,910	CY	\$1,200.00	\$3,492,000
5	REINFORCED CONCRETE (HORIZONTAL) - FOR SLOPE PAVEMENT COMPRISING TRAPEZOIDAL CHANNEL	1,400	CY	\$1,200.00	\$1,680,000
6	REINFORCED CONCRETE (HORIZONTAL) - FOR RETAINING WALLS	1,200	CY	\$1,200.00	\$1,440,000
7	REINFORCED CONCRETE (VERTICAL) - FOR RETAINING WALLS	1,200	CY	\$2,000.00	\$2,400,000
<b>PROJECT TOTAL</b>					<b>\$11,071,900</b>

**APPENDIX G: TOTAL PROJECT COSTS (ALTERNATIVES 3A AND 3B)**



HCFCD POOR FARM DITCH CONVEYANCE IMPROVEMENTS PROJECT  
HARRIS COUNTY FLOOD CONTROL DISTRICT

TOTAL PROJECT COST

MAY 16, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 3A

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>OPINION OF PROBABLE CONSTRUCTION COST - GENERAL CIVIL ITEMS</b>					
1	MOBILIZATION (NTE 5% OF TOTAL COST FOR WORK PERFORMED BY CONTRACTOR)	1	LS	\$766,000.00	\$766,000
2	CARE OF WATER	1	LS	\$200,000.00	\$200,000
3	CLEARING AND GRUBBING	1	LS	\$20,000.00	\$20,000
4	TRAFFIC CONTROL	1	LS	\$50,000.00	\$50,000
5	STORMWATER POLLUTION PREVENTION PLAN	1	LS	\$30,000.00	\$30,000
6	FINAL GRADING, HYDROMULCH, AND CLEAN-UP	1	LS	\$15,000.00	\$15,000
				<b>SUB =</b>	<b>\$1,081,000</b>
<b>OPINION OF PROBABLE CONSTRUCTION COST - CHANNEL IMPROVEMENT ITEMS</b>					
<b>DEMOLITION, ETC.</b>					
7	REMOVAL AND DISPOSAL OF EXISTING SLOPE PAVEMENT	119,400	SF	\$6.00	\$716,400
8	REMOVAL AND DISPOSAL OF EXISTING PIPES REQUIRING RELOCATION	1,400	LF	\$10.00	\$14,000
9	NEW PVC PIPING (VARYING DIAMETERS)	1,060	LF	\$10.00	\$10,600
10	NEW 24" DIAMETER RCPs	240	LF	\$100.00	\$24,000
11	NEW 30"-36" DIAMETER RCPs	80	LF	\$250.00	\$20,000
12	NEW 48" DIAMETER RCPs	20	LF	\$350.00	\$7,000
13	NEW CONCRETE COLLARS	17	EA	\$2,000.00	\$34,000
14	ADJUSTMENT OF EXISTING OVERHEAD ELECTRIC LINES	1	LS	\$75,000.00	\$75,000
<b>NEW CONSTRUCTION</b>					
15	SOIL ANCHORS	64,400	LF	\$25.00	\$1,610,000
16	EXCAVATION AND OFF-SITE DISPOSAL	16,890	CY	\$25.00	\$422,250
17	IMPORTED FILL	4,530	CY	\$40.00	\$181,200
18	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	3,950	CY	\$1,200.00	\$4,740,000
19	REINFORCED CONCRETE (HORIZONTAL) - FOR SLOPE PAVEMENT COMPRISING TRAPEZOIDAL CHANNEL	850	CY	\$1,200.00	\$1,020,000
20	REINFORCED CONCRETE (HORIZONTAL) - FOR RETAINING WALLS	1,200	CY	\$1,200.00	\$1,440,000
21	REINFORCED CONCRETE (VERTICAL) - FOR RETAINING WALLS	1,200	CY	\$2,000.00	\$2,400,000
22	FENCING	6,200	LF	\$25.00	\$155,000
23	UPSTREAM TRANSITION SECTION	175	LF	\$7,100.00	\$1,242,500
24	DOWNSTREAM TRANSITION SECTION	125	LF	\$7,100.00	\$887,500
				<b>SUB =</b>	<b>\$14,999,450</b>
				<b>SUBTOTAL:</b>	<b>\$16,080,450</b>
				<b>CONTINGENCY 30%</b>	<b>\$4,824,135</b>
				<b>OPCC</b>	<b>\$20,904,585</b>
				<b>ENGINEERING DESIGN FEES</b>	<b>\$2,000,000</b>
				<b>CONSTRUCTION MANAGEMENT</b>	<b>\$836,183</b>

**TOTAL PROJECT COST \$23,740,768**

NOTE:

(1) Costs for the transition sections were developed assuming that a rectangular configuration would be required. The actual configuration will be developed during final design.



TOTAL PROJECT COST

MAY 16, 2017

ESTIMATOR  
KRK

CHECKED BY  
AC

ACCOUNT NO.  
HCF15148

ALTERNATIVE 3B

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
<b>OPINION OF PROBABLE CONSTRUCTION COST - GENERAL CIVIL ITEMS</b>					
1	MOBILIZATION (NTE 5% OF TOTAL COST FOR WORK PERFORMED BY CONTRACTOR)	1	LS	\$647,000.00	\$647,000
2	CARE OF WATER	1	LS	\$200,000.00	\$200,000
3	CLEARING AND GRUBBING	1	LS	\$20,000.00	\$20,000
4	TRAFFIC CONTROL	1	LS	\$50,000.00	\$50,000
5	STORMWATER POLLUTION PREVENTION PLAN	1	LS	\$30,000.00	\$30,000
6	FINAL GRADING, HYDROMULCH, AND CLEAN-UP	1	LS	\$18,000.00	\$18,000
				<b>SUB =</b>	<b>\$965,000</b>
<b>OPINION OF PROBABLE CONSTRUCTION COST - CHANNEL IMPROVEMENT ITEMS</b>					
<b>DEMOLITION, ETC.</b>					
7	REMOVAL AND DISPOSAL OF EXISTING SLOPE PAVEMENT	119,400	SF	\$6.00	\$716,400
8	REMOVAL AND DISPOSAL OF EXISTING PIPES REQUIRING RELOCATION	1,400	LF	\$10.00	\$14,000
9	NEW PVC PIPING (VARYING DIAMETERS)	1,060	LF	\$10.00	\$10,600
10	NEW 24" DIAMETER CMPs	240	LF	\$100.00	\$24,000
11	NEW 30"-36" DIAMETER CMPs	80	LF	\$250.00	\$20,000
12	NEW 48" DIAMETER CMPs	20	LF	\$350.00	\$7,000
13	NEW CONCRETE COLLARS	17	EA	\$2,000.00	\$34,000
14	ADJUSTMENT OF EXISTING OVERHEAD ELECTRIC LINES	1	LS	\$75,000.00	\$75,000
<b>NEW CONSTRUCTION</b>					
15	SOIL ANCHORS	58,800	LF	\$25.00	\$1,470,000
16	EXCAVATION AND OFF-SITE DISPOSAL	12,700	CY	\$25.00	\$317,500
17	IMPORTED FILL	6,810	CY	\$40.00	\$272,400
18	REINFORCED CONCRETE (HORIZONTAL) - FOR FLOWLINE SLAB	2,910	CY	\$1,200.00	\$3,492,000
19	REINFORCED CONCRETE (HORIZONTAL) - FOR SLOPE PAVEMENT COMPRISING TRAPEZOIDAL CHANNEL	850	CY	\$1,200.00	\$1,020,000
20	REINFORCED CONCRETE (HORIZONTAL) - FOR RETAINING WALLS	1,200	CY	\$1,200.00	\$1,440,000
21	REINFORCED CONCRETE (VERTICAL) - FOR RETAINING WALLS	1,200	CY	\$2,000.00	\$2,400,000
22	FENCING	6,200	LF	\$25.00	\$155,000
23	UPSTREAM TRANSITION SECTION	175	LF	\$3,800.00	\$665,000
24	DOWNSTREAM TRANSITION SECTION	125	LF	\$3,800.00	\$475,000
				<b>SUB =</b>	<b>\$12,607,900</b>
SUBTOTAL:					<b>\$13,572,900</b>
CONTINGENCY 30%					<b>\$4,071,870</b>
OPCC					<b>\$17,644,770</b>
ENGINEERING DESIGN FEES					<b>\$2,000,000</b>
CONSTRUCTION MANAGEMENT					<b>\$705,791</b>

TOTAL PROJECT COST

\$20,350,561

NOTE:

(1) Costs for the transition sections were developed assuming that a rectangular configuration would be required. The actual configuration will be developed during final design.

## **APPENDIX H: ENGINEERING REVIEW BOARD SUMMARY DOCUMENT**

## Summary for ERB POOR FARM DITCH CONVEYANCE D111-00-00-C001

### Purpose

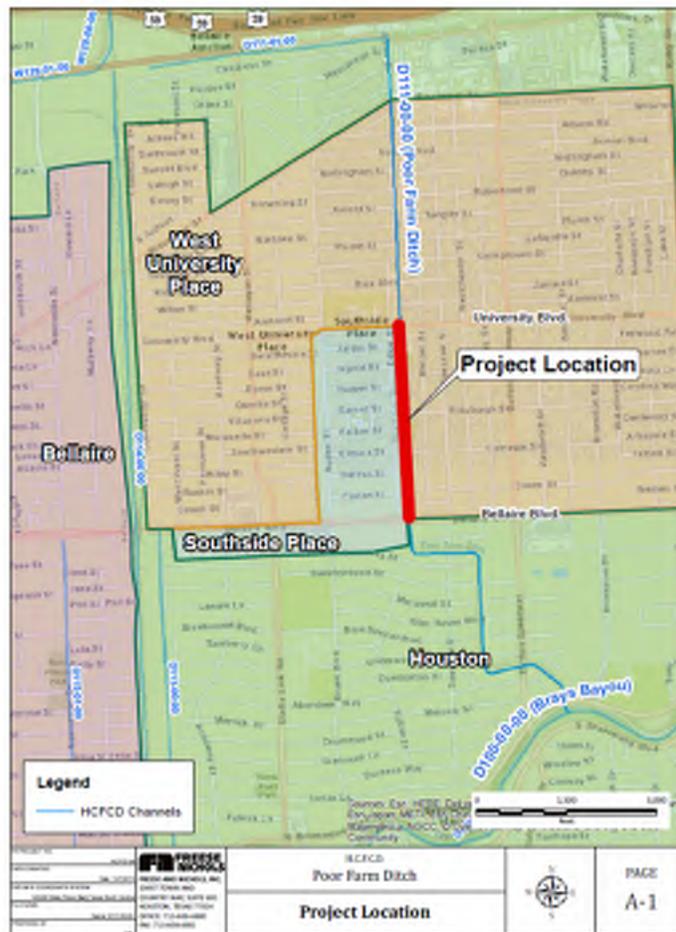
The purpose of the meeting with the Engineering Review Board is to:

- Consider the findings, existing conditions, conveyance, and encroachment issues reported in the Preliminary Engineering Study; and
- With ERB's concurrence, proceed to the design of the recommended alternative.

### Location

Poor Farm Ditch is a tributary to Brays Bayou (D100-00-00) and provides drainage to approximately 1,330 acres of developed watershed. The project reach is situated between the cities of Southside Place (SSP) on the west side of the channel and West University Place (WUP) on the east side of the channel between University Boulevard and Bellaire Boulevard.

Harris County Precinct: 3  
Key Map Page 532-B,F



## Background

This portion of Poor Farm Ditch is over 55 years old, and the reinforced concrete pavement has deteriorated significantly and buckled at several locations. Harris County Flood Control District (HCFCD) has historically performed spot repairs to prevent an overall failure of the channel, but these repairs have proven to be only short-term solutions. Some property owners within SSP have encroached into the easement by placing fill and various structures along the channel, which has exacerbated the issues.

## Historical Project Timeline & Outcomes:

HCFCD in the past has engaged sub consultants to perform studies to determine what the best solution is to fully rehabilitate Poor Farm Ditch. Each of the studies performed had different constraints, as HCFCD was trying to implement the project with minimal impacts and obtain consensus from numerous stakeholders on the path forward. The following discussion serves to summarize these previous efforts:

1. In a 2004 feasibility study, performed by Claunch & Miller, Inc. titled Poor Farm Kilmarnock Regional Study, a recommendation was made to increase the existing hydraulic capacity of Poor Farm Ditch between Bellaire and University Boulevards. This increase would improve stormwater conveyance in the area as this reach was estimated to convey only a 10 percent annual exceedance probability storm event.

➤ **OUTCOME:** *Concurrence with all stakeholders could not be reached.*

2. In 2009, HCFCD contracted with Tolunay-Wong Engineers, Inc. to perform geotechnical investigations along Poor Farm Ditch and submit a report.

➤ **OUTCOME:** *This investigation was only performed to obtain more information regarding soil stability.*

3. In a January 2012 report prepared by Binkley and Barfield, Inc. (BBI), the six following alternatives were presented to rehabilitate the project reach:

- Existing channel repair only;
- Trapezoidal channel with low flow section;
- Enclosed box channel;
- Open box channel with concrete berms;
- Open box channel with grass berms; and
- Enclosed box channel.

Hydrologic and hydraulic analyses, which were the main focus of the 2012 BBI report, were performed for each alternative. Each alternative was also evaluated in terms of mitigation, construction cost, constructability, environmental impacts and channel conveyance.

Also, this report noted that over 8,000 linear feet (LF) of fence, trees and several structures of varying size would have to be removed or relocated. A technical stakeholder group (TSG), including representatives from HCFCD,

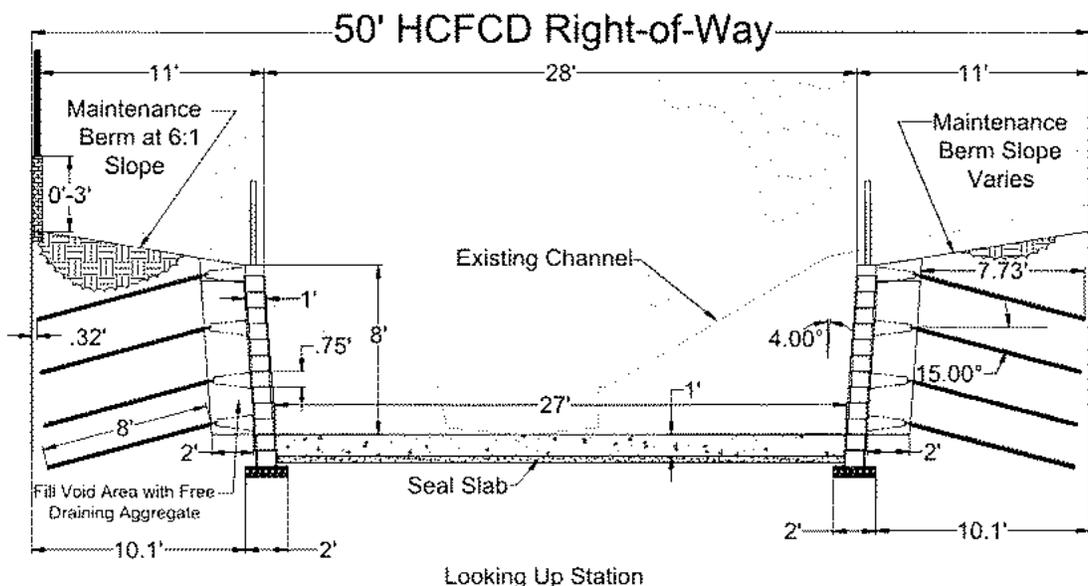
SSP, WUP, City of Houston (COH), and the neighborhoods involved, was created to discuss project status, technical issues, gather public input, and address public concerns.

➤ **OUTCOME:** This process was costly and did not yield consensus for a final design alternative.

4. In an October 2013 report prepared by Parsons Brinckerhoff (PB), the three following alternatives were presented (each spanning across the full 50-foot wide HCFCD Right of Way (ROW)):

- U-shaped, cast in place concrete channel (22 feet wide) with 8-foot tall vertical walls, referred to as the “**HCFCD preferred alternative;**”
- U-shaped, cast in place concrete channel (24 feet wide) with a 12.5-foot vertical wall on the SSP side of the channel and a 9.3-foot tall vertical wall on the WUP side, referred to as the “**SSP preferred alternative;**” and
- Various geometric configurations of a soil nailed wall with a block face.

The recommendation presented in PB’s report was an 8-foot tall soil nail wall with the nails extending across the full 50-foot HCFCD ROW, which is shown as Figure 1.



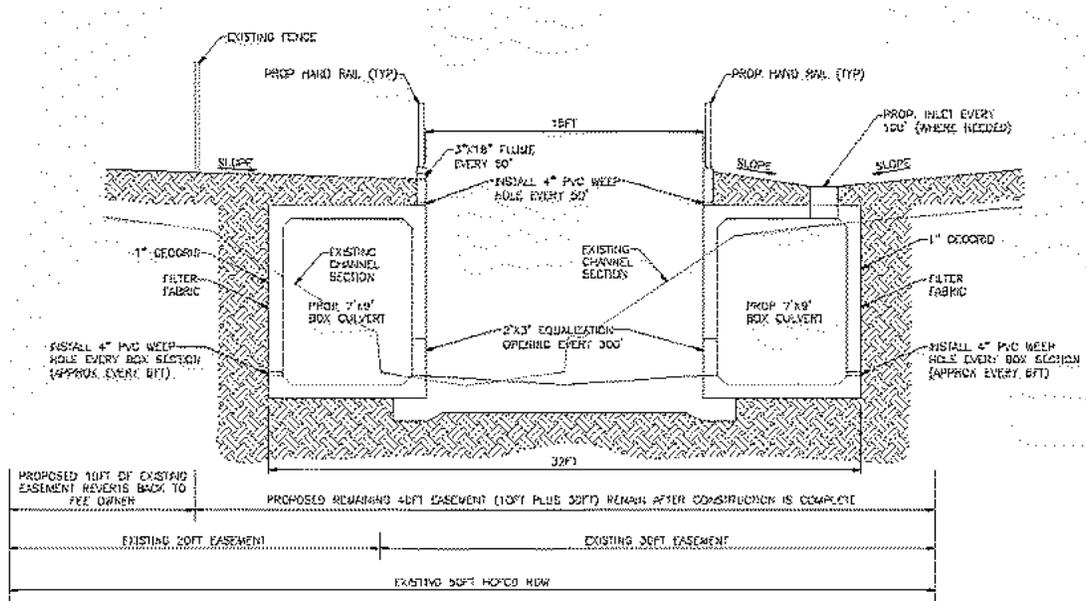
**Figure 1 – Parson Brinckerhoff’s Recommended Channel Configuration**

➤ **OUTCOME:** This study was done to reduce the project cost, but this solution would have been difficult to implement due to existing encroachments and so did not materialize to final consensus among parties.

5. On October 9, 2014, HCFCD held an audit committee meeting to discuss the channel rehabilitation alternatives as well as the encroachment issues on the

SSP side of the channel. A new concept was developed internally within HCFCD, using the information provided by BBI as a basis of the additional alternative. This new concept included two 7-feet wide by 9-feet tall reinforced concrete box culverts (RCBs) placed on the outside edges of a 40-foot wide corridor with a concrete lined open channel (approximately 15-feet wide) in between. See Figure 2 showing this design concept.

The HCFCD new design concept was developed to resolve the encroachment issues over the 20-foot HCFCD easement with the SSP residences. If only a 40-foot wide total ROW width is required, then the western most ten feet of the easement would not be required long term after construction is complete. HCFCD is currently identifying the process to transfer and/or vacate a portion of this existing easement.



**Figure 2 – HCFCD New Design Concept**

- **OUTCOME:** On July 23, 2016, HCFCD issued a contract for Freese & Nichols, Inc. (FNI) to develop construction drawings to implement HCFCD’s new design concept along the project reach, limited to the 40-foot proposed ROW width.
6. After survey and additional geotechnical information were received, this solution revealed constructability concerns requiring a reduction of the proposed cross section.
- **OUTCOME:** FNI recommended that further analysis be performed to identify and evaluate possible design alternatives that maximized the channel capacity.
7. On September 9, 2016, HCFCD issued a notice authorizing FNI to proceed with developing a Preliminary Engineering Report (PER) to identify and evaluate possible alternatives for Poor Farm Ditch constrained by the 40-foot proposed ROW.

## Challenges:

This portion of Poor Farm Ditch is over 55 years old. The reinforced concrete pavement has deteriorated significantly and buckled at many locations. The underline problems constitute the following:

1. Severely deteriorated, unstable channel;
2. Rehabilitation options more difficult due to encroachments within HCFCD easement; and
3. Low hydraulic capacity (10-Year);
  - The channel reach **upstream** of the University Boulevard crossing is hydraulically adequate for **50-year storm**.
  - The channel reach **downstream** of the Bellaire Boulevard crossing is hydraulically adequate for **100-year storm**.

## Goal and Objectives:

The goal is to fully rehabilitate the channel between Bellaire Blvd and University Blvd by achieving the following objectives:

1. Through leveraging the six person Management Committee, work through the process to obtain consensus with SSP and WUP on the design concept.
2. Provide a stable channel;
3. Construct within the existing HCFCD ROW and resolve encroachment issues;
4. Design a new channel that has adequate maintenance access;
5. Select an alternative that is constructible at lowest possible cost;
6. Minimize construction activity impacts within the project limits;
7. Achieve the best possible design life;
8. Minimize impacts to the environment; and
9. Improve hydraulic conveyance to reduce flood levels, if possible, without producing adverse impacts to the water surface elevations or impacting public safety.

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### Scope of the Project/Study

Gather and analyze all historical data and existing conditions to provide a recommended alternative to rehabilitate Poor Farm Ditch given the project constraints.

---

### Summary of the Study

#### Existing Conditions:

The cross-section of the channel is comprised of a 10-foot wide by 2.5-foot deep rectangular pilot channel. Above the pilot channel, the channel banks extend at 1.5H:1V side slopes, defining a top width of approximately 28 feet. Reinforced concrete pavement armors the rectangular pilot channel as well as approximately 4.5 vertical feet of the side slopes. There are no defined entry points for

maintenance access, nor are there maintenance berms associated with either side of the channel. Figure 3 provides a generalized cross-section of the constrained portions of the project reach with select dimensions shown.



**Figure 3 – Cross-Section Depicting Constrained Portions of Poor Farm Ditch**

### **Right of Way:**

The Harris County Flood Control District (HCFCD) ROW within the project reach varies from 50 feet to 75 feet. For the first 420 feet of the most downstream reach, the HCFCD ROW width is 75 feet. The ROW then narrows to 55 feet for 615 feet further upstream. For the remainder of the upstream section, the HCFCD ROW is 50 feet wide, of which 20 feet is an easement within SSP and 30 feet is a joint use agreement with the city of WUP.

See Attachment 1 for a map showing the existing ROW.

### **Environmental:**

On July 16, 2014, an Approved Jurisdictional Determination (AJD) was issued for this reach of Poor Farm Ditch by the United States Army Corps of Engineers (USACE). This AJD (SWG-2009-00591), which expires on July 16, 2019, indicates that Poor Farm Ditch is non-jurisdictional by USACE.

### **Cause of Failure:**

The following identify items contributing to the causes of failure, which include but are not limited to:

1. The reinforced concrete channel lining has significantly deteriorated.
2. Surcharge loads from encroached fill placed along adjacent properties are exacerbating the situation.
3. Existing narrower sections have higher velocities.
4. Due to excessive sprinkling on the backyards, the soil behind the concrete lining of the channel may have become very soft.

## **Conceptual Alternatives:**

See Attachment 2 for conceptual cross sections of alternatives. As previously discussed, each of the alternatives were developed to fit permanent design features within a 40-foot wide corridor. Alternatives 1A, 2A, 2C, and 3A take exception, as the soil nails extend beyond the western extent of the 40-foot wide corridor. However, the soil nails for these alternatives do not extend beyond the existing 50-foot wide HCFCD ROW. It is also important to note that the contractor will likely need full use of the 50-foot wide HCFCD ROW to construct any of the alternatives, requiring the coordination with SSP homeowners for access into backyards. Each of the alternatives are further discussed below.

### **Alternative 1A:**

This alternative was evaluated for stability against uplift and sliding. It consists of two 7x7 RCBs placed on a 2-foot thick reinforced concrete slab on grade. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures.

- 0.5H:1V temporary excavated slope on City of Southside Place (West Side) stabilized by temporary soil nails underground;
- 1H:1V on City of West University (East Side); and
- A 21-foot wide cross section, measured from the outside edges of each of the culverts, of which approximately 4 feet is open between the culverts.
- Anticipated maintenance access widths:
  - West Side = 9 feet; East Side = 13 feet

### **Alternative 1B:**

This alternative was evaluated for stability against uplift and sliding. It consists of two 7x7 RCBs placed on a 2-foot thick reinforced concrete slab on grade. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures.

- Constructed using sheetpile walls at a depth of 150% of the depth of excavation; and
- Each RCB culvert would be set 2-feet from each sheet pile resulting in a 32-foot wide cross section, measured from the outside edges of each of the culverts, of which approximately 15-feet would be open between the culverts.
- Anticipated maintenance access widths:
  - West Side = 12.4 feet; East Side = 12.4 feet

### **Alternative 2A:**

This alternative consists of cast-in-place rectangular channel with a slab thickness of 2 feet and wall thickness of 1.5 feet. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures.

- 0.5H:1V temporary excavated slope on City of Southside Place (West Side) stabilized by temporary soil nails underground;
- 1H:1V on City of West University (East Side); and
- A 25-foot wide cross section, of which 15 feet is open for conveyance between the walls.
- Anticipated maintenance access widths:
  - West Side = 10 feet; East Side = 15 feet

**Alternative 2B:**

This alternative consists of cast-in-place rectangular channel with a slab thickness of 2 feet and wall thickness of 1.5 feet. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures.

- Constructed using sheetpile walls at a depth of 150% of the depth of excavation; and
- Each cast-in-place wall would be set 5 feet from each sheet pile resulting in a 26-foot wide cross section, of which 15.5 feet would be open for conveyance between the walls.
- Anticipated maintenance access widths:
  - West Side = 12.3 feet; East Side = 12.3 feet

**Alternative 2C:**

This alternative consists of cast-in-place rectangular channel with a slab thickness of 2 feet and wall thickness of 1.5 feet. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures.

- As there was not much gained from the use of sheet piles versus temporary soil nails in terms of available width for conveyance in alternatives 2A and 2B, a hybrid option 2C was created to maximize the width;
- The west (City of SSP) side utilizes a 0.5H:1V temporary excavation slope on the SSP side of the channel stabilized with temporary soil nails underground;
- The east (City of WU) side utilizes a sheet pile wall with the cast-in place wall set 5 feet from the sheet pile; and
- This results in a 28-foot wide cross section, of which 17.5 feet would be open for conveyance between the walls.
- Anticipated maintenance access widths:
  - West Side = 10.3 feet; East Side = 12.3 feet

**Alternative 3A:**

This alternative consists of reinforced concrete slope pavement anchored with permanent soil nails. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures, and would be further considered as a part of final design.

- 1H:1V slopes with permanent soil nails extending to the limits of the current 50-foot easement; and
- This would require maintaining an easement to allow the nails to remain in place, including the 10 feet of easement originally proposed to be vacated on the SSP side of the channel.
- Maintenance access is only anticipated from the bottom of the channel. There is opportunity for a maintenance ramp to be constructed in conjunction with a proposed concrete-lined swale structure with SSP near Edloe Street and Harper Street.

**Alternative 3B:**

This alternative consists of reinforced concrete slope pavement anchored with permanent soil nails. Drainage along the back side of any walls would have to be accounted for through cutouts or outfall pipes through the wall, which are not reflected in the figures, and would be further considered as a part of final design.

- 1H:1V slopes with permanent soil nails extending only to the limits of the proposed 40-foot easement.
- Maintenance access is only anticipated from the bottom of the channel. There is opportunity for a maintenance ramp to be constructed in conjunction with a proposed concrete-lined swale structure with SSP near Edloe Street and Harper Street.

**Evaluation Matrix:**

Since the underlying problems with the channel are deterioration, hydraulic capacity, and construction constraints due to encroachments, the following criterion were developed to evaluate each alternative using a weighted factors analysis:

- Hydraulic Capacity -----→ Criteria Weight = 30 percent
- Project Cost\* -----→ Criteria Weight = 20 percent
- Design Life -----→ Criteria Weight = 10 percent
- Maintenance -----→ Criteria Weight = 15 percent
- Construction Duration -----→ Criteria Weight = 10 percent
- Impact of Construction Activities ---→ Criteria Weight = 15 percent

**\*For evaluation purposes, the project cost of each alternative solely encompassed the proposed channel cross-section for a distance of 2,800 linear feet (i.e., general civil items and the transition sections were excluded). Assumptions associated with these project costs are further discussed in Section 4.7 of the PER.**

For all alternatives, scores were attributed to each of the above criteria. The scores were then multiplied by the corresponding criteria weight and added together for a total sum. For a weighted factor analysis, the alternative yielding the highest total sum is recognized as the most favorable.

To supplement the weighted factors analysis, a pairwise analysis was performed to determine the tradeoffs between evaluation criteria as a function of their relative importance. Though the same criteria were used as done in the previous exercise (i.e., hydraulic capacity, project cost, etc.), the relative weightings differ because a pairwise analysis has more objectivity. The process of determining a total sum for each alternative, like the weighted factors analysis, involves attributing a score to each of the criteria and then multiplying each score by the applicable criteria weight. The scores are then added together for a total sum. The alternative yielding the highest total sum is recognized as the most favorable.

### **Cost Considerations:**

- The total project costs for Alternatives 3A and 3B were determined to be \$23,740,768 and \$20,350,561, respectively. The following assumptions are noted:
  - The Opinion of Probable Construction Costs (OPCCs) for Alternative 3A and 3B were determined to be \$20,904,585 and \$17,644,770, respectively. The OPCCs include a 30% contingency factor to account for:
    - Uncertainties associated with the contractor's care of water plan, as well as dealing with limited site access and staging opportunities; and
    - Adjusting, or working around, existing and proposed structures and facilities adjacent to the channel. Specific items already identified include a proposed concrete-lined swale feature within SSP, and an existing sanitary sewer lift station as well as a group of maintenance boxes associated with ATT underground cables within WUP.
  - The total engineering design fee, inclusive of FNI's contract as well as previous studies, was set equal to \$2,000,000.00; and
  - The anticipated construction management fees were set equal to 4% of the respective OPCCs.

### **Construction Considerations:**

- Anticipated provisions for the contractor's mobilization efforts include use of:
  - The vacant lot between 6401 and 6409 Edloe Street owned by SSP;
  - A portion of the parking lot owned by the West University United Methodist Church at the upstream end of the channel;
  - Select streets running parallel to the channel (e.g., Virginia Court and Duke Street); and
  - A portion of Bellaire Boulevard and the property located along the eastern edge of the downstream end of the channel.
- As part of the existing channel demolition, existing trees, fencing, and existing storm drain outfall structures would require removal. With the proximity of numerous structures adjacent to the limits of construction, the contractor should be required to perform a pre-construction survey to document the existing conditions;
- Given the constraints associated with accessing and navigating the existing channel, concrete placement would likely be accomplished by pumping operations. To maintain the desired mix design criteria, various measures would be required to keep concrete from flashing within the pump hose, which could include: working at night, placing wet burlap sacks over the pump hose, temporarily burying the pump hose, increasing the cement content in the concrete mix, and providing adequate space for a wash out area.
- For a project of this nature with significant risks related to care of water, complex project phasing, and high visibility with nearby residents, awarding the construction contract based on a one-step or two-step Competitively Sealed

Proposal (CSP) rather than Low Bid should be considered.

- The construction documents should be developed to require the contractor to prepare a care of water plan as part of their proposal (for which a separate pay item should be assigned). Requiring contractors to include a care of water plan in the proposals and providing a separate pay item for care of water could provide the following benefits:
  - The existing hydraulic capacity of the channel could be maintained through construction;
  - The contractor would provide protective measures for materials, equipment, and work progress for a specific level of risk;
  - The contractor would be less likely to distribute extra costs among the other pay items due to anticipated risk associated with care of water; and
  - The contractor's understanding of care of water as it relates to the successful construction of the project could be used as a metric by which HCFCD could evaluate potential contractors.

### **Recommended Alternative:**

Using the weighted factors method, Alternatives 3A and 3B were both ranked the highest, in the best interest of the District. Using the pairwise method, Alternative 3B was ranked the highest with Alternative 3A as the second highest.

Alternative 3B was ranked high based upon the following:

1. Decrease in WSELs when compared to both the Effective Model and Corrected Effective Model for all storm events;
2. Lowest project cost; and
3. Least impact of construction activities to nearby residences.

The most significant tradeoffs associated with this alternative when compared to others are that:

- The anticipated access width would be limited to approximately 8 feet along either side of the channel, requiring maintenance vehicles (as well as vehicles used during construction) to operate along the bottom of the channel;
- The time of construction is longer than all other alternatives;
- The hydraulic benefits are not as great when compared to Alternative 3A; and
- The design life is slightly less than other alternatives.

The primary difference in scoring was that Alternative 3A had more significant impact of construction activities to nearby residences due to the extended soil nails that utilize the full 50-foot HCFCD ROW. It is worth noting, however, that Alternative 3A provides greater hydraulic benefits when compared to Alternative 3B, as it lowers WSELs by an additional 0.2 feet on average within the study reach, as reflected in Table 4-3 of the PER. See Attachment 3 for a hydraulic profile associated with Alternative 3B.

## Project Benefits:

Project benefits include, but are not limited to, the following:

- Channel is constructed based on a design concept approved by SSP and WUP;
- Channel is constructed to exhibit long-term stability based on a design concept supported by recent geotechnical investigations and analyses;
- Channel is constructed within a 40-foot wide corridor such as to resolve existing encroachment issues;
- Channel is constructed with provisions for maintenance access;
- Cost of constructing new channel is less expensive than an emergency “in-kind” replacement;
- Construction limits will utilize the existing 50-foot wide HCFCD ROW to alleviate disturbances to SSP and WUP;
- New channel capable of improving hydraulic performance to reduce flood levels, without producing adverse impacts or impacting public safety.

---

## Risks

Risks, assumptions and/or critical success factors are:

- Risks include failure in reaching easement agreement with City of SSP and associated property owners;
- Assumptions include that the full easement width will be available during construction and that HCFCD will receive a combined project contribution from SSP and WUP of approximately 25% of the total construction cost; and
- The critical success factor is that the District gets concurrence with SSP, WUP, and COH for the project construction.

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## Deliverables

Preliminary Engineering Report

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## Recommendation

As previously discussed, Alternatives 3A and 3B scored the same for the weighted factors analysis; though Alternative 3B scored highest for the Pairwise analysis. **Alternative 3B is hereby recommended as the preferred design concept given that the anticipated impact of construction activities and projected total cost are both less than compared to those of Alternative 3A.**

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## Next Steps

With ERB concurrence, proceed with design of the recommended Alternative 3B

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# Attachment 1

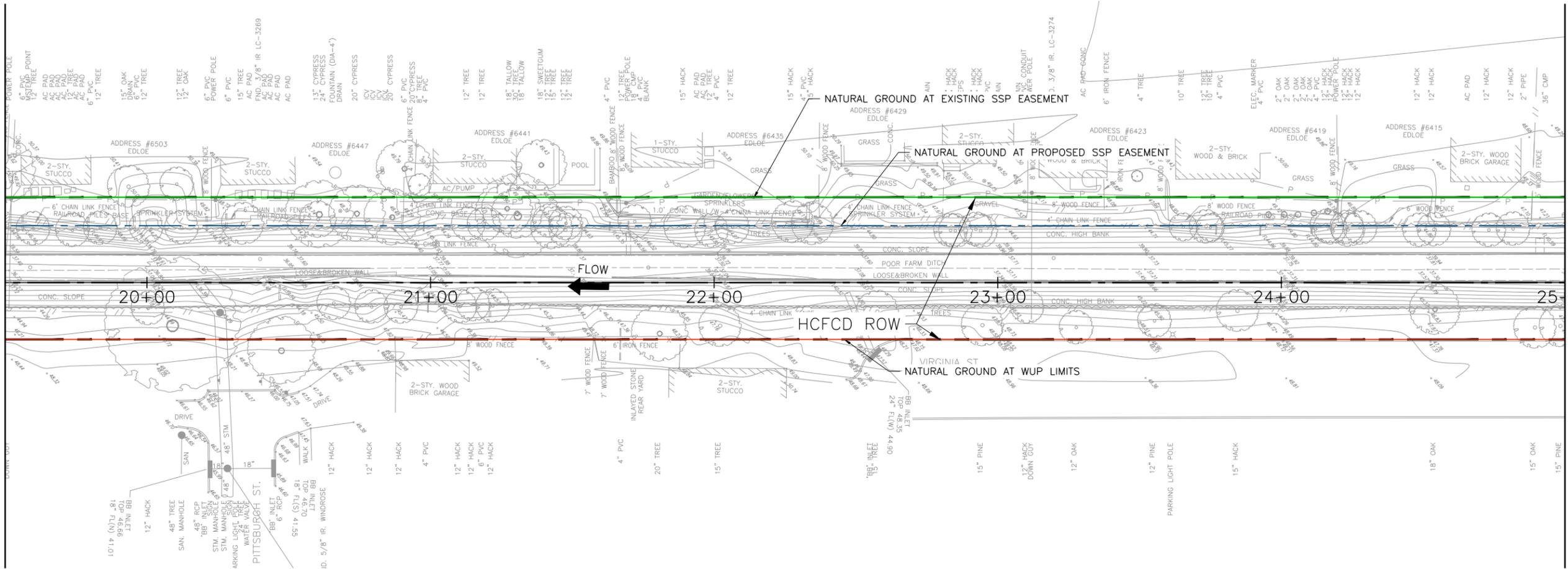




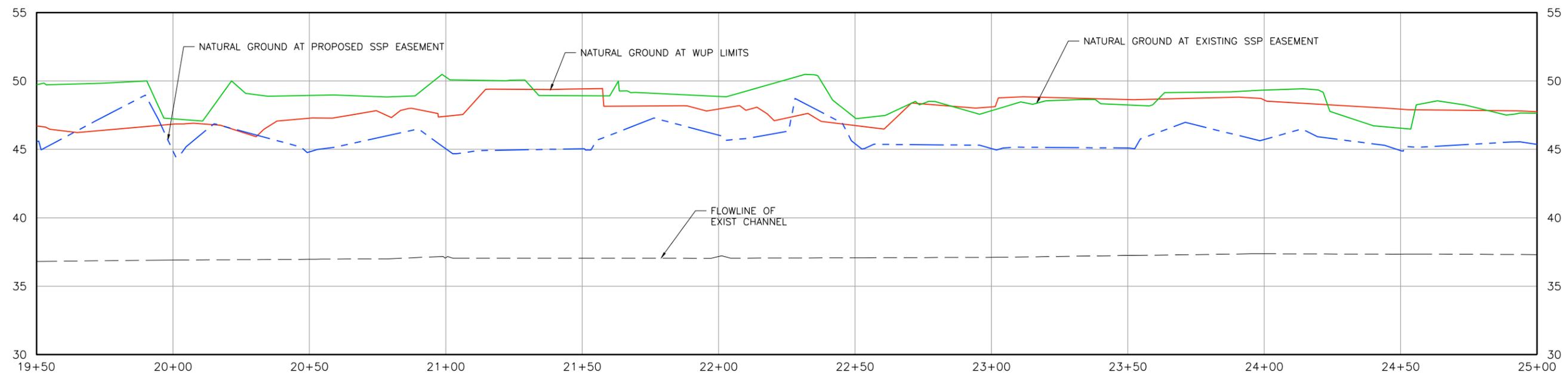


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 REFERENCE FILE: 97235

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 SEE PAGE A-4



MATCH LINE STA 25+00  
 SEE PAGE A-6



DATE	APPR	DESCRIPTION	REV

APPENDIX A	PREPARED:
POOR FARM DITCH IMPROVEMENTS	CHECKED:
HARRIS COUNTY FLOOD CONTROL	APPROVED:
EXISTING PLAN AND PROFILE	

<p>10497 Town and Country Way,          Suite 600          Houston, Texas 77024          Phone - (713) 600-6800          Fax - (713) 600-6801</p>
<p>9900 Northwest Freeway          Houston, Texas 77092</p>

DATE: DECEMBER 2016  
 SCALE: AS SHOWN

PAGE  
 A-5

**NOT FOR CONSTRUCTION**  
 THIS DOCUMENT IS RELEASED FOR THE  
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 TEXAS NO: 122407 ON DATE: 12/16/2016  
 IT IS NOT TO BE USED FOR CONSTRUCTION,  
 BIDDING OR PERMIT PURPOSES.





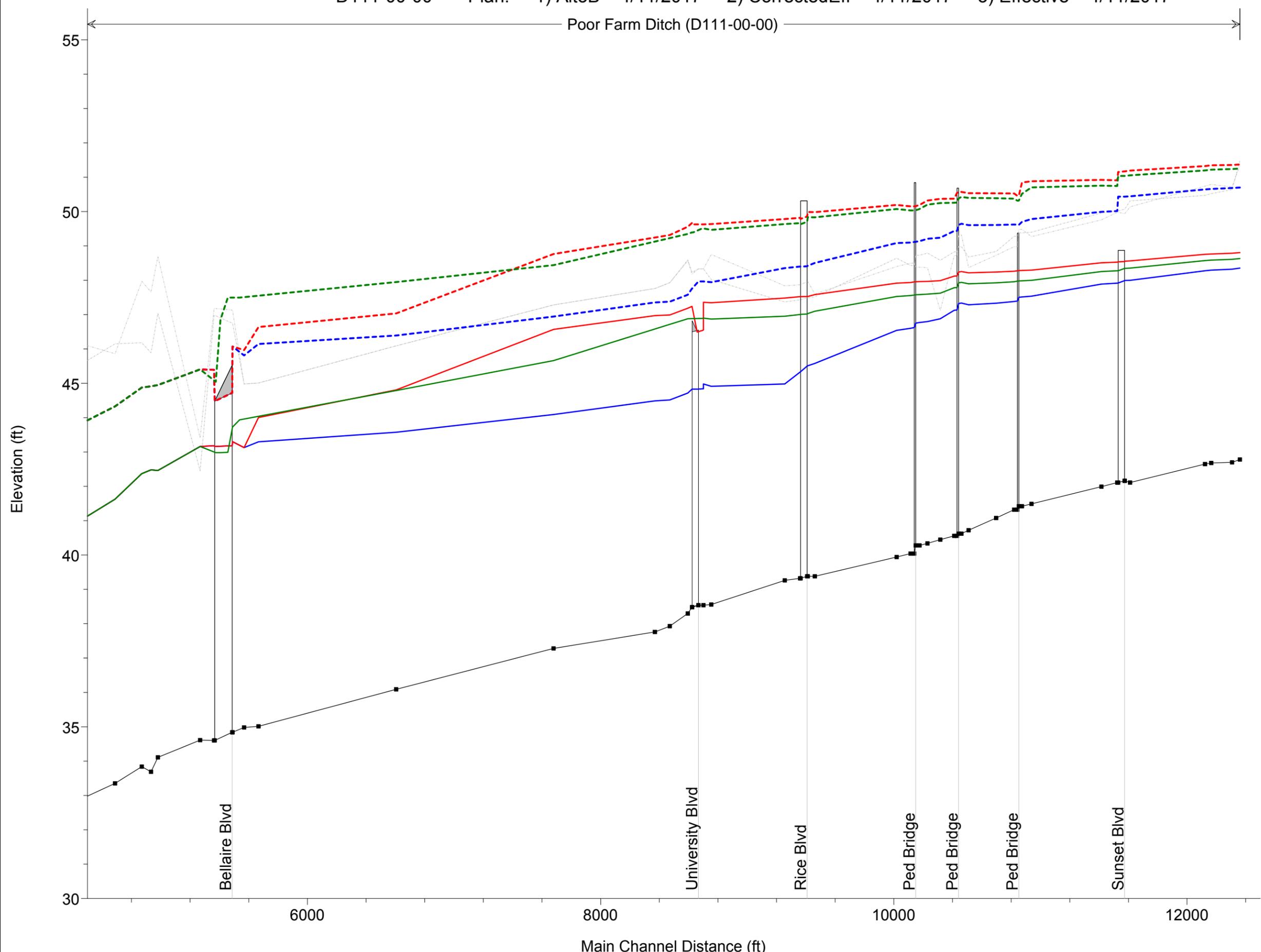
# Attachment 2





# Attachment 3

Poor Farm Ditch (D111-00-00)



Legend	
WS 1PCT_100yr - Alt3B	(Blue dashed line)
WS 1PCT_100yr - CorrectedEff	(Red dashed line)
WS 1PCT_100yr - Effective	(Green dashed line)
WS 10PCT_10yr - Alt3B	(Blue solid line)
WS 10PCT_10yr - Effective	(Green solid line)
WS 10PCT_10yr - CorrectedEff	(Red solid line)
Ground	(Black line with square markers)
LOB	(Dotted line)
ROB	(Dashed line)

## **APPENDIX I: PRELIMINARY MITIGATION RESULTS**

# MEMORANDUM



Innovative approaches  
Practical results  
Outstanding service

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**TO:** Zahid Mahmood, P.E., PMP; Alan Black, P.E.

**CC:** Alem Gebriel, P.E.; Todd Ward, P.E., CFM

**FROM:** Cory Stull, P.E., CFM, GISP; Ashley Poe, P.E., CFM

**SUBJECT:** Poor Farm Ditch – Preliminary Mitigation Results

**DATE:** September 27, 2017

**PROJECT:** Poor Farm Ditch Conveyance Improvements (HCF15148)

---

As a part of the design for the Poor Farm Ditch Conveyance Improvements between University Blvd and Bellaire Blvd, Freese and Nichols, Inc. (FNI) will be completing an Impact Analysis associated with the final proposed design section. While the design has not been finalized and is still dependent on several variables, FNI performed a preliminary H&H analysis to determine potential mitigation volume required by the preferred channel section (Alternative 3B) identified in the Preliminary Engineering Report (PER) . This memorandum documents the hydrologic and hydraulic methodologies and preliminary results for mitigation volume required for the proposed channel conveyance improvements.

## Hydrology

For the duplicate effective model, the effective HEC-HMS model for Brays Bayou (D100-00-00) was downloaded and run in HEC-HMS version 3.3.

To create the corrected effective model, the effective drainage area for Poor Farm Ditch (D111A) was subdivided into five subareas as shown in Exhibit 1. No modifications were made to the outer boundary of the effective drainage area (D111A). The five subbasins were delineated based on topography, storm sewer data, and recommendations from both HCFCF staff who have previous knowledge of the area as well as the engineering consultant for the City of West University Place, with the primary modification being the addition of a subbasin to represent the Buffalo Speedway storm sewer and overland flow system, which outfalls south of Bellaire Blvd. In addition, several characteristics of the subbasins were updated to determine TC and R values, including watershed length, length to centroid, channel slope, and overland slope. Percent urban development (DLU), percent channel improvement (DCI), percent channel conveyance (DCC), percent ponding (DPP), DLU affected by detention (DET), and percent impervious were left unchanged. No changes were made to loss parameters. Modified puls routing was used for the three routing reaches representing Poor Farm Ditch.

For proposed conditions, no changes were made to the basins or their parameters.

## Hydraulics

The effective hydraulic model for Poor Farm Ditch (D111-00-00) was downloaded from M3 and run in HEC-RAS 5.0.3 to represent duplicate effective conditions.

To create the corrected effective hydraulic model, approximately 16 cross sections were added to the study reach bounded by University Blvd on the upstream end and Bellaire Blvd on the downstream end. All channel geometry data for the cross sections within the study reach were updated to reflect 2016 survey while overbanks were represented with 2001 LiDAR, which is consistent with the topography used to build the effective model. Furthermore, fence lines as shown on Exhibit 2A and 2B were represented as ineffective flow areas set at the height of the fence, and the channel Manning's roughness was increased from 0.015 to 0.02 to account for the failing concrete and vegetation which has grown up within the study reach. Manning's roughness of overbanks was kept consistent with the effective geometry, as confirmed by aerial imagery and survey. In addition, the crossings at Bellaire Blvd and University Blvd were updated to reflect current conditions based on 2016 survey.

As mitigation was determined using unsteady-state modeling, minor additional changes were made to the geometry to ensure stability in the model. These changes included adding station-elevation points at ineffective flow area end points, adding Manning's roughness breaks, cleaning up ineffective flow areas if they extended past cross section limits, and correcting the high flow bridge modeling method to pressure/weir for Bridge Sta 11600 to account for it being submerged. FNI limited adjustments made to the geometry outside of the study area.

For proposed conditions, the preferred typical section from the PER (Alternative 3B) was used to represent the channel within the study reach. Ineffective flow areas were added in instances where existing topography just outside of the section was lower than the proposed channel banks. To account for the east channel overbank which outfalls via the Buffalo Speedway system downstream of Bellaire Blvd, levee points were used from just upstream of Bellaire Blvd to the upstream end of the model. Use of the levee points removes the overbank channel section from available storage unless the levee high point (left channel overbank) is overtopped. This is appropriate for Poor Farm Ditch because the Buffalo Speedway system does not provide available storage unless the east channel banks are overtopped. When water spills over the east channel banks, it drains east into the Buffalo Speedway system.

To support this assumption of overland drainage pathways for Poor Farm Ditch, a test was completed using gridded rainfall on mesh within HEC-RAS 2D. HGAC 2008 LiDAR was used to develop the terrain mesh, as it provides a higher resolution of topography than the 2001 LiDAR, and break lines were defined along the main channel, east and west banks, Buffalo Speedway, University, and Holcombe. As expected, when stages within Poor Farm Ditch are high enough to spill out into the left overbank, flow drains east through streets and then south down Buffalo Speedway as separate, parallel conveyance. The flow that spills out of Poor Farm Ditch and enters the Buffalo Speedway system does not return to Poor Farm Ditch until downstream of Bellaire Blvd via storm sewer or over land.

### Mitigation Volume

In 2010, HCFCD secured volume within the Meyer Stormwater Detention Basin (HCFCD Unit D500-08-00), which provides a total of 191 ac-ft of stormwater storage. HCFCD owns 39 ac-ft of this total. Per HCFCD, 13.5 ac-ft has already been allocated for the College Storm Sewer Project, and 10.3 ac-ft has already been allocated for the Bellaire Bridge replacement. Therefore, it is assumed that HCFCD has a remaining available volume of approximately 15.2 ac-ft within the Meyer Basin, although it is recommended that these numbers be verified by referencing previous Memoranda of Understanding.

To determine if the Meyer Basin has sufficient available volume to mitigate Poor Farm Ditch channel improvements, FNI has preliminarily calculated mitigation volumes associated with both the channel

improvements as well as the Bellaire Bridge replacement, as was done in previous determinations of mitigation requirements. Through the development of the corrected effective model, FNI determined that the existing channel geometry and adjacent encroachments/fences within the HCFCD easement served to restrict conveyance more than had been shown within previous modeling used to determine mitigation requirements for the Bellaire bridge replacement by itself, as the previous modeling did not incorporate survey to reflect current conditions along the reach. As such, improvements to the Bellaire bridge may not have provided as much relief as was expected and likewise, the mitigation volume allocated to the project may not have been fully required at the time of the improvements. To determine mitigation needs associated with each project when using the current approach, mitigation volume was calculated for both channel improvements and the Bellaire Bridge replacement.

Mitigation volume was calculated as the sum of all increases in the proposed flow hydrograph over the corrected effective hydrograph at the Poor Farm Ditch outfall to Brays Bayou (D100-00-00). These hydrographs were obtained from the downstream end of the unsteady-state HEC-RAS model. Mitigation volume was calculated for the 1% annual exceedance probability, or 100-year event.

A table of the resulting mitigation volumes associated with each scenario previously described is provided below.

*Table 1: Mitigation Volume Resulting from Hydrograph Comparison at Poor Farm Ditch Outfall*

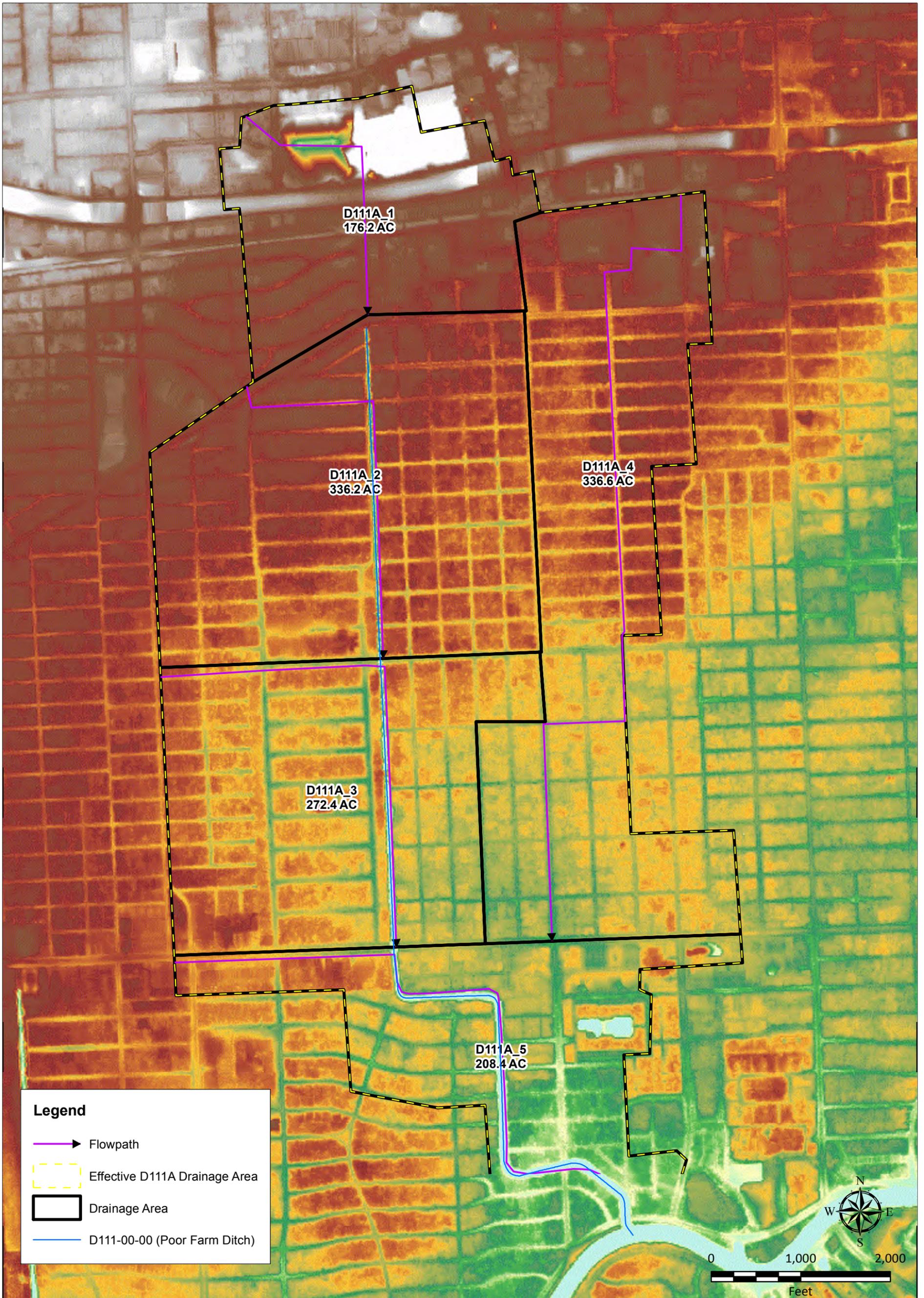
<b>Scenario</b>	<b>Mitigation Volume Calculated using Unsteady-State Modeling (ac-ft)</b>
Bellaire Bridge Replacement Only	2.7
Channel Improvements Only	17.9
Bellaire Bridge AND Channel Improvements	18.7

It should be noted that the mitigation requirements for the bridge replacement and channel improvements individually are not additive; that is, the combined mitigation requirement may be less when both projects are modeled in combination. While the total mitigation volume required for only channel improvements is greater than the volume HCFCD had previously allocated for channel improvements (15.2 ac-ft), the Bellaire Bridge Replacement was over-mitigated for by 7.6 ac-ft. Additionally, a total of 18.7 ac-ft is required to mitigate both the channel improvements and Bellaire Bridge Replacement, which is less than the total volume HCFCD had previously designated for the projects (25.5 ac-ft). Therefore, it is assumed that the mitigation volume allocated to these projects within the Meyer Basin is adequate.

### Future Considerations

Although the recommended channel section modeled within this analysis is not anticipated to change significantly through final design, there are several variables which will impact the final design and, ultimately, the final mitigation volume required for the proposed channel improvements. These variables include location and design of maintenance access points, upstream and downstream transitions, potential accommodation of an existing lift station conflict, and overbank tie-ins. A final mitigation volume associated with the channel improvements will be calculated as these final design items are established, although it is not anticipated that the remaining variables discussed above will significantly impact mitigation requirements.

It should be noted that this analysis focused solely on the determination of potential mitigation volumes, and did not assess potential increases to water surface elevations upstream or downstream of the project - an exercise which will be performed in the final project impact analysis. Furthermore, potential impacts to storm sewer outfalls downstream of the project reach will be assessed in the final project impact analysis. Finally, existing channel conveyance capacity as well as the mitigation volume calculated for the channel improvements is highly influenced by adjacent encroachments which have occurred over time and are not reflected in previous modeling which has been performed. As such, comparisons to previous studies or the corrected effective model may not provide a like comparison for assessing project performance and mitigation requirements.



**Legend**

-  Flowpath
-  Effective D111A Drainage Area
-  Drainage Area
-  D111-00-00 (Poor Farm Ditch)

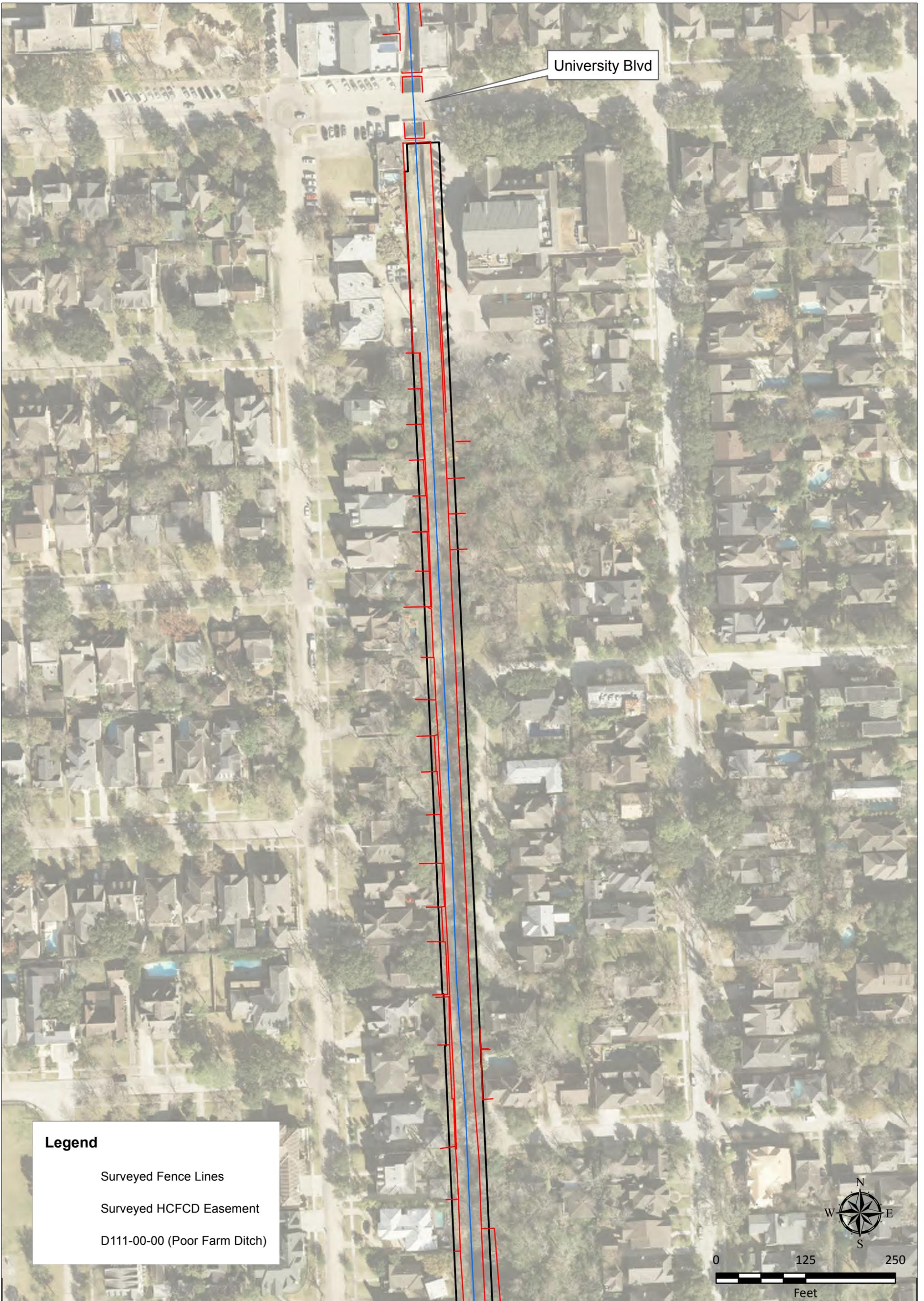
FN PROJECT NO.	HCF15148
DATE CREATED	Date: 7/7/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Fig1_DrainageAreas
PREPARED BY	ASP

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 FAX: 713-600-6801

HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**CORRECTED EFFECTIVE HYDROLOGIC WORKMAP**

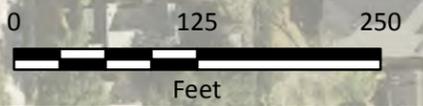


EXHIBIT  
 1



**Legend**

- Surveyed Fence Lines
- Surveyed HCFC D Easement
- D111-00-00 (Poor Farm Ditch)



FN PROJECT NO.	HCF15148
DATE CREATED	Date: 7/7/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Fig2_Fences
PREPARED BY	ASP

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HARRIS COUNTY FLOOD CONTROL DISTRICT  
**D111-00-00 (POOR FARM DITCH)**  
**UPSTREAM - STUDY REACH**  
**EXISTING FENCE LINES**

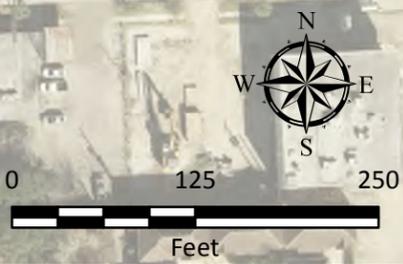


EXHIBIT  
**2A**



**Legend**

- Surveyed Fence Lines
- Surveyed HCFC D Easement
- D111-00-00 (Poor Farm Ditch)



FN PROJECT NO.	HCF15148
DATE CREATED	Date: 7/7/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Fig2_Fences
PREPARED BY	ASP

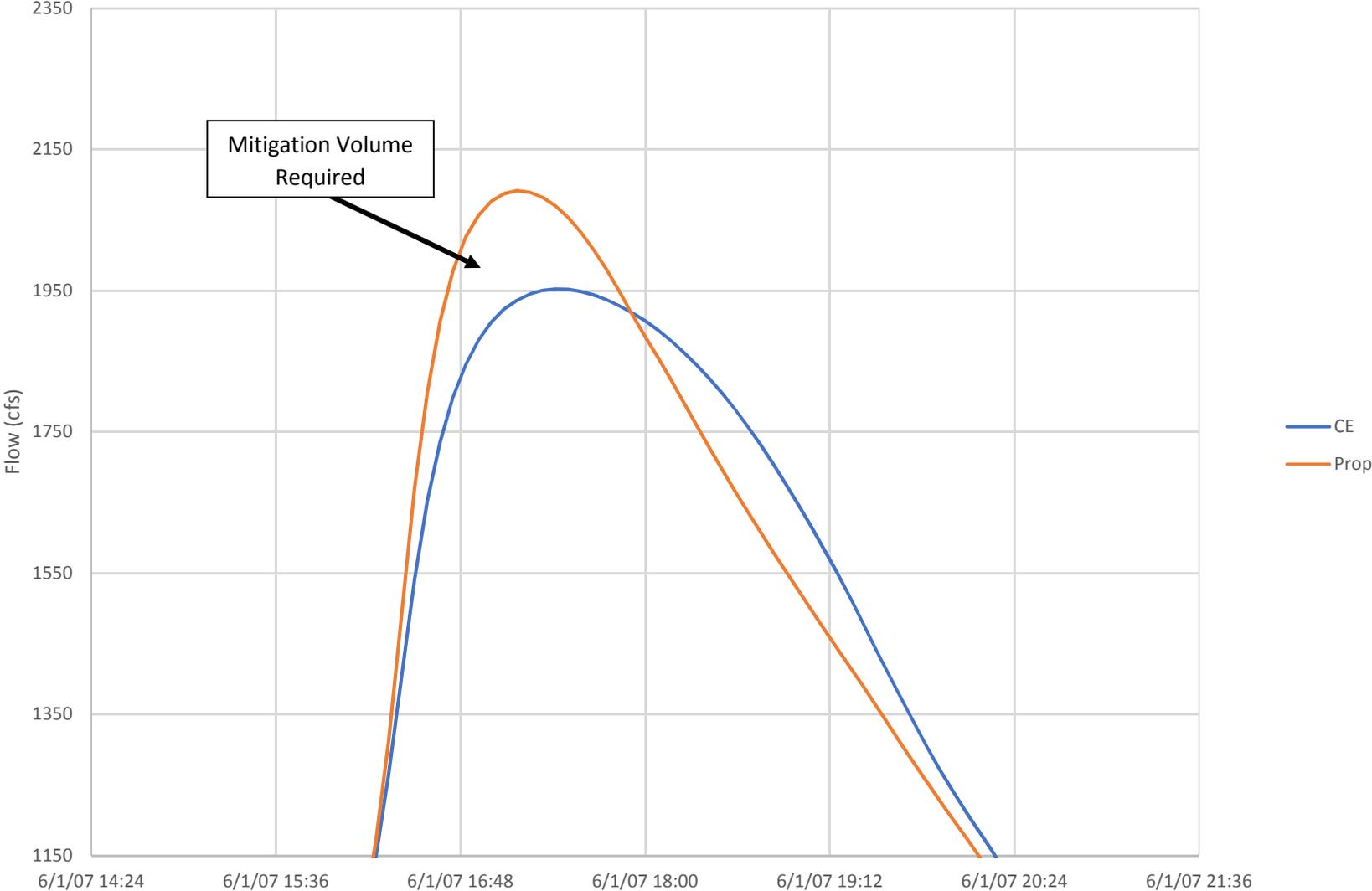
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HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**DOWNSTREAM - STUDY REACH**  
**EXISTING FENCE LINES**

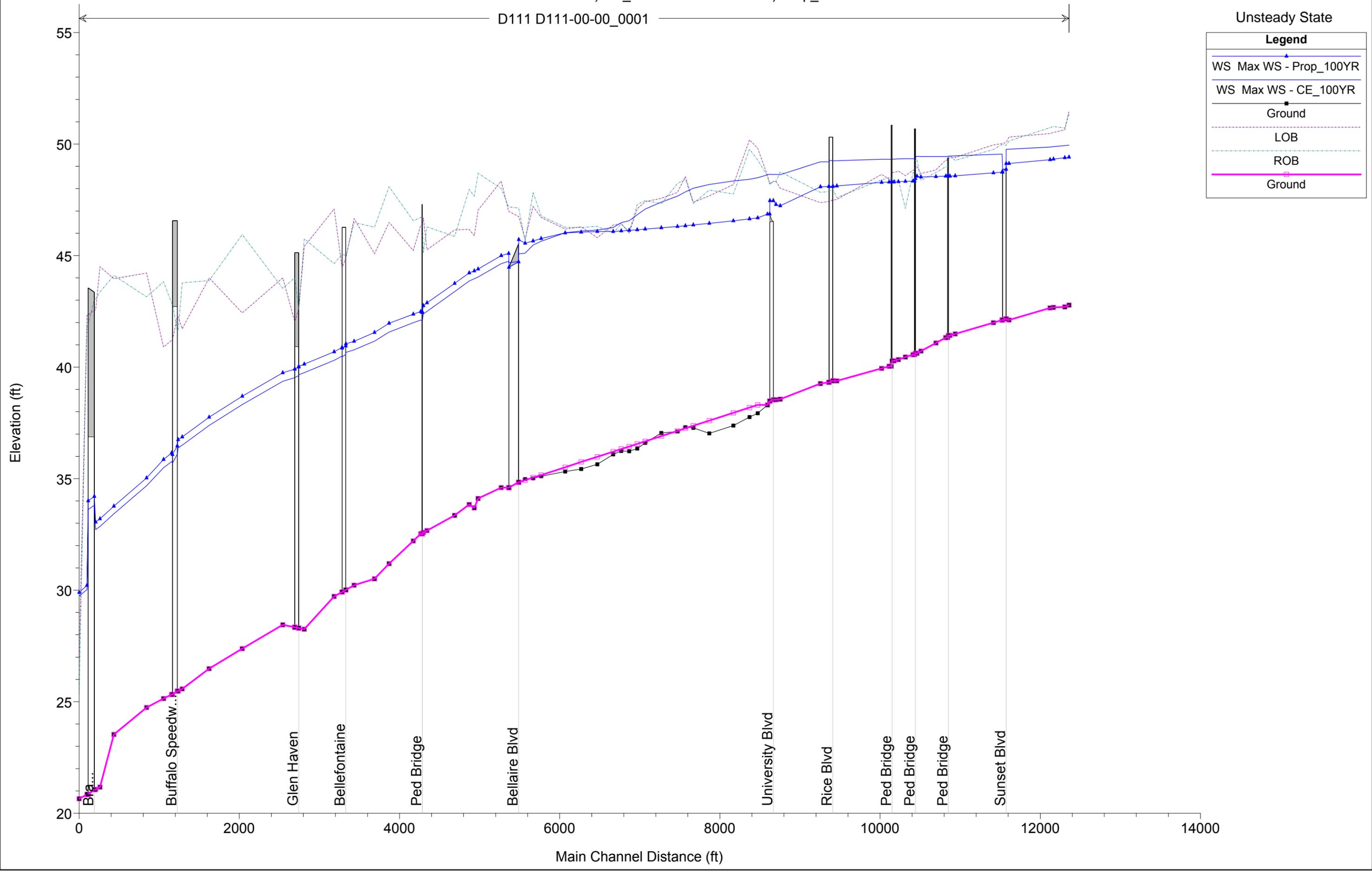


EXHIBIT  
 2B

Unsteady State 100YR Hydrographs at Outfall



D111 D111-00-00\_0001



**Unsteady State**

Legend	
WS Max WS - Prop_100YR	▲
WS Max WS - CE_100YR	▲
Ground	■
LOB	- - -
ROB	...
Ground	■

# **POOR FARM DITCH CONVEYANCE IMPROVEMENTS BETWEEN BELLAIRE AND UNIVERSITY BOULEVARDS**

Prepared for:

**Harris County Flood Control District**

February 20, 2018

Prepared by:

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# POOR FARM DITCH CONVEYANCE IMPROVEMENTS BETWEEN BELLAIRE AND UNIVERSITY BOULEVARDS

Prepared for:

**Harris County Flood Control District**



02/20/18

  
FREESE AND NICHOLS, INC.  
TEXAS REGISTERED  
ENGINEERING FIRM  
F-2144



02/20/18

  
FREESE AND NICHOLS, INC.  
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HCF15148

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- Appendix A – Detailed Hydrologic Calculations
- Appendix B – Detailed Hydraulic Calculations & Results
- Appendix C – Digital Data

## **EXECUTIVE SUMMARY**

On July 23, 2015, the Harris County Flood Control District (HCFCD) contracted with Freese and Nichols, Inc. (FNI) to develop the construction documents for improvements to HCFCD Unit Number D111-00-00 (Poor Farm Ditch) between Bellaire and University Boulevards.

Poor Farm Ditch (D111-00-00), located between Bellaire and University Boulevards, is over 55 years old, and the reinforced concrete slope pavement has deteriorated significantly and buckled at many locations. HCFCD has historically performed spot repairs to prevent overall failure of the channel but these repairs were intended to be temporary solutions. Due to the continued deterioration of the channel, a full rehabilitation is required. After FNI completed an evaluation of alternatives for a full rehabilitation in the Preliminary Engineering Report (PER) dated May 23, 2017, one alternative was unanimously approved at HCFCD's Engineering Review Board (ERB). The purpose of this report is to document the analysis completed to show that the proposed channel improvements cause no adverse impact to Poor Farm Ditch for storm events up to and including the 100-year event.

In order to adequately model the proposed project, the effective HEC-HMS and HEC-RAS models were downloaded from HCFCD's M3 website and then modified to create corrected effective conditions and proposed conditions. The corrected effective geometry includes additional cross sections, updated ineffective flow areas and manning's roughness coefficients, and updated cross-section geometries and roadway crossings at Bellaire and University Boulevards based on 2016 survey. The proposed geometry includes modifications to reflect the proposed channel improvements, which begin on the upstream side of Bellaire Boulevard and transition to a concrete-lined trapezoidal section. Approximately 1,050 feet upstream of Bellaire Boulevard, the channel transitions from the trapezoidal section to a rectangular section and back to the trapezoidal section to accommodate a lift station in the left overbank. The channel improvements proceed upstream with the trapezoidal section until transitioning to the downstream side of University Boulevard. No improvements are proposed to either roadway crossing.

Through the implementation of the proposed channel section improvements, the capacity of the project reach is increased from approximately a 10-year storm event in current conditions to a 50-year storm event for the majority of the reach. The increase in channel conveyance results in some minor increases at the downstream portion of the reach, caused by insufficient capacity through the Bellaire Blvd. bridge. All increases in the 10-year water surface elevation are contained within channel banks. All increases in

the 100-year water surface elevation are contained within channel banks or HCFCD ROW. Downstream of Bellaire Boulevard, there is a maximum water surface elevation increase of 0.04 ft during the 10-year event and 0.12 ft during the 100-year event, both of which are contained within both HCFCD ROW and channel banks. Furthermore, while there are increases in peak flow from the Poor Farm Ditch outfall due to the proposed channel improvements, there are no increases in peak flow for three nodes downstream on Brays Bayou.

Increasing the outflows from Poor Farm Ditch also results in a need for mitigation for the project. In 2010, HCFCD secured volume within the Meyer Stormwater Detention Basin (HCFCD Unit D500-08-00), which provides a total of 191 ac-ft of stormwater storage. HCFCD owns 39 ac-ft of this total. Per HCFCD, 13.5 ac-ft has already been allocated for the College Storm Sewer Project, and 10.3 ac-ft has already been allocated for the Bellaire Bridge replacement. Therefore, it is assumed that HCFCD has a remaining available volume of approximately 15.2 ac-ft within the Meyer Basin. The Poor Farm Ditch channel improvements require a mitigation volume of 6.4 ac-ft, which is less than the 15.2 ac-ft of volume available within the Meyer Basin; therefore, it is assumed that the mitigation volume allocated for the proposed channel improvements is adequate.

As all increases in water surface elevations are contained within channel banks or HCFCD ROW and adequate mitigation volume is provided, it can be demonstrated that the proposed channel improvements between Bellaire and University Boulevards do not cause any adverse impact to Poor Farm Ditch (D111-000-00) for storm events up to and including the 100-year.

## **1.0 INTRODUCTION**

### **1.1 PROJECT NAME AND PURPOSE**

On July 23, 2015, the Harris County Flood Control District (HCFCD) contracted with Freese and Nichols, Inc. (FNI) to develop the construction documents for improvements to HCFCD Unit Number D111-00-00 (Poor Farm Ditch) between Bellaire and University Boulevards.

The project reach is over 55 years old, and the reinforced concrete slope pavement has deteriorated significantly and buckled at many locations. HCFCD has historically performed spot repairs to prevent overall failure of the channel but these repairs were intended to be temporary solutions. Due to the continued deterioration of the channel, a full rehabilitation is required.

Multiple efforts were undertaken to evaluate options for a full rehabilitation and documented in the Preliminary Engineering Report (PER) dated May 23, 2017. After presenting the results of this alternatives analysis at HCFCD's Engineering Review Board (ERB), one alternative was unanimously approved and FNI proceeded with the design.

The purpose of this analysis is to document that the chosen alternative from the ERB causes no adverse impact for storm events up to and including the 100-year for Poor Farm Ditch (D111-00-00).

### **1.2 PROJECT LIMITS**

The project reach is located between the cities of Southside Place (SSP) on the west side of the channel and West University Place (WUP) on the east side of the channel between Bellaire and University Boulevards. Figure 1 shows a map of the Project Area.



FN PROJECT NO.	HCF15148
DATE CREATED	Date: 12/12/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Figure1_ProjectAreaMap
PREPARED BY	ASP

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 FAX: 713-600-6801

HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**PROJECT AREA MAP**



**FIGURE 1**

### **1.3 PROJECT OBJECTIVES**

The objective of the H&H analysis and this report is to accomplish the following:

- Update the effective hydrologic and hydraulic models available from M3 to reflect current conditions for the Poor Farm Ditch (D111-00-00).
- Revise the corrected effective hydrologic and hydraulic models to reflect the proposed channel improvements located between Bellaire and University Boulevards.
- Verify that the proposed modifications to the channel result in no adverse impact to Poor Farm Ditch (D111-00-00) or Brays Bayou (D100-00-00).
- Demonstrate that no additional volume outside of the Meyer Basin is required to mitigate the channel improvements.

### **1.4 ASSUMPTIONS AND CONSTRAINTS**

This analysis is based on the proposed channel improvements to Poor Farm Ditch (D111-00-00) between Bellaire and University Boulevards. The analysis is based on the effective hydrologic and hydraulic models available from M3.

### **1.5 PRIOR STUDIES**

Due to the limited capacity and failing concrete-lining of Poor Farm Ditch, HCFCD has commissioned several studies to evaluate alternatives in order to improve the flood conveyance capacity of the ditch. A list of all of the previously completed studies for the area is provided for reference below.

- June 2004 Feasibility Study by Claunch & Miller, Inc.
- March 2010 H&H Analysis by Binkley & Barfield, Inc.
- October 2010 H&H Analysis Addendum by Binkley & Barfield, Inc.
- January 2012 Project Development Report by Binkley & Barfield, Inc.
- October 2013 Technical Review by Parsons Brinkerhoff

## **2.0 EXISTING CONDITIONS**

### **2.1 LOCATION AND TOPOGRAPHY**

The proposed project is located on Poor Farm Ditch (D111-00-00), which is located within southwest Harris County in the Brays Bayou (D100-00-00) watershed. The project reach is located between the cities of Southside Place (SSP) on the west side of the channel and West University Place (WUP) on the east side of the channel between Bellaire and University Boulevards.

A combination of 2016 survey for the channel and immediate overbanks and 2001 LiDAR for the extended overbanks was used to model the reach.

### **2.2 LAND USE**

Poor Farm Ditch provides drainage for approximately 1,330 acres of primarily residential developed area within the Brays Bayou watershed. No changes are proposed to the effective land use.

### **2.3 FLOODPLAIN**

A review of the effective FIRM panel 48201C0860L (06/18/2007) indicates that the project reach is currently within the 100-year floodplain and controlled by a backwater elevation of 49 ft from Brays Bayou (D100-00-00).

### **2.4 HCFCD FACILITIES AND UNIT NUMBERS**

Poor Farm Ditch (D111-00-00) is a tributary to Brays Bayou (D100-00-00).

### **2.5 RIGHT-OF-WAY**

The HCFCD right-of-way (ROW) within the project reach varies from 45 feet to 80 feet as shown in Exhibits 2A and 2B. For the first 420 feet of the most downstream portion of the reach, the HCFCD ROW width varies between 60 feet and 80 feet. For the next 615 feet upstream, the ROW width is 55 feet. The ROW then narrows to 50 feet for 2,030 feet further upstream, of which 20 feet is an easement within the SSUP and 30 feet is a joint-use agreement with the City of WUP. For the remaining 40 feet of the project reach, the HCFCD ROW is 45 feet wide.

## **2.6 PIPELINES AND UTILITIES**

There are no pipelines within the immediate project reach and one lift station located approximately 1,050 feet upstream of Bellaire Boulevard on the east side of the channel.

## **3.0 HYDROLOGY AND HYDRAULICS**

### **3.1 ANALYSIS OBJECTIVE**

In order to evaluate the channel improvements, the current effective hydrologic model for D100-00-00 and hydraulic model for D111-00-00 were revised to accurately reflect existing conditions and then updated to represent proposed conditions. The following sections detail how the effective hydrologic and hydraulic models were modified, and comparisons are provided to show that the proposed channel improvements cause no adverse impact to Poor Farm Ditch (D111-00-00).

### **3.2 HYDROLOGIC METHODOLOGY**

The effective hydrologic model was downloaded from HCFCD's M3 website and was developed in HEC-HMS 3.3. The same software version was used in this analysis.

#### ***Duplicate Effective***

The effective HEC-HMS model for D100-00-00 was obtained from HCFCD's M3 website and used as a starting point for developing the corrected effective and proposed models.

#### ***Corrected Effective***

The following changes were made to the duplicate effective basin model to create the corrected effective model.

- The effective basin delineation for D111A was subdivided into five subareas as shown in Exhibit 1. No modifications were made to the outer boundary of the effective drainage area (D111A). The five subbasins were delineated based on topography, storm sewer data, and recommendations from both HCFCD staff who have previous knowledge of the area as well as the engineering consultant for the City of West University Place, with the primary modification being the addition of a subbasin to represent the Buffalo Speedway storm sewer and overland flow system, which outfalls south of Bellaire Blvd.

- Several characteristics of the subbasins were updated to determine TC and R values, including watershed length, length to centroid, channel slope, and overland slope as shown in Appendix A. Percent urban development (DLU), percent channel improvement (DCI), percent channel conveyance (DCC), percent ponding (DPP), DLU affected by detention (DET), and percent impervious were left unchanged. No changes were made to loss parameters.
- Modified puls routing was used for the three routing reaches representing Poor Farm Ditch. It should be noted that two profiles that would have been used to calculate the number of subreaches for the most upstream reach were not used due to their drastically larger travel times, which would have resulted in a skewed number of subreaches.

### **3.3 HYDRAULIC METHODOLOGY**

The effective hydraulic model was downloaded for D111-00-00 from HCFCD's M3 website and was developed in HEC-RAS 3.0.1. This analysis uses the most updated version of HEC-RAS (version 5.0.3).

#### ***Duplicate Effective***

The effective HEC-RAS model for D111-00-00 was obtained from HCFCD's M3 website and used as a starting point for developing the corrected effective and proposed models.

#### ***Corrected Effective***

The following changes were made to the duplicate effective geometry to create the corrected effective model.

- Approximately 22 cross sections were added to the study reach bounded by University Blvd on the upstream end and Bellaire Blvd on the downstream end to better account for the existing channel geometry and overbank encroachments.
- All channel and immediate overbank geometry data for the cross sections within the study reach were updated to reflect 2016 survey while extended overbanks were represented with 2001 LiDAR, which is consistent with the topography used to develop the effective model.
- Fence lines as shown on Exhibit 2A and 2B were represented as ineffective flow areas set at the height of the fence.

- Channel Manning's roughness coefficients were increased from 0.015 to 0.02 to account for the failing concrete and vegetation which has grown up within the study reach.
- Manning's roughness of overbanks was kept consistent with the effective geometry, as confirmed by aerial imagery and survey.
- The crossings at Bellaire Blvd and University Blvd were updated to reflect current conditions based on 2016 survey. The Bellaire Blvd bridge was updated from a conspan arch culvert to a conspan bridge opening reflected in the bridge low chord data, which was recommended by Contech (the manufacturer of the conspan). The channel elevations upstream and downstream of Bellaire Blvd and the high chord were updated to match survey as well. At University Blvd, no changes were made to the culvert sizes, but the high chord and bridge width were updated to reflect survey. Ineffective flow areas were also updated at both crossings as appropriate.

## **4.0 PROPOSED DRAINAGE PLAN**

### **4.1 DESCRIPTION**

The proposed channel improvements begin at the upstream end of Bellaire Boulevard and transition to a concrete-lined trapezoidal section. Approximately 1,050 feet upstream of Bellaire Boulevard, the channel transitions from the trapezoidal section to a rectangular section and back to the trapezoidal section to accommodate a lift station in the left overbank. The channel improvements proceed upstream until transitioning to the downstream side of University Boulevard. No improvements are proposed to either crossing.

### **4.2 HYDROLOGIC ANALYSIS**

For proposed conditions, no changes were made to the basins or their parameters.

### **4.3 HYDRAULIC ANALYSIS**

A summary of the changes to the corrected effective model to represent the proposed channel improvements is provided below. On December 13, 2017, FNI submitted 80% design plans to HCFCF for review. These plans should be used to verify proposed geometry changes.

- For the majority of the project reach, a trapezoidal section was used. It is a 10 ft deep section with a 12.5 ft bottom width, 1:1 side slopes for 5 ft on either side which then open to 5 ft vertical walls. These vertical walls are tied into natural ground with a 2% slope within the proposed ROW and then either a vertical wall or a 1% slope outside of proposed ROW. An example cross section comparison is provided in Figure 2.
- The manning's roughness coefficient for the proposed channel improvements was also updated to reflect finished concrete, clear of vegetation.
- The stream centerline was shifted approximately 5 ft east.
- A 3.5 ft guardrail will be located on the top of banks of the proposed ditch and was represented with permanent ineffective areas.

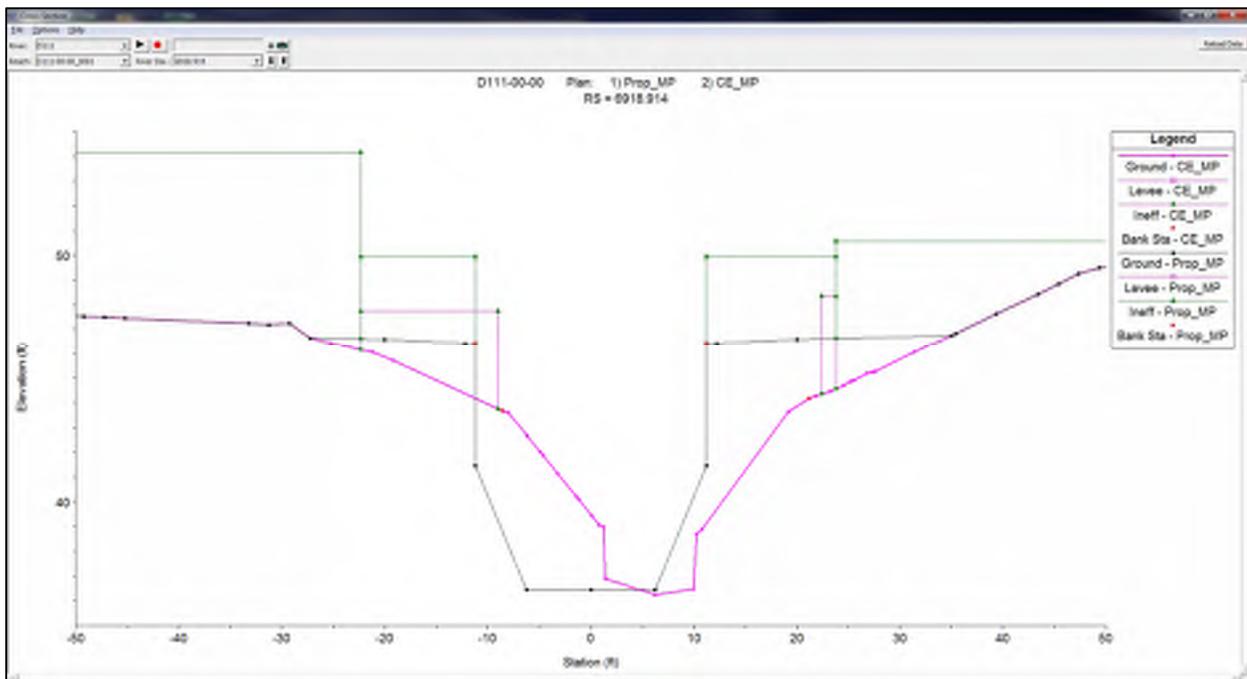


Figure 2: Typical Proposed Cross Section vs. Existing Cross Section

- To account for the left overbank which outfalls away from Poor Farm Ditch via the Buffalo Speedway system downstream of Bellaire Blvd, levee points were used from just upstream of Bellaire Blvd to the upstream end of the model. Use of the levee points removes the overbank channel section from available storage unless the levee high point (left channel overbank) is

overtopped. This is appropriate for Poor Farm Ditch as the Buffalo Speedway system does not provide available storage unless the left banks are overtopped. If water spills over channel banks, it drains east into the Buffalo Speedway system. In order to support this assumption, a test was completed using gridded rainfall on mesh with HEC-RAS 2D. The 2008 Lidar was used as it provides a higher resolution of topography, and break lines were defined along the main channel, east and west banks, Buffalo Speedway, University, and Holcombe. As expected, when stages within Poor Farm Ditch are high enough to spill out of the left overbank, flow continues east and then drains south on Buffalo Speedway, where it returns to Poor Farm Ditch downstream of Bellaire Blvd.

- Maintenance access ramps are proposed at both University and Bellaire Boulevards, and the downstream sections for University Blvd and the upstream sections for Bellaire Blvd were updated to include these ramps in the station-elevation data.
- There is a lift station located approximately 1,050 feet upstream of Bellaire Boulevard in the left overbank. The trapezoidal section will be transitioned to a rectangular section at this location in order to avoid the need for relocating the lift station.

After the HEC-RAS model was updated with the proposed channel improvements, modified puls was also re-run in HEC-HMS to update the multi-profile flows in the HEC-RAS model.

#### **4.4 RESULTS**

HEC-RAS output have been provided in Appendix B, and water surface elevation profile comparisons have been provided as Exhibits 3 and 4 for reference. Table 1 and Table 2 show comparisons of the 10- and 100-year water surface elevations within the project reach.



**Table 1: Comparison of 10-year WSE within Project Reach**

Cross Section	Water Surface Elevation (ft-msl)			Difference in WSE (ft)	
	Effective	Corrected Effective	Proposed	CE - Eff	Prop - CE
8677	<i>University Blvd</i>				
8674.259	46.81	46.90	45.13	+0.09	-1.77
8645.981	46.82	46.89	45.14	+0.07	-1.75
8545.785	-	46.63	44.67	-	-1.96
8421.371	-	46.54	44.61	-	-1.93
8220.54	-	46.46	44.52	-	-1.94
7919.857	-	46.29	44.40	-	-1.89
7730.22	45.52	46.02	44.18	+0.50	-1.84
7619.578	-	45.91	44.13	-	-1.78
7520.923	-	45.77	44.09	-	-1.68
7320.456	-	45.48	44.00	-	-1.48
7119.101	-	45.16	43.92	-	-1.24
7019.39	-	44.90	43.89	-	-1.01
6918.914	-	44.69	43.85	-	-0.84
6819.645	-	44.51	43.82	-	-0.69
6718.587	-	44.35	43.79	-	-0.56
6679.703	-	44.31	43.77	-	-0.54
6639.971	-	44.25	43.82	-	-0.43
6559.903	-	44.17	43.80	-	-0.37
6520.549	-	44.13	43.70	-	-0.43
6320.234	-	44.06	43.64	-	-0.42
6119.156	-	43.82	43.59	-	-0.23
5818.864	-	43.52	43.52	-	0.00
5717.684	-	43.45	43.50	-	+0.05*
5663.459	-	43.40	43.49	-	+0.09*
5563.926	-	43.59	43.62	-	+0.03*
5540.284	43.73	43.50	43.53	-0.23	+0.03*
5430	<i>Bellaire Blvd</i>				

*\*Water surface elevation increases are contained within channel banks*

**Table 2: Comparison of 100-year WSE within Project Reach**

Cross Section	Water Surface Elevation (ft-msl)			Difference in WSE (ft)	
	Effective	Corrected Effective	Proposed	CE - Eff	Prop - CE
8677	<i>University Blvd</i>				
8674.259	49.32	48.93	47.64	-0.39	-1.29
8645.981	49.28	48.80	47.65	-0.48	-1.15
8545.785	-	48.55	47.14	-	-1.41
8421.371	-	48.42	47.09	-	-1.33
8220.54	-	48.34	47.01	-	-1.33
7919.857	-	48.18	46.89	-	-1.29
7730.22	48.32	47.87	46.62	-0.45	-1.25
7619.578	-	47.76	46.57	-	-1.19
7520.923	-	47.60	46.53	-	-1.07
7320.456	-	47.33	46.44	-	-0.89
7119.101	-	47.09	46.36	-	-0.73
7019.39	-	46.92	46.32	-	-0.6
6918.914	-	46.68	46.28	-	-0.4
6819.645	-	46.58	46.24	-	-0.34
6718.587	-	46.43	46.20	-	-0.23
6679.703	-	46.39	46.19	-	-0.2
6639.971	-	46.35	46.22	-	-0.13
6559.903	-	46.28	46.19	-	-0.09
6520.549	-	46.23	46.11	-	-0.12
6320.234	-	46.21	46.04	-	-0.17
6119.156	-	46.04	45.98	-	-0.06
5818.864	-	45.77	45.89	-	+0.12*
5717.684	-	45.71	45.87	-	+0.16*
5663.459	-	45.70	45.85	-	+0.15*
5563.926	-	45.91	46.05	-	+0.14*
5540.284	47.48	45.76	45.90	-1.72	+0.14*
5430	<i>Bellaire Blvd</i>				

*\*Water surface elevation increases are contained within channel banks or HCFCF ROW*

Through the implementation of the proposed channel section improvements, the capacity of the project reach is increased from approximately a 10-year storm event in current conditions to a 50-year storm event for the majority of the reach. The increase in conveyance results in some minor increases at the downstream portion of the reach, caused due to insufficient capacity through the Bellaire Boulevard bridge. All increases in the 10-year water surface elevation are contained within channel banks. All increases in the 100-year water surface elevation are contained within channel banks or HCFCF ROW. Downstream of Bellaire Boulevard, there is a maximum water surface elevation increase of 0.04 ft during the 10-year event and 0.12 ft during the 100-year event, both of which are contained within both HCFCF ROW and channel banks, as there is substantial available freeboard capacity within the channel.

While the water surface elevation increases are contained within HCFCD channel banks and ROW for storm events up to and including the 100-year storm, FNI ran an additional two scenarios (2- and 25-year storm events) and compared the 2-, 10-, and 25-year water surface elevation increases to all outfalls located within the Poor Farm Ditch downstream of Bellaire Boulevard. This comparison is provided in the following table, and Exhibit 6 shows all outfalls and their locations relative to the HEC-RAS cross sections.

As demonstrated in the table, water surface elevations increase up to 0.03 ft during the 2-year, 0.04 ft during the 10-year, and 0.08 ft during the 25-year storm events downstream of Bellaire Boulevard, and none of the increases in water surface elevation result in a previously unsubmerged outfall becoming submerged. Additionally, the water surface elevations within the project reach (located between Bellaire Blvd and University Blvd) decrease up to 2.17 ft in the 2-year, 1.96 ft in the 10-year, and 1.72 ft in the 25-year storm events.



**Table 3: Water Surface Elevations at Storm Sewer Outfalls Downstream of Bellaire Boulevard**

ID #	Corresponding RAS Station	Size, Material	Top of Pipe	CORRECTED EFFECTIVE			PROPOSED			PROPOSED - CORRECTED EFF.		
				2-year WSEL	10-year WSEL	25-year WSEL	2-year WSEL	10-year WSEL	25-year WSEL	2-year WSEL	10-year WSEL	25-year WSEL
<b>Bellaire Boulevard</b>												
	5430											
34	5173	18" CMP	42.53	28.08	30.10	30.87	28.10	30.12	30.91	0.02	0.02	0.04
33	5147	12" RCP	45.16	29.00	30.97	31.94	29.02	31.01	31.99	0.02	0.03	0.05
32	5103	8" PVC	42.91	29.29	31.20	32.25	29.30	31.24	32.30	0.01	0.04	0.05
31	5102	4" PVC	43.04	31.90	34.59	35.44	31.92	34.60	35.49	0.02	0.01	0.05
30	5059	8" PVC	42.55	32.37	34.99	35.82	32.39	35.00	35.86	0.02	0.01	0.04
29	5010	8" PVC	39.74	32.57	35.17	35.99	32.59	35.18	36.03	0.02	0.01	0.04
28	5006	24" CMP	40.27	32.61	35.20	36.02	32.63	35.21	36.05	0.02	0.01	0.04
27	4877	36" CMP	38.05	33.20	35.87	36.73	33.22	35.88	36.76	0.02	0.01	0.03
26	4642	8" PVC	41.14	33.40	36.12	37.01	33.42	36.13	37.04	0.02	0.01	0.03
25	4427	4" PVC	40.50	33.92	36.95	37.89	33.94	36.96	37.94	0.02	0.01	0.05
24	4325	24" CMP	41.98	34.27	37.48	38.42	34.29	37.49	38.47	0.02	0.01	0.06
23	4294	48" CMP	38.03	34.32	37.56	38.50	34.34	37.57	38.55	0.02	0.01	0.06
22	4067	4" PVC	43.86	34.63	37.96	38.90	34.65	37.97	38.95	0.02	0.01	0.05
21	4021	4" PVC	44.40	35.43	38.39	39.32	35.41	38.39	39.36	-0.02	0.00	0.04
20	3830	24" CMP	37.21	35.50	38.48	39.41	35.48	38.48	39.46	-0.02	0.01	0.05
19	3789	66" RCP	42.48	36.61	39.32	40.30	36.61	39.32	40.34	0.00	0.00	0.04
19	3789	66" RCP	42.34	36.44	39.16	40.12	36.45	39.17	40.17	0.01	0.01	0.05
18	3664	6" PVC	38.28	36.71	39.41	40.40	36.71	39.41	40.45	0.00	0.00	0.05
17	3565	6" PVC	38.82	36.78	39.56	40.59	36.79	39.56	40.64	0.01	0.00	0.05
16	3381	42" CMP	34.91	36.78	39.56	40.59	36.79	39.56	40.64	0.01	0.00	0.05
15	3066	30" CMP	36.09	36.78	39.63	40.68	36.79	39.63	40.73	0.01	0.00	0.05
14	2994	66" RCP	38.50	37.20	39.92	40.97	37.22	39.93	41.03	0.02	0.00	0.06
13	2719	24" CMP	35.00	37.39	39.98	41.01	37.41	39.98	41.07	0.02	0.00	0.06
12	2449	24" CMP	34.38	38.13	40.26	41.22	38.15	40.26	41.28	0.02	0.00	0.06
11	2408	42" CMP	33.06	38.20	40.35	41.30	38.22	40.35	41.36	0.02	0.00	0.06
10	2129	24" CMP	33.71	38.44	40.72	41.72	38.46	40.73	41.78	0.02	0.01	0.06

Poor Farm Ditch Conveyance Improvements between Bellaire and University Boulevards

Harris County Flood Control District



ID #	Corresponding RAS Station	Size, Material	Top of Pipe	CORRECTED EFFECTIVE			PROPOSED			PROPOSED - CORRECTED EFF.		
				2-year WSEL	10-year WSEL	25-year WSEL	2-year WSEL	10-year WSEL	25-year WSEL	2-year WSEL	10-year WSEL	25-year WSEL
9	1710	24" CMP	34.09	38.77	41.27	42.31	38.79	41.28	42.37	0.02	0.01	0.07
8	1593	6" RCP (Broken)	33.77	39.59	42.10	43.06	39.61	42.11	43.13	0.02	0.01	0.07
7	1298	18" CMP	38.39	39.94	42.38	43.29	39.96	42.39	43.37	0.02	0.01	0.07
6	1287	18" CMP	38.63	39.91	42.37	43.30	39.94	42.38	43.37	0.03	0.01	0.08
5	1260	6" CMP	33.38	39.89	42.43	43.36	39.92	42.44	43.44	0.03	0.01	0.08
4	1196	24" CMP	28.52	40.05	42.53	43.46	40.07	42.54	43.54	0.03	0.01	0.08
3	498	24" CMP	29.60	40.05	42.53	43.46	40.08	42.55	43.54	0.03	0.01	0.08
2	391	24" CMP	29.35	40.21	42.64	43.56	40.24	42.65	43.64	0.03	0.01	0.08
1	203	24" RCP	33.91	40.31	42.70	43.62	40.33	42.72	43.70	0.03	0.01	0.08

With the increased conveyance capacity of the project reach, additional flow is sent downstream, which subsequently outfalls into Brays Bayou (D111-00-00). Per HCFCD requirements, flows must not increase when compared for the three downstream nodes in the HEC-HMS model. As shown in Table 4, there are no increases to flows along Brays Bayou (D100-00-00) downstream of Poor Farm Ditch outfall due to the proposed project.

**Table 4: Comparison of Peak Flows on Brays Bayou Downstream of Poor Farm Ditch Outfall**

HMS Node	Description	10-year Peak Flow (cfs)			100-year Peak Flow (cfs)		
		Corrected Effective	Proposed	Difference	Corrected Effective	Proposed	Difference
Outfall	Poor Farm Outfall	1274.4	1278.8	+4.4	2091.8	2126.6	+34.8
D1000000_0641_J	1st Node Downstream	25958.6	25952.2	-6.4	29449.7	29428.4	-21.3
D1000000_0783_J	2nd Node Downstream	28504.1	28504.0	-0.1	32668.2	32660.7	-7.5
D1000000_0515_J	3rd Node Downstream	27996.3	27994.0	-2.3	31956.1	31954.1	-2.0

It is also important to note that floodplain mapping within the study reach is mostly driven by Brays Bayou backwater elevation. When modeling the Poor Farm Ditch hydraulic reach, a normal depth outfall condition is assumed. Modeling of tributaries to major waterways using this approach often produces lower water surface elevations at the confluence location than those generated by the major waterway. In this case, Brays Bayou produces a 100-year water surface elevation that extends upstream well past the Bellaire Bridge and into the project reach. While improvements through the study reach may improve local flooding conditions, they may not impact floodplain mapping and Brays Bayou-driven flooding where the Poor Farm Ditch WSELs are lower than the Brays Bayou Base Flood Elevation.

Additionally, HCFCD is currently updating the model and mapping for D100-00-00 (Brays Bayou) as a part of the Risk Map 6 Study. Because the downstream boundary condition for the Poor Farm Ditch model is not based on a known water surface elevation, any update to the backwater mapping due to the Risk Map 6 Study will not impact the results of this analysis but may update the mapping for the area.

#### **4.5 MITIGATION VOLUME DETERMINATION**

In 2010, HCFCD secured volume within the Meyer Stormwater Detention Basin (HCFCD Unit D500-08-00), which provides a total of 191 ac-ft of stormwater storage. HCFCD owns 39 ac-ft of this total. Per HCFCD, 13.5 ac-ft has already been allocated for the College Storm Sewer Project, and 10.3 ac-ft has already been allocated for the Bellaire Bridge replacement. Therefore, it is assumed that HCFCD has a remaining

available volume of approximately 15.2 ac-ft within the Meyer Basin, although it is recommended that these numbers be verified by referencing previous Memoranda of Understanding.

To determine if the Meyer Basin has sufficient available volume to mitigate Poor Farm Ditch channel improvements, FNI calculated mitigation volume associated with the channel improvements. This was completed by calculating the sum of all increases in the proposed flow hydrograph over the corrected effective hydrograph at the Poor Farm Ditch outfall to Brays Bayou (D100-00-00). These hydrographs were obtained from the junction titled "Outfall" in the HEC-HMS model and are shown in a comparison in Exhibit 5. Mitigation volume was calculated for the 1% annual exceedance probability or 100-year event. Based on this calculation, it was determined that the Poor Farm Ditch channel improvements require a mitigation volume of 6.4 ac-ft, which is less than the 15.2 ac-ft of volume available within the Meyer Basin; therefore, it is assumed that the mitigation volume available for the proposed channel improvements is adequate.

#### **4.6 RIGHT-OF-WAY REQUIREMENTS**

The existing HCFCD ROW is described previously in Section 2.5. The proposed channel design only requires a permanent ROW of 40-ft total, and as a result, the westernmost ten feet of HCFCD's existing easement will not be required long-term after construction has been completed.

#### **4.7 POTENTIAL PIPELINE AND UTILITY CONFLICTS**

The proposed channel improvements to the existing ditch are not expected to have any conflicts with existing pipelines; however, there is a lift station located approximately 1,050 feet upstream of Bellaire Boulevard in the left overbank which will not be relocated and would pose a conflict if the typical section was used in this area. Therefore, the proposed design includes transitions of the typical trapezoidal channel section to a rectangular section to circumvent the lift station.

#### **4.8 GEOTECHNICAL REQUIREMENTS**

A geotechnical report will be provided as a part of the design to ensure adequate materials are used for the construction of the proposed channel improvements.

#### **4.9 MAINTENANCE ACCESS**

There are currently no existing maintenance access points for the project reach. The proposed channel improvements accommodate two new maintenance access points via University Blvd and Bellaire Blvd.

### **5.0 SUMMARY AND CONCLUSIONS**

Poor Farm Ditch (D111-00-00), located between University Blvd and Bellaire Blvd, is over 55 years old, has deteriorated significantly, and is in need of a full rehabilitation. The proposed design includes using a concrete-lined trapezoidal section. The trapezoidal section will transition as needed to tie into the existing crossings at Bellaire and University Boulevards as well as accommodate a lift station in the left overbank.

The proposed channel improvements increase the effective flow area of the ditch, increasing the conveyance capacity from approximately a 10-year storm to a 50-year storm through the project reach. This sends additional flow downstream, which results in slight increases to water surface elevations within and downstream of the project reach. However, the increases in the 10- and 100-year water surface elevations just upstream and downstream of Bellaire Boulevard are located within channel banks or HCFCD ROW. Furthermore, the minor increases in water surface elevation for the 2-, 10-, and 25-year events downstream of Bellaire Boulevard do not result in any previously unsubmerged storm sewer outfalls becoming submerged. There are also no increases to peak flow along Brays Bayou just downstream of the Poor Farm Ditch outfall. Finally, it was determined that the required mitigation volume for the increase in 100-year flow at the Poor Farm Ditch outfall is provided through volume previously reserved within the Meyer Basin.

As the increase in water surface elevations are contained within channel banks or ROW and mitigation volume is available, it can be demonstrated that the proposed channel improvements for Poor Farm Ditch between Bellaire and University Boulevards will cause no adverse impact for storm events up to and including the 100-year.

## **EXHIBITS**

**Exhibit 1: Corrected Effective Hydrologic Workmap**

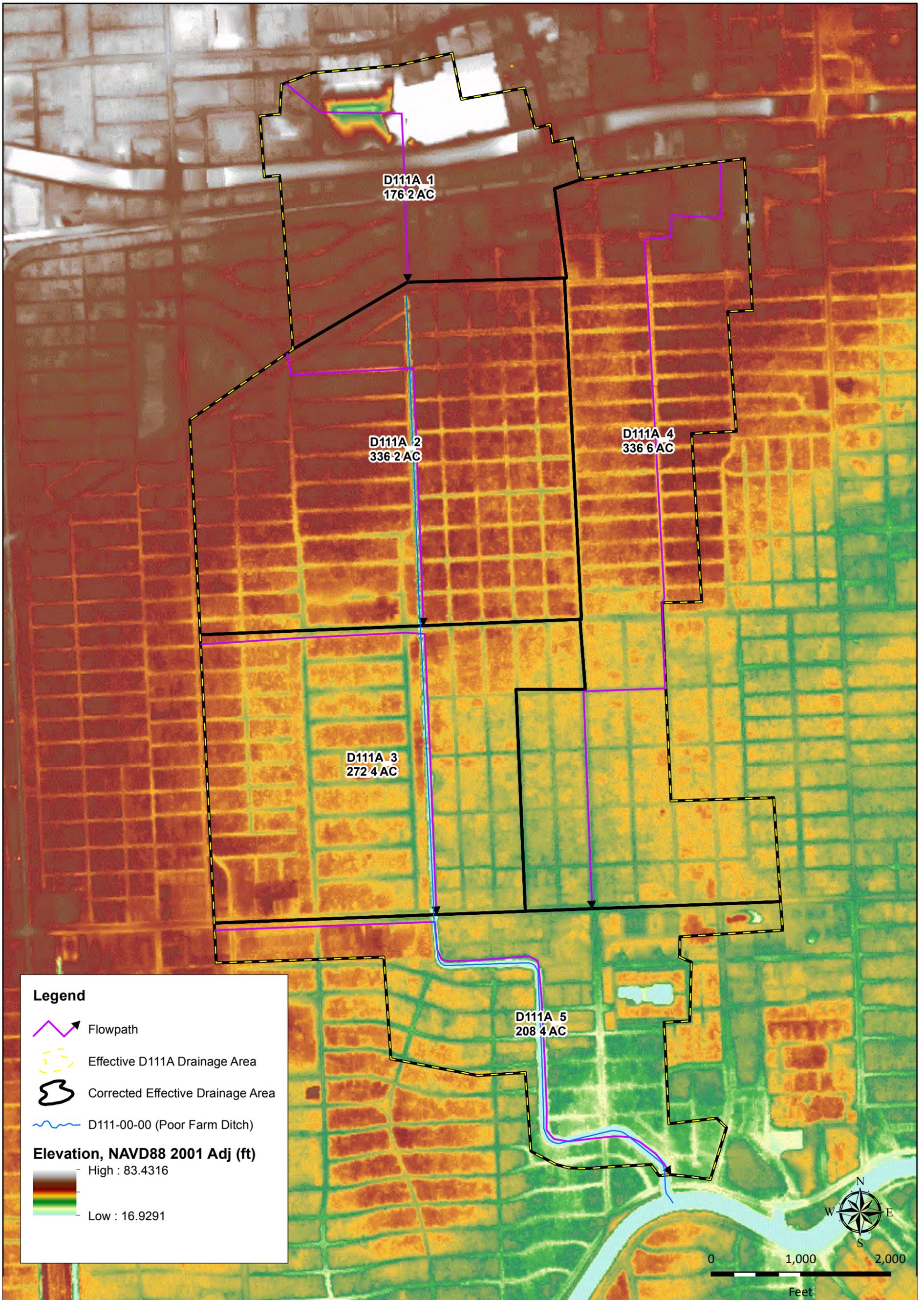
**Exhibits 2A and 2B: Surveyed Fence Lines**

**Exhibit 3: 10-year WSE Profile Comparison**

**Exhibit 4: 100-year WSE Profile Comparison**

**Exhibit 5: 100-year Hydrograph Comparison at Outfall**

**Exhibit 6: Storm Sewer Outfall Locations Downstream of Bellaire**



FN PROJECT NO.	HCF15148
DATE CREATED	Date: 12/12/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Exhibit1_HydrologicWorkmap
PREPARED BY	ASP

**FREESE AND NICHOLS, INC.**  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
 OFFICE: 713-600-6800  
 FAX: 713-600-6801

HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**CORRECTED EFFECTIVE HYDROLOGIC WORKMAP**



EXHIBIT  
 1



**Legend**

-  Surveyed Fence Lines
-  Surveyed HCFCF ROW
-  D111-00-00 (Poor Farm Ditch)

FN PROJECT NO.	HCF15148
DATE CREATED	Date: 2/20/2018
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Exhibit2A_Fences
PREPARED BY	ASP

**FREES AND NICHOLS**  
**FREES AND NICHOLS, INC.**  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
 OFFICE: 713-600-6800  
 FAX: 713-600-6801

HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**UPSTREAM - STUDY REACH**  
**EXISTING FENCE LINES**



EXHIBIT  
 2A



**Legend**

-  Surveved Fence Lines
-  Surveved HCFC District ROW
-  D111-00-00 (Poor Farm Ditch)

FN PROJECT NO.	HCF15148
DATE CREATED	Date: 2/20/2018
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Exhibit2B_Fences
PREPARED BY	ASP

**FREES AND NICHOLS**  
**FREES AND NICHOLS, INC.**  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
 OFFICE: 713-600-6800  
 FAX: 713-600-6801

HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**DOWNSTREAM - STUDY REACH**  
**EXISTING FENCE LINES**

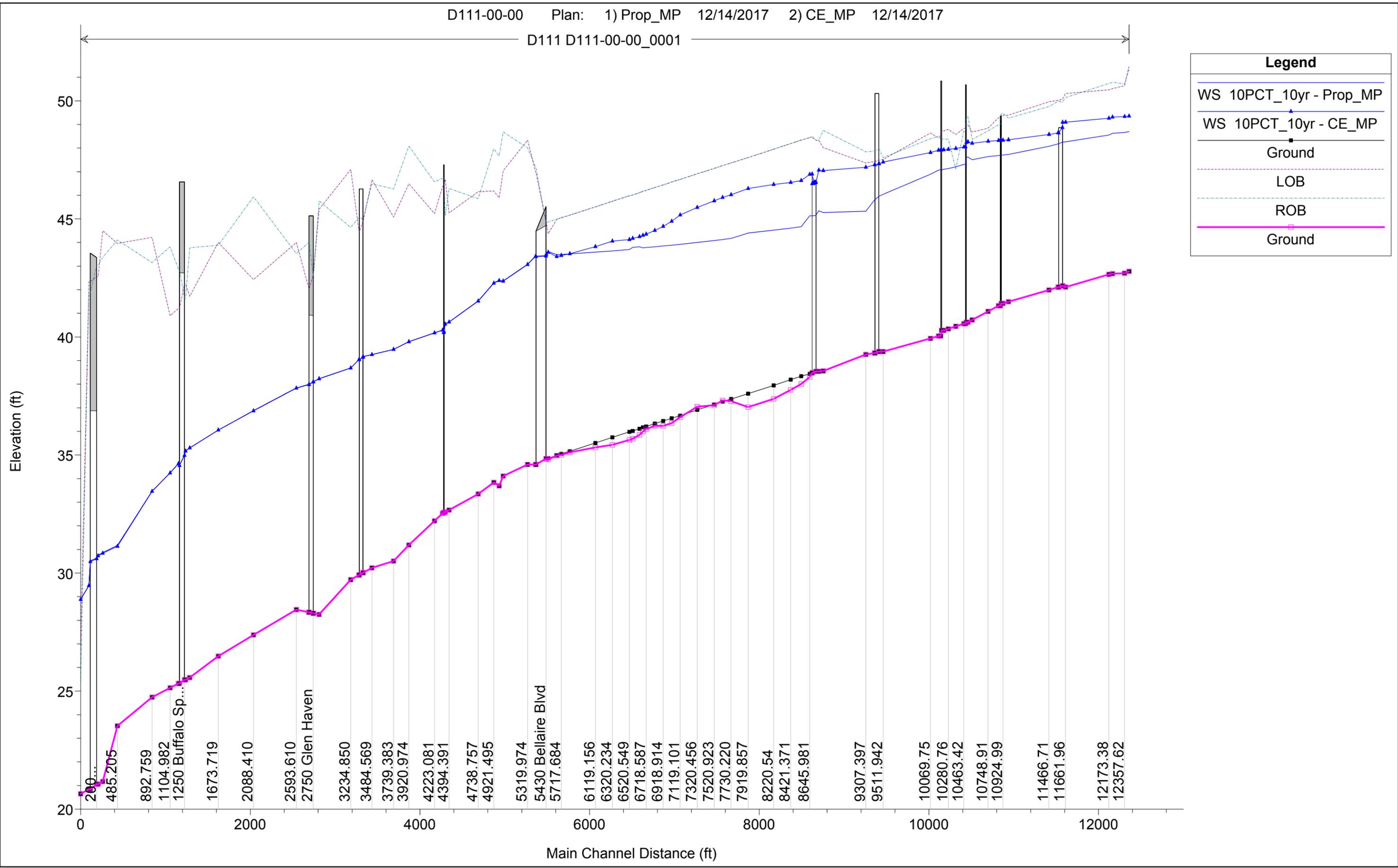


EXHIBIT  
**2B**

### Exhibit 3: 10-YR Water Surface Elevation Comparison

D111-00-00 Plan: 1) Prop\_MP 12/14/2017 2) CE\_MP 12/14/2017

D111 D111-00-00\_0001

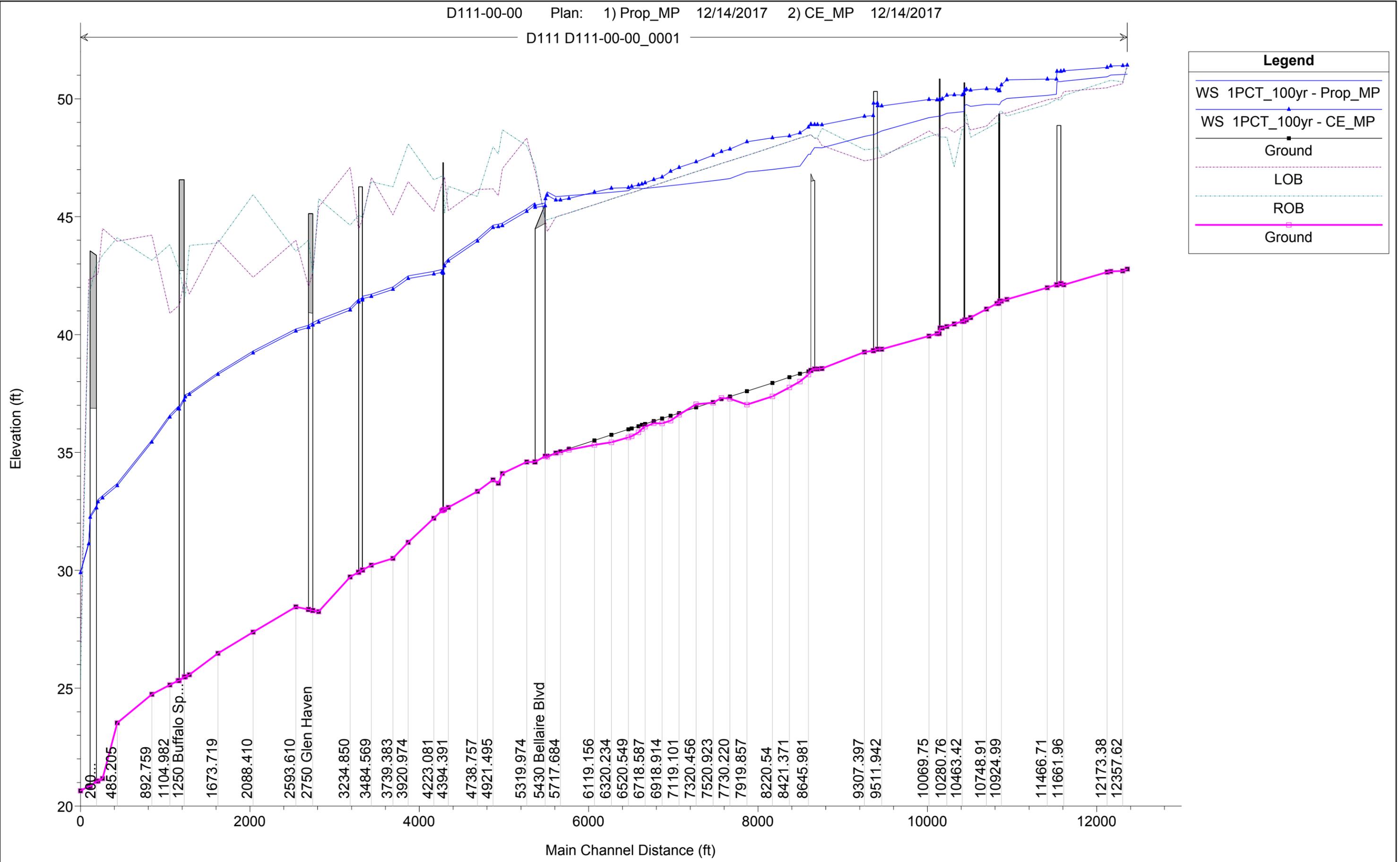


Legend	
—▲—	WS 10PCT_10yr - Prop_MP
—▲—	WS 10PCT_10yr - CE_MP
—■—	Ground
- - -	LOB
- - -	ROB
—□—	Ground

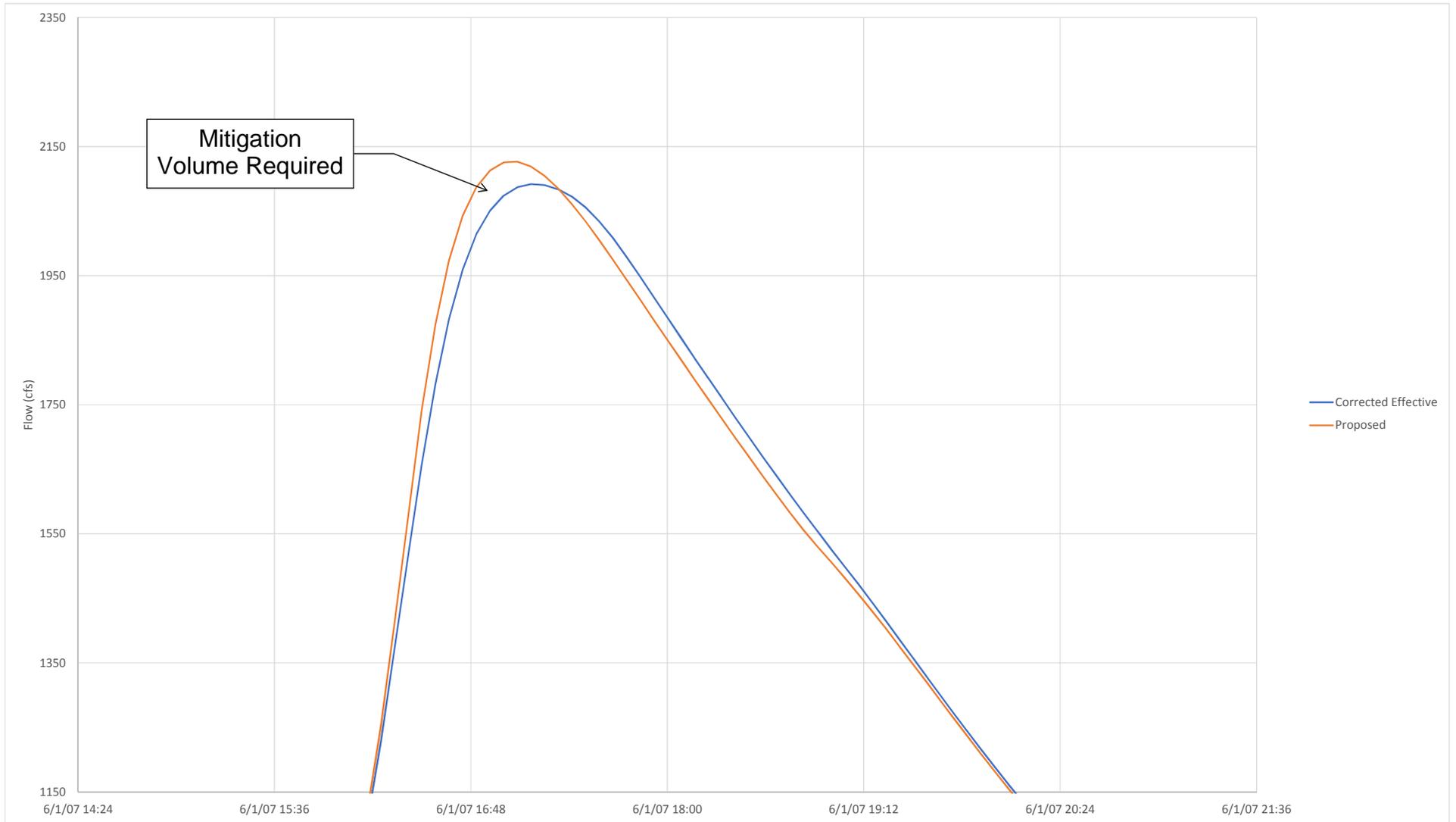
# Exhibit 4: 100YR Water Surface Elevation Comparison

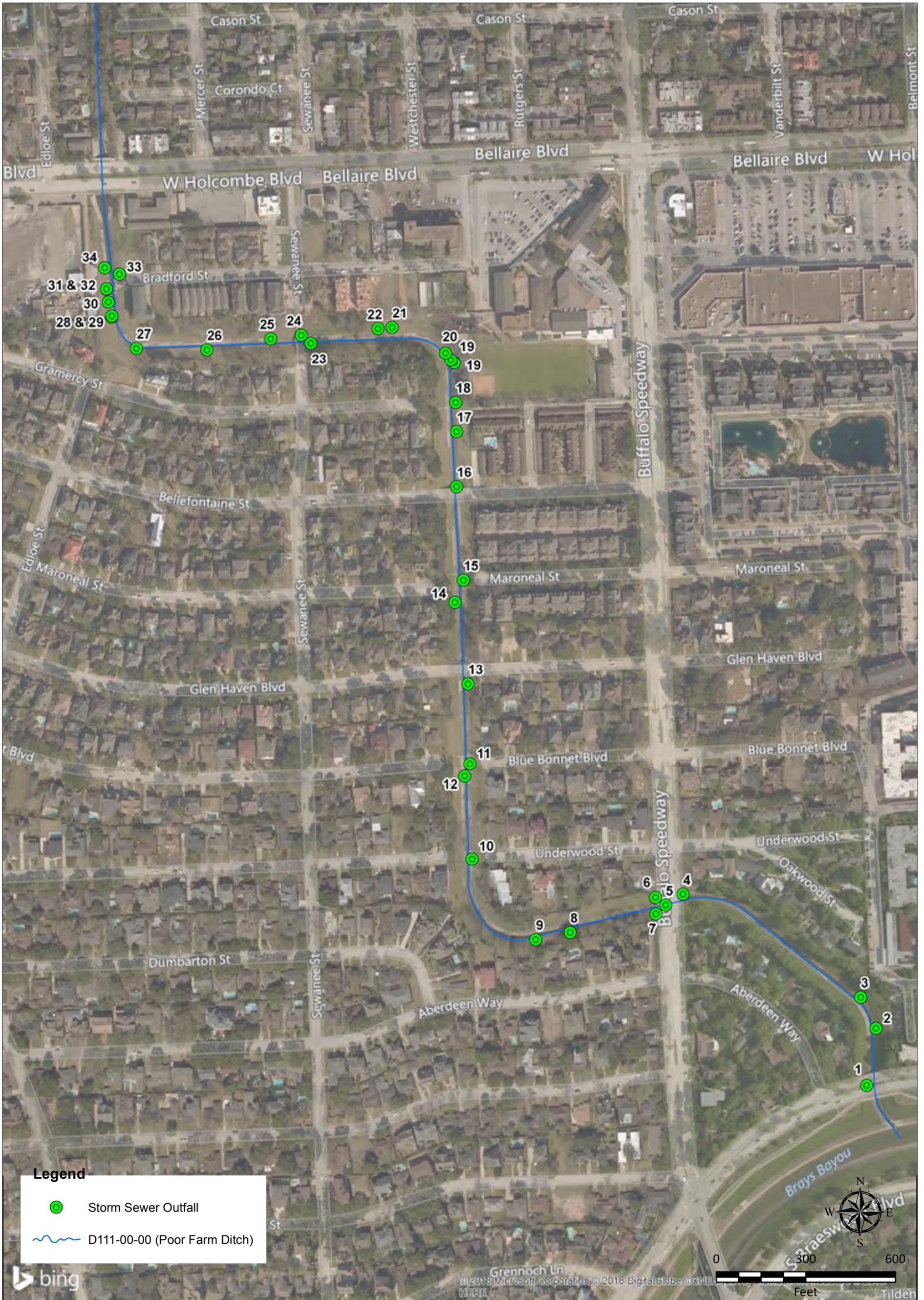
D111-00-00 Plan: 1) Prop\_MP 12/14/2017 2) CE\_MP 12/14/2017

D111 D111-00-00\_0001



# Exhibit 5: 100-YR Hydrograph Comparison at Poor Farm Outfall





FN PROJECT NO.	HCF15148
DATE CREATED	Date: 2/12/2018
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texas S Central
FILE NAME	Name: Exhibit6_DS_StormSewers
PREPARED BY	ASP

**FRESE AND NICHOLS, INC.**  
 10497 TOWN AND COUNTRY WAY, SUITE 600  
 HOUSTON, TEXAS 77024  
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 FAX: 713-600-6801

HARRIS COUNTY FLOOD CONTROL DISTRICT  
 D111-00-00 (POOR FARM DITCH)  
**STORM SEWER OUTFALL LOCATIONS  
 DOWNSTREAM OF BELLAIRE**



EXHIBIT  
**6**

**APPENDIX A**  
**Detailed Hydrologic Calculations**



**FEMA Effective Model as of June 18, 2007**  
**TC&R values for FNI Corrected Effective Model**  
**Brays Bayou Watershed**  
**HCFCFD TC&R Excel Template**

Subwatershed	Drainage Area* (acres)	Drainage Area (sq.mi.)	Watershed Length (mi.)	L	Length to Centroid(mi.)	Lca	Channel Slope(ft./mi)	S	Overland Slope(ft./mi.)	So	D	Percent Urban Development 2002	DLU	Percent Channel Improvement	DCI	Percent Channel Conveyance	DCC	Percent Ponding	DPP	DLU affected by Detention	DET	Percent Impervious 2002	(IC+R)''	IC''	R''	DLU Minimum	DLU (Detention)
	D111A_1	176.0	0.28	0.63	0.20	0.20	0.20	4.53	4.53	35.95	35.95	3.79	95.27	95.27	100.00	100.00	50.00	50.00	0.00	0.00	0.00	0.00	58.22	1.88	0.12	1.76	46.56
D111A_2	336.0	0.53	0.85	0.33	0.33	0.33	5.87	5.87	14.70	14.70	2.46	95.27	95.27	100.00	100.00	50.00	50.00	0.00	0.00	0.00	0.00	58.22	2.12	0.12	2.01	46.56	95.27
D111A_3	272.0	0.43	1.07	0.32	0.32	0.32	3.84	3.84	15.76	15.76	2.46	95.27	95.27	100.00	100.00	50.00	50.00	0.00	0.00	0.00	0.00	58.22	2.91	0.14	2.77	46.56	95.27
D111A_4	337.0	0.22	1.91	0.93	0.93	0.93	4.22	4.22	19.74	19.74	2.46	95.27	95.27	100.00	100.00	50.00	50.00	0.00	0.00	0.00	0.00	58.22	4.22	0.41	3.81	46.56	95.27
D111A_5	208.0	0.33	1.42	0.56	0.56	0.56	3.77	3.77	33.08	33.08	3.79	95.27	95.27	100.00	100.00	50.00	50.00	0.00	0.00	0.00	0.00	58.22	3.57	0.40	3.18	46.56	95.27

- Denotes values changed by FNI

\*The proposed drainage areas are smaller than 1 sq.mi. that HCFCFD suggests for Clark's Unit Hydrograph Method; however, FNI is continuing to use Clark's UH for consistency with the effective model.

**Modified Puls Subreach Calculations for FNI Corrected Effective Model**

HMS Element	Stream	Upstream Junction	Downstream Junction	Reach	Upstream XS	Downstream XS	RAS Geometry	Reach Length (ft)	Flow Profile Selected	Travel Time Avg (hrs)	K	Time Step (min)	Number of Subreaches	Reach	Average Number of Subreaches
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.369	12411.01	8752.369	CE	3658.641	20% 100YR	0.24	9.6	5	2	Reach-1	2
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.370	12411.01	8752.369	CE	3658.641	40% 100YR	0.22	8.8	5	2	Reach-2	1
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.371	12411.01	8752.369	CE	3658.641	60% 100YR	0.23	9.2	5	2	Reach-4	2
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.372	12411.01	8752.369	CE	3658.641	80% 100YR	0.82	32.8	5	7		
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.373	12411.01	8752.369	CE	3658.641	100% 100YR	1.42	56.8	5	11		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	CE	3212.085	20% 100YR	0.21	8.4	5	2		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	CE	3212.085	40% 100YR	0.17	6.8	5	1		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	CE	3212.085	60% 100YR	0.15	6.0	5	1		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	CE	3212.085	80% 100YR	0.14	5.6	5	1		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	CE	3212.085	100% 100YR	0.15	6.0	5	1		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	CE	5489.015	20% 100YR	0.22	8.8	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	CE	5489.015	40% 100YR	0.21	8.4	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	CE	5489.015	60% 100YR	0.24	9.6	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	CE	5489.015	80% 100YR	0.24	9.6	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	CE	5489.015	100% 100YR	0.24	9.6	5	2		

Not used due to skewed travel time

**Modified Puls Subreach Calculations for FNI Proposed Model**

HMS Element	Stream	Upstream Junction	Downstream Junction	Reach	Upstream XS	Downstream XS	RAS Geometry	Reach Length (ft)	Flow Profile Selected	Travel Time Avg (hrs)	K	Time Step (min)	Number of Subreaches	Reach	Average Number of Subreaches
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.369	12411.01	8752.369	PROPOSED	3658.641	20% 100YR	0.20	8.0	5	2	Reach-1	1
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.370	12411.01	8752.369	PROPOSED	3658.641	40% 100YR	0.18	7.2	5	1	Reach-2	1
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.371	12411.01	8752.369	PROPOSED	3658.641	60% 100YR	0.18	7.2	5	1	Reach-4	2
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.372	12411.01	8752.369	PROPOSED	3658.641	80% 100YR	0.24	9.6	5	2		
Reach-1	D111-00-00	Bissonnet	University BLVD	XS 12411.01 - XS 8752.373	12411.01	8752.369	PROPOSED	3658.641	100% 100YR	0.79	31.6	5	6		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	PROPOSED	3212.085	20% 100YR	0.19	7.6	5	2		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	PROPOSED	3212.085	40% 100YR	0.15	6.0	5	1		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	PROPOSED	3212.085	60% 100YR	0.13	5.2	5	1		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	PROPOSED	3212.085	80% 100YR	0.12	4.8	5	1		
Reach-2	D111-00-00	University BLVD	Bellaire BLVD	XS 8752.373 - XS 5540.284	8752.369	5540.284	PROPOSED	3212.085	100% 100YR	0.12	4.8	5	1		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	PROPOSED	5489.015	20% 100YR	0.22	8.8	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	PROPOSED	5489.015	40% 100YR	0.21	8.4	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	PROPOSED	5489.015	60% 100YR	0.24	9.6	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	PROPOSED	5489.015	80% 100YR	0.24	9.6	5	2		
Reach-4	D111-00-00	Bellaire BLVD	Outfall	XS 5540.284 - XS 51.269	5540.284	51.269	PROPOSED	5489.015	100% 100YR	0.24	9.6	5	2		

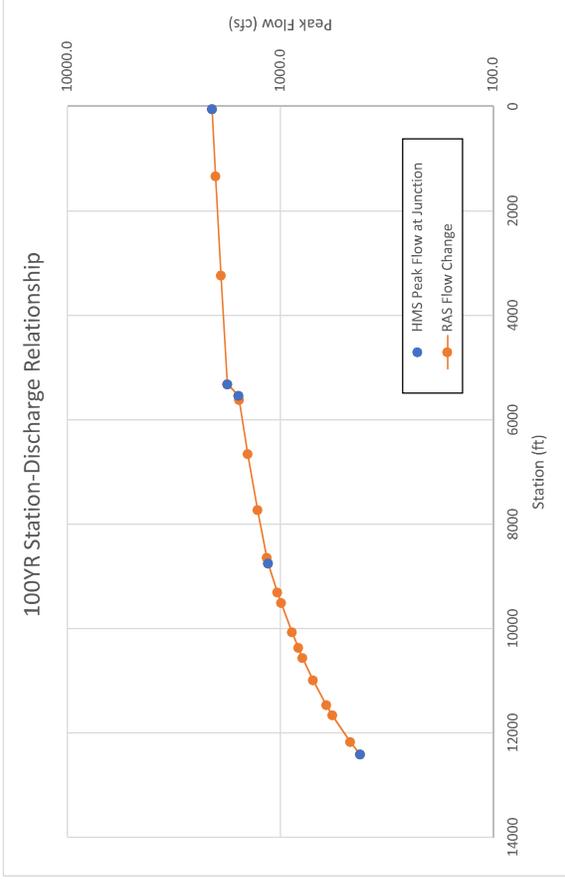
Not used for consistency with Corrected Effective calculation.

**APPENDIX B**  
**Detailed Hydraulic Calculations & Results**

**Flow Change Location Calculations for FNI Corrected Effective Model**

HMS Junction	HEC-HMS				
	Corresponding RAS XS	10YR (cfs)	50YR (cfs)	100YR (cfs)	500YR (cfs)
Bissonnet	12411.01	263.2	368.0	422.0	566.3
University BLVD	8752.369	701.4	991.8	1140.3	1510.2
US Bellaire	5540.284	981.9	1379.6	1570.1	2064.0
DS Bellaire	5319.974	1102.8	1554.6	1773.0	2344.1
Outfall	51.269	1274.4	1823.8	2091.8	2780.7

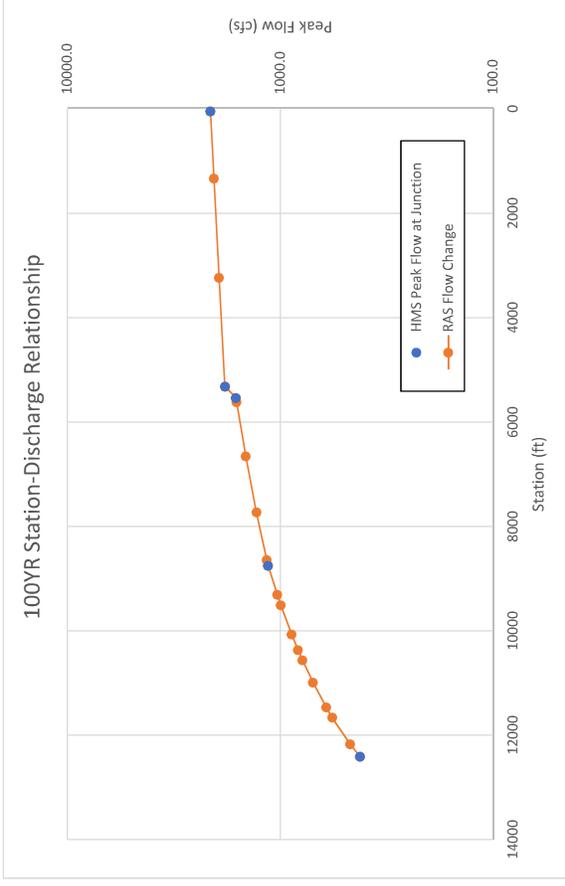
Flow Change Location*	HEC-RAS				
	10YR (cfs)	50YR (cfs)	100YR (cfs)	500YR (cfs)	500YR (cfs)
12411.01	263.2	368.0	422.0	566.3	566.3
12173.88	291.6	408.4	468.6	627.5	627.5
11661.96	352.9	495.7	569.1	759.5	759.5
11466.71	376.3	529.0	607.4	809.9	809.9
10989.81	433.4	610.3	701.0	933.0	933.0
10561.45	484.7	683.4	785.1	1043.5	1043.5
10368.23	507.9	716.3	823.1	1093.3	1093.3
10069.75	543.6	767.2	881.7	1170.3	1170.3
9511.942	610.4	862.3	991.2	1314.2	1314.2
9307.397	634.9	897.2	1031.3	1367.0	1367.0
8752.369	701.4	991.8	1140.3	1510.2	1510.2
8645.981	710.7	1004.6	1154.5	1528.5	1528.5
7730.22	790.7	1115.2	1277.1	1686.4	1686.4
6656.935	884.4	1244.8	1420.7	1871.5	1871.5
5619.191	975.0	1370.1	1559.5	2050.4	2050.4
5540.284	981.9	1379.6	1570.1	2064.0	2064.0
5319.974	1102.8	1554.6	1773.0	2344.1	2344.1
3234.85	1170.7	1661.1	1899.2	2516.9	2516.9
1337.589	1232.5	1758.1	2014.0	2674.1	2674.1
51.269	1274.4	1823.8	2091.8	2780.7	2780.7



**Flow Change Location Calculations for FNI Proposed Model**

HMS Junction	HEC-HMS				
	Corresponding RAS XS	10YR (cfs)	50YR (cfs)	100YR (cfs)	500YR (cfs)
Bissonnet	12411.01	263.2	368.0	422.0	566.3
University BLVD	8752.369	702.6	993.0	1141.8	1523.6
US Bellaire	5540.284	987.0	1407.0	1616.7	2154.9
DS Bellaire	5319.974	1107.2	1580.2	1818.6	2434.1
Outfall	51.269	1278.8	1843.4	2126.6	2873.6

Flow Change Location*	HEC-RAS				
	10YR (cfs)	50YR (cfs)	100YR (cfs)	100YR (cfs)	500YR (cfs)
12411.01	263.2	368.0	422.0	422.0	566.3
12173.88	291.7	408.5	468.7	468.7	628.3
11661.96	353.2	496.0	569.4	569.4	762.3
11466.71	376.6	529.3	607.8	607.8	813.4
10989.81	433.9	610.8	701.6	701.6	938.2
10561.45	485.3	684.0	785.9	785.9	1050.2
10368.23	508.5	717.0	823.9	823.9	1100.8
10069.75	544.4	768.0	882.6	882.6	1178.9
9511.942	611.4	863.2	992.4	992.4	1324.9
9307.397	635.9	898.2	1032.6	1032.6	1378.4
8752.369	702.6	993.0	1141.8	1141.8	1523.6
8645.981	712.0	1006.7	1157.5	1157.5	1544.5
7730.22	793.1	1124.7	1292.9	1292.9	1724.5
6656.935	888.1	1263.1	1451.6	1451.6	1935.4
5619.191	980.0	1396.8	1605.0	1605.0	2139.4
5540.284	987.0	1407.0	1616.7	1616.7	2154.9
5319.974	1107.2	1580.2	1818.6	1818.6	2434.1
3234.85	1175.1	1684.4	1940.5	1940.5	2608.0
1337.589	1236.9	1779.1	2051.4	2051.4	2766.3
51.269	1278.8	1843.4	2126.6	2126.6	2873.6



Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	12411.01	10PCT_10yr	263.20	42.78	49.36	45.72	49.47	0.000136	2.66	98.84	22.67	0.22
D111-00-00_0001	12411.01	2PCT_50yr	368.00	42.78	50.70	46.33	50.82	0.000133	2.80	131.47	27.83	0.23
D111-00-00_0001	12411.01	1PCT_100yr	422.00	42.78	51.42	46.60	51.54	0.000148	2.70	179.42	211.79	0.24
D111-00-00_0001	12411.01	0.2PCT_500yr	566.30	42.78	52.48	47.27	52.48	0.000004	0.51	9409.14	4679.73	0.04
D111-00-00_0001	12357.62	10PCT_10yr	263.20	42.70	49.34	45.85	49.46	0.000169	2.78	94.69	23.68	0.25
D111-00-00_0001	12357.62	2PCT_50yr	368.00	42.70	50.68	46.52	50.81	0.000144	2.84	132.23	48.23	0.23
D111-00-00_0001	12357.62	1PCT_100yr	422.00	42.70	51.41	46.82	51.53	0.000115	2.79	175.03	183.70	0.21
D111-00-00_0001	12357.62	0.2PCT_500yr	566.30	42.70	52.31	47.52	52.46	0.000118	3.14	243.51	789.71	0.22
D111-00-00_0001	12215.95	10PCT_10yr	263.20	42.68	49.31	45.81	49.43	0.000202	2.79	94.45	23.62	0.25
D111-00-00_0001	12215.95	2PCT_50yr	368.00	42.68	50.65	46.49	50.78	0.000341	2.85	130.00	110.07	0.23
D111-00-00_0001	12215.95	1PCT_100yr	422.00	42.68	51.40	46.79	51.50	0.000259	2.66	256.87	236.92	0.20
D111-00-00_0001	12215.95	0.2PCT_500yr	566.30	42.68	52.32	47.49	52.43	0.000234	2.81	418.35	525.89	0.20
D111-00-00_0001	12173.38	10PCT_10yr	291.60	42.65	49.26	46.01	49.42	0.000219	3.16	92.28	23.05	0.28
D111-00-00_0001	12173.38	2PCT_50yr	408.40	42.65	50.60	46.72	50.77	0.000187	3.25	126.07	117.74	0.27
D111-00-00_0001	12173.38	1PCT_100yr	468.60	42.65	51.33	47.04	51.49	0.000154	3.18	170.40	221.78	0.25
D111-00-00_0001	12173.38	0.2PCT_500yr	627.50	42.65	52.22	47.77	52.41	0.000156	3.55	242.23	512.52	0.25
D111-00-00_0001	11661.96	10PCT_10yr	352.90	42.11	49.10	45.91	49.29	0.000265	3.54	99.73	24.19	0.31
D111-00-00_0001	11661.96	2PCT_50yr	495.70	42.11	50.44	46.70	50.65	0.000284	3.67	141.17	61.91	0.29
D111-00-00_0001	11661.96	1PCT_100yr	569.10	42.11	51.19	47.04	51.39	0.000223	3.58	209.20	160.64	0.27
D111-00-00_0001	11661.96	0.2PCT_500yr	759.50	42.11	52.08	47.83	52.31	0.000227	3.99	309.91	324.36	0.28
D111-00-00_0001	11626.60	10PCT_10yr	352.90	42.16	49.09	45.92	49.28	0.000244	3.46	101.97	24.91	0.30
D111-00-00_0001	11626.60	2PCT_50yr	495.70	42.16	50.43	46.68	50.64	0.000190	3.68	137.26	127.38	0.28
D111-00-00_0001	11626.60	1PCT_100yr	569.10	42.16	51.17	47.02	51.38	0.000162	3.69	185.70	414.38	0.26
D111-00-00_0001	11626.60	0.2PCT_500yr	759.50	42.16	52.04	47.78	52.29	0.000173	4.16	367.34	1260.80	0.27
D111-00-00_0001	11600 Sunset Blvd	Bridge										
D111-00-00_0001	11574.81	10PCT_10yr	352.90	42.11	48.64	45.87	48.87	0.000326	3.82	92.30	23.67	0.34
D111-00-00_0001	11574.81	2PCT_50yr	495.70	42.11	50.01	46.64	50.25	0.000244	3.93	126.08	494.30	0.31
D111-00-00_0001	11574.81	1PCT_100yr	569.10	42.11	50.83	46.97	51.07	0.000194	3.88	152.27	995.67	0.28
D111-00-00_0001	11574.81	0.2PCT_500yr	759.50	42.11	52.21	47.73	52.25	0.000042	2.09	2735.38	1735.34	0.14
D111-00-00_0001	11466.71	10PCT_10yr	376.30	41.99	48.58	45.90	48.83	0.000358	4.02	93.49	23.83	0.36
D111-00-00_0001	11466.71	2PCT_50yr	529.00	41.99	49.95	46.67	50.21	0.000311	4.08	131.37	50.84	0.34
D111-00-00_0001	11466.71	1PCT_100yr	607.40	41.99	50.84	47.01	51.02	0.000188	3.58	203.84	97.66	0.28
D111-00-00_0001	11466.71	0.2PCT_500yr	809.90	41.99	52.08	47.79	52.21	0.000115	3.23	343.02	334.40	0.22
D111-00-00_0001	10989.81	10PCT_10yr	433.40	41.49	48.35	45.70	48.64	0.000394	4.33	100.20	24.67	0.38
D111-00-00_0001	10989.81	2PCT_50yr	610.30	41.49	49.82	46.53	50.07	0.000271	4.12	265.37	340.82	0.33
D111-00-00_0001	10989.81	1PCT_100yr	701.00	41.49	50.81	46.89	50.93	0.000129	3.20	706.24	559.66	0.23
D111-00-00_0001	10989.81	0.2PCT_500yr	933.00	41.49	52.08	47.71	52.15	0.000070	2.69	1640.87	1434.60	0.18
D111-00-00_0001	10924.99	10PCT_10yr	433.40	41.42	48.33	45.61	48.61	0.000373	4.23	102.48	25.15	0.37
D111-00-00_0001	10924.99	2PCT_50yr	610.30	41.42	49.75	46.43	50.04	0.000635	4.32	141.59	89.12	0.35
D111-00-00_0001	10924.99	1PCT_100yr	701.00	41.42	50.59	46.80	50.87	0.000492	4.22	166.47	117.85	0.31
D111-00-00_0001	10924.99	0.2PCT_500yr	933.00	41.42	52.09	47.61	52.12	0.000454	1.70	1785.77	5322.79	0.13
D111-00-00_0001	10900 Ped Bridge	Bridge										
D111-00-00_0001	10871.51	10PCT_10yr	433.40	41.32	48.32	45.50	48.59	0.000354	4.14	104.56	25.40	0.36
D111-00-00_0001	10871.51	2PCT_50yr	610.30	41.32	49.67	46.34	49.95	0.000290	4.27	146.79	146.76	0.34
D111-00-00_0001	10871.51	1PCT_100yr	701.00	41.32	50.41	46.70	50.67	0.000229	4.16	176.30	273.68	0.31
D111-00-00_0001	10871.51	0.2PCT_500yr	933.00	41.32	51.56	47.52	51.67	0.000104	3.18	702.38	790.70	0.21
D111-00-00_0001	10748.91	10PCT_10yr	433.40	41.08	48.29	45.27	48.53	0.000309	3.94	110.01	26.08	0.34
D111-00-00_0001	10748.91	2PCT_50yr	610.30	41.08	49.66	46.09	49.89	0.000225	3.91	177.89	77.21	0.30
D111-00-00_0001	10748.91	1PCT_100yr	701.00	41.08	50.43	46.46	50.61	0.000159	3.61	244.39	109.70	0.26
D111-00-00_0001	10748.91	0.2PCT_500yr	933.00	41.08	51.48	47.28	51.64	0.000129	3.61	389.03	628.48	0.24
D111-00-00_0001	10561.45	10PCT_10yr	484.70	40.72	48.21	45.17	48.47	0.000325	4.13	117.35	26.96	0.35
D111-00-00_0001	10561.45	2PCT_50yr	683.40	40.72	49.60	46.03	49.84	0.000230	4.09	203.74	94.51	0.31
D111-00-00_0001	10561.45	1PCT_100yr	785.10	40.72	50.36	46.41	50.57	0.000175	3.89	289.59	303.11	0.27
D111-00-00_0001	10561.45	0.2PCT_500yr	1043.50	40.72	51.56	47.26	51.58	0.000029	1.77	5400.28	3717.27	0.11
D111-00-00_0001	10511.71	10PCT_10yr	484.70	40.62	48.26	45.20	48.39	0.000214	2.82	172.03	59.60	0.24
D111-00-00_0001	10511.71	2PCT_50yr	683.40	40.62	49.64	45.89	49.78	0.000179	2.99	228.53	241.85	0.22
D111-00-00_0001	10511.71	1PCT_100yr	785.10	40.62	50.40	46.17	50.52	0.000143	2.68	319.82	358.92	0.21
D111-00-00_0001	10511.71	0.2PCT_500yr	1043.50	40.62	51.56	46.74	51.58	0.000040	1.31	4605.88	3736.87	0.10
D111-00-00_0001	10500 Ped Bridge	Bridge										
D111-00-00_0001	10463.42	10PCT_10yr	484.70	40.56	48.04	44.95	48.33	0.000340	4.27	113.63	25.06	0.35
D111-00-00_0001	10463.42	2PCT_50yr	683.40	40.56	49.40	45.83	49.71	0.000302	4.49	165.21	81.07	0.34
D111-00-00_0001	10463.42	1PCT_100yr	785.10	40.56	50.16	46.22	50.45	0.000242	4.39	224.23	151.27	0.32
D111-00-00_0001	10463.42	0.2PCT_500yr	1043.50	40.56	51.53	47.10	51.56	0.000046	2.19	4453.47	4792.08	0.14
D111-00-00_0001	10368.23	10PCT_10yr	507.90	40.45	47.98	44.96	48.29	0.000345	4.44	114.98	25.61	0.36
D111-00-00_0001	10368.23	2PCT_50yr	716.30	40.45	49.37	45.86	49.68	0.000272	4.60	178.78	365.00	0.33
D111-00-00_0001	10368.23	1PCT_100yr	823.10	40.45	50.17	46.26	50.40	0.000190	4.17	244.04	658.13	0.28
D111-00-00_0001	10368.23	0.2PCT_500yr	1093.30	40.45	51.54	47.14	51.55	0.000019	1.49	7403.51	4654.00	0.09
D111-00-00_0001	10280.76	10PCT_10yr	507.90	40.34	47.94	45.00	48.25	0.000375	4.47	113.64	25.35	0.37
D111-00-00_0001	10280.76	2PCT_50yr	716.30	40.34	49.35	45.90	49.66	0.000291	4.53	177.94	79.82	0.34

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	10280.76	1PCT_100yr	823.10	40.34	50.15	46.30	50.39	0.000201	4.13	248.42	145.73	0.29
D111-00-00_0001	10280.76	0.2PCT_500yr	1093.30	40.34	51.51	47.18	51.54	0.000045	2.22	4387.28	3911.20	0.14
D111-00-00_0001	10225.63	10PCT_10yr	507.90	40.28	47.93	44.94	48.23	0.000365	4.43	114.72	25.48	0.37
D111-00-00_0001	10225.63	2PCT_50yr	716.30	40.28	49.28	45.84	49.63	0.000750	4.70	157.75	53.74	0.36
D111-00-00_0001	10225.63	1PCT_100yr	823.10	40.28	50.00	46.23	50.34	0.000636	4.70	202.52	129.89	0.34
D111-00-00_0001	10225.63	0.2PCT_500yr	1093.30	40.28	51.10	47.12	51.44	0.000560	4.93	485.90	824.47	0.32
D111-00-00_0001	10200 Ped Bridge	Bridge										
D111-00-00_0001	10164.78	10PCT_10yr	507.90	40.04	47.91	44.83	48.20	0.000353	4.37	116.19	25.52	0.36
D111-00-00_0001	10164.78	2PCT_50yr	716.30	40.04	49.25	45.74	49.59	0.000306	4.69	162.33	266.77	0.35
D111-00-00_0001	10164.78	1PCT_100yr	823.10	40.04	49.96	46.13	50.30	0.000267	4.73	209.13	327.23	0.33
D111-00-00_0001	10164.78	0.2PCT_500yr	1093.30	40.04	51.05	47.03	51.27	0.000174	4.23	934.77	1168.76	0.28
D111-00-00_0001	10069.75	10PCT_10yr	543.60	39.94	47.81	44.90	48.15	0.000404	4.67	116.29	25.52	0.39
D111-00-00_0001	10069.75	2PCT_50yr	767.20	39.94	49.22	45.84	49.56	0.000336	4.78	204.05	208.70	0.37
D111-00-00_0001	10069.75	1PCT_100yr	881.70	39.94	49.98	46.25	50.23	0.000232	4.33	392.94	333.71	0.31
D111-00-00_0001	10069.75	0.2PCT_500yr	1170.30	39.94	51.05	47.16	51.24	0.000166	4.09	834.13	772.63	0.27
D111-00-00_0001	9511.942	10PCT_10yr	610.40	39.38	47.41	44.64	47.78	0.001787	4.92	124.04	27.08	0.41
D111-00-00_0001	9511.942	2PCT_50yr	862.30	39.38	48.84	45.61	49.25	0.001424	5.19	190.35	168.64	0.38
D111-00-00_0001	9511.942	1PCT_100yr	991.20	39.38	49.70	46.04	50.02	0.000997	4.75	397.07	357.29	0.32
D111-00-00_0001	9511.942	0.2PCT_500yr	1314.20	39.38	50.90	46.96	51.09	0.000628	4.20	999.03	1873.70	0.26
D111-00-00_0001	9463.775	10PCT_10yr	610.40	39.38	47.34	44.51	47.71	0.001298	4.88	125.12	27.60	0.40
D111-00-00_0001	9463.775	2PCT_50yr	862.30	39.38	48.79	45.48	49.18	0.001040	5.04	190.14	285.43	0.37
D111-00-00_0001	9463.775	1PCT_100yr	991.20	39.38	49.70	45.90	49.93	0.000597	4.21	510.86	540.44	0.29
D111-00-00_0001	9463.775	0.2PCT_500yr	1314.20	39.38	50.92	46.84	51.02	0.000312	3.40	1420.75	2282.00	0.21
D111-00-00_0001	9450 Rice Blvd	Bridge										
D111-00-00_0001	9411.652	10PCT_10yr	610.40	39.32	47.29	44.45	47.66	0.000428	4.86	125.60	27.66	0.40
D111-00-00_0001	9411.652	2PCT_50yr	862.30	39.32	48.72	45.42	49.12	0.000345	5.12	196.51	236.44	0.38
D111-00-00_0001	9411.652	1PCT_100yr	991.20	39.32	49.29	45.84	49.69	0.000317	5.22	308.61	348.02	0.37
D111-00-00_0001	9411.652	0.2PCT_500yr	1314.20	39.32	50.81	46.77	50.97	0.000133	3.91	2178.67	2386.94	0.25
D111-00-00_0001	9307.397	10PCT_10yr	634.90	39.26	47.19	44.49	47.59	0.000724	5.11	124.24	27.49	0.42
D111-00-00_0001	9307.397	2PCT_50yr	897.20	39.26	48.68	45.48	49.06	0.000754	5.05	191.63	118.95	0.37
D111-00-00_0001	9307.397	1PCT_100yr	1031.30	39.26	49.26	45.92	49.63	0.000674	5.08	227.77	258.53	0.36
D111-00-00_0001	9307.397	0.2PCT_500yr	1367.00	39.26	50.81	46.85	50.94	0.000257	3.63	1891.50	2138.61	0.23
D111-00-00_0001	8805.521	10PCT_10yr	634.90	38.56	47.04	42.35	47.25	0.000392	3.64	174.44	27.52	0.25
D111-00-00_0001	8805.521	2PCT_50yr	897.20	38.56	48.34	43.22	48.62	0.000895	4.24	212.94	270.20	0.28
D111-00-00_0001	8805.521	1PCT_100yr	1031.30	38.56	48.90	43.63	49.21	0.000995	4.51	238.22	952.60	0.29
D111-00-00_0001	8805.521	0.2PCT_500yr	1367.00	38.56	50.64	44.55	50.77	0.000458	3.51	1032.60	2356.78	0.20
D111-00-00_0001	8752.369	10PCT_10yr	701.40	38.54	47.06	41.41	47.22	0.000090	3.23	217.26	30.41	0.20
D111-00-00_0001	8752.369	2PCT_50yr	991.80	38.54	48.35	42.15	48.58	0.000165	3.91	351.84	315.71	0.23
D111-00-00_0001	8752.369	1PCT_100yr	1140.30	38.54	48.91	42.50	49.16	0.000171	4.13	509.76	679.03	0.23
D111-00-00_0001	8752.369	0.2PCT_500yr	1510.20	38.54	50.53	43.32	50.75	0.000137	4.10	1200.21	2697.48	0.21
D111-00-00_0001	8677 University Blvd	Culvert										
D111-00-00_0001	8674.259	10PCT_10yr	701.40	38.48	46.90	41.34	47.06	0.000124	3.26	215.33	70.53	0.20
D111-00-00_0001	8674.259	2PCT_50yr	991.80	38.48	48.26	42.09	48.47	0.000148	3.78	555.05	807.70	0.21
D111-00-00_0001	8674.259	1PCT_100yr	1140.30	38.48	48.93	42.44	49.12	0.000133	3.75	916.36	1391.58	0.20
D111-00-00_0001	8674.259	0.2PCT_500yr	1510.20	38.48	50.61	43.25	50.73	0.000084	3.29	2249.10	5142.73	0.17
D111-00-00_0001	8645.981	10PCT_10yr	710.70	38.30	46.89	41.28	47.06	0.000218	3.28	216.68	26.09	0.20
D111-00-00_0001	8645.981	2PCT_50yr	1004.60	38.30	48.21	42.05	48.45	0.000289	3.99	251.64	250.15	0.23
D111-00-00_0001	8645.981	1PCT_100yr	1154.50	38.30	48.80	42.40	49.09	0.000314	4.29	271.18	502.98	0.25
D111-00-00_0001	8645.981	0.2PCT_500yr	1528.50	38.30	50.29	43.23	50.65	0.000341	4.84	329.14	2720.09	0.27
D111-00-00_0001	8545.785	10PCT_10yr	710.70	38.01	46.63	43.39	46.97	0.000615	4.70	151.06	30.41	0.37
D111-00-00_0001	8545.785	2PCT_50yr	1004.60	38.01	47.95	44.37	48.36	0.000626	5.17	194.41	123.23	0.39
D111-00-00_0001	8545.785	1PCT_100yr	1154.50	38.01	48.55	44.80	49.00	0.000612	5.35	215.84	177.01	0.39
D111-00-00_0001	8545.785	0.2PCT_500yr	1528.50	38.01	50.09	45.76	50.57	0.000508	5.58	275.15	1935.22	0.36
D111-00-00_0001	8421.371	10PCT_10yr	710.70	37.76	46.54	43.25	46.89	0.000586	4.77	149.89	45.28	0.36
D111-00-00_0001	8421.371	2PCT_50yr	1004.60	37.76	47.84	44.27	48.29	0.000561	5.39	188.67	158.20	0.37
D111-00-00_0001	8421.371	1PCT_100yr	1154.50	37.76	48.42	44.71	48.92	0.000556	5.67	206.26	219.89	0.37
D111-00-00_0001	8421.371	0.2PCT_500yr	1528.50	37.76	49.92	45.69	50.50	0.000512	6.17	255.35	2034.89	0.37
D111-00-00_0001	8220.54	10PCT_10yr	710.70	37.38	46.46	42.79	46.76	0.000626	4.38	162.24	96.80	0.33
D111-00-00_0001	8220.54	2PCT_50yr	1004.60	37.38	47.76	43.79	48.15	0.000620	5.02	200.21	195.49	0.34
D111-00-00_0001	8220.54	1PCT_100yr	1154.50	37.38	48.34	44.24	48.78	0.000623	5.31	217.31	252.80	0.34
D111-00-00_0001	8220.54	0.2PCT_500yr	1528.50	37.38	49.85	45.21	50.37	0.000591	5.84	283.56	4692.26	0.34
D111-00-00_0001	7919.857	10PCT_10yr	710.70	37.03	46.29	42.52	46.57	0.000592	4.27	166.31	56.31	0.32
D111-00-00_0001	7919.857	2PCT_50yr	1004.60	37.03	47.59	43.52	47.96	0.000587	4.90	205.70	181.04	0.33
D111-00-00_0001	7919.857	1PCT_100yr	1154.50	37.03	48.18	43.97	48.59	0.000590	5.19	223.61	381.50	0.33
D111-00-00_0001	7919.857	0.2PCT_500yr	1528.50	37.03	49.68	44.93	50.19	0.000583	5.71	276.86	4639.91	0.34
D111-00-00_0001	7730.220	10PCT_10yr	790.70	37.28	46.02	43.06	46.43	0.000628	5.14	154.17	54.57	0.39
D111-00-00_0001	7730.220	2PCT_50yr	1115.20	37.28	47.30	44.06	47.83	0.000611	5.85	191.38	333.60	0.40
D111-00-00_0001	7730.220	1PCT_100yr	1277.10	37.28	47.87	44.49	48.46	0.000607	6.16	208.11	911.65	0.41
D111-00-00_0001	7730.220	0.2PCT_500yr	1686.40	37.28	49.35	45.43	50.06	0.000566	6.74	255.48	2177.95	0.40

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	7619.578	10PCT_10yr	790.70	37.31	45.91	43.16	46.36	0.000966	5.35	147.66	39.59	0.42
D111-00-00_0001	7619.578	2PCT_50yr	1115.20	37.31	47.19	44.18	47.75	0.000901	6.02	185.34	168.89	0.42
D111-00-00_0001	7619.578	1PCT_100yr	1277.10	37.31	47.76	44.62	48.38	0.000883	6.31	202.26	240.79	0.42
D111-00-00_0001	7619.578	0.2PCT_500yr	1686.40	37.31	49.26	45.53	49.99	0.000866	6.81	247.50	1513.70	0.43
D111-00-00_0001	7520.923	10PCT_10yr	790.70	37.11	45.77	43.13	46.25	0.000998	5.59	141.39	33.06	0.44
D111-00-00_0001	7520.923	2PCT_50yr	1115.20	37.11	47.04	44.18	47.66	0.000945	6.31	176.67	138.37	0.44
D111-00-00_0001	7520.923	1PCT_100yr	1277.10	37.11	47.60	44.63	48.29	0.000932	6.64	192.45	188.96	0.44
D111-00-00_0001	7520.923	0.2PCT_500yr	1686.40	37.11	49.08	45.54	49.89	0.000872	7.21	237.20	940.53	0.44
D111-00-00_0001	7320.456	10PCT_10yr	790.70	37.05	45.48	43.30	46.04	0.001113	5.96	132.57	33.67	0.48
D111-00-00_0001	7320.456	2PCT_50yr	1115.20	37.05	46.76	44.34	47.45	0.001021	6.67	167.20	157.19	0.47
D111-00-00_0001	7320.456	1PCT_100yr	1277.10	37.05	47.33	44.70	48.09	0.000999	7.00	182.56	311.78	0.48
D111-00-00_0001	7320.456	0.2PCT_500yr	1686.40	37.05	48.84	45.53	49.69	0.001127	7.40	231.91	1272.94	0.51
D111-00-00_0001	7119.101	10PCT_10yr	790.70	36.60	45.16	42.67	45.65	0.005064	5.58	141.69	35.63	0.45
D111-00-00_0001	7119.101	2PCT_50yr	1115.20	36.60	46.50	43.70	47.09	0.004371	6.13	182.02	47.92	0.44
D111-00-00_0001	7119.101	1PCT_100yr	1277.10	36.60	47.09	44.14	47.72	0.004210	6.40	199.68	124.00	0.44
D111-00-00_0001	7119.101	0.2PCT_500yr	1686.40	36.60	48.57	45.07	49.31	0.003752	6.91	244.23	591.57	0.43
D111-00-00_0001	7019.39	10PCT_10yr	790.70	36.35	44.90	42.28	45.31	0.001333	5.15	158.25	43.10	0.40
D111-00-00_0001	7019.39	2PCT_50yr	1115.20	36.35	46.31	43.23	46.78	0.001128	5.57	214.12	78.35	0.38
D111-00-00_0001	7019.39	1PCT_100yr	1277.10	36.35	46.92	43.63	47.42	0.001071	5.76	239.04	230.93	0.38
D111-00-00_0001	7019.39	0.2PCT_500yr	1686.40	36.35	48.49	44.47	49.01	0.000892	6.00	350.19	966.11	0.36
D111-00-00_0001	6918.914	10PCT_10yr	790.70	36.23	44.69	42.29	45.18	0.000958	5.66	140.50	38.28	0.46
D111-00-00_0001	6918.914	2PCT_50yr	1115.20	36.23	46.08	43.31	46.67	0.000795	6.14	184.41	72.56	0.44
D111-00-00_0001	6918.914	1PCT_100yr	1277.10	36.23	46.68	43.78	47.31	0.000764	6.40	203.03	131.37	0.44
D111-00-00_0001	6918.914	0.2PCT_500yr	1686.40	36.23	48.17	44.64	48.91	0.000676	6.89	255.70	885.77	0.42
D111-00-00_0001	6819.645	10PCT_10yr	790.70	36.24	44.51	42.31	45.07	0.001144	6.03	131.28	32.08	0.51
D111-00-00_0001	6819.645	2PCT_50yr	1115.20	36.24	45.97	43.35	46.58	0.000902	6.33	179.51	42.52	0.46
D111-00-00_0001	6819.645	1PCT_100yr	1277.10	36.24	46.58	43.80	47.23	0.000852	6.53	201.68	79.68	0.45
D111-00-00_0001	6819.645	0.2PCT_500yr	1686.40	36.24	48.12	44.78	48.83	0.000725	6.86	262.48	334.89	0.43
D111-00-00_0001	6718.587	10PCT_10yr	790.70	36.09	44.35	42.30	44.95	0.001282	6.20	127.58	31.85	0.53
D111-00-00_0001	6718.587	2PCT_50yr	1115.20	36.09	45.83	43.33	46.48	0.000968	6.49	171.76	59.02	0.48
D111-00-00_0001	6718.587	1PCT_100yr	1277.10	36.09	46.43	43.78	47.14	0.000915	6.73	189.83	87.20	0.47
D111-00-00_0001	6718.587	0.2PCT_500yr	1686.40	36.09	47.95	44.71	48.75	0.000789	7.17	235.24	350.54	0.45
D111-00-00_0001	6679.703	10PCT_10yr	790.70	36.00	44.31	42.22	44.90	0.001251	6.18	127.88	28.93	0.51
D111-00-00_0001	6679.703	2PCT_50yr	1115.20	36.00	45.78	43.25	46.45	0.000967	6.54	171.23	42.98	0.47
D111-00-00_0001	6679.703	1PCT_100yr	1277.10	36.00	46.39	43.70	47.10	0.000915	6.79	189.37	83.60	0.47
D111-00-00_0001	6679.703	0.2PCT_500yr	1686.40	36.00	47.91	44.60	48.72	0.000786	7.23	235.08	604.47	0.45
D111-00-00_0001	6639.971	10PCT_10yr	790.70	35.85	44.25	41.92	44.84	0.001958	6.14	128.71	27.46	0.50
D111-00-00_0001	6639.971	2PCT_50yr	1115.20	35.85	45.74	43.00	46.39	0.002044	6.47	172.35	58.95	0.48
D111-00-00_0001	6639.971	1PCT_100yr	1277.10	35.85	46.35	43.46	47.05	0.001915	6.70	190.63	224.71	0.47
D111-00-00_0001	6639.971	0.2PCT_500yr	1686.40	35.85	47.89	44.52	48.67	0.001638	7.10	256.36	1013.60	0.45
D111-00-00_0001	6559.903	10PCT_10yr	790.70	35.69	44.17	41.98	44.70	0.000962	5.83	135.79	31.73	0.47
D111-00-00_0001	6559.903	2PCT_50yr	1115.20	35.69	45.66	42.96	46.26	0.000757	6.21	180.28	40.57	0.44
D111-00-00_0001	6559.903	1PCT_100yr	1277.10	35.69	46.28	43.37	46.92	0.000721	6.46	198.67	87.01	0.44
D111-00-00_0001	6559.903	0.2PCT_500yr	1686.40	35.69	47.83	44.23	48.56	0.000645	6.87	272.80	452.86	0.43
D111-00-00_0001	6520.549	10PCT_10yr	790.70	35.64	44.13	41.95	44.66	0.000971	5.88	135.87	36.43	0.47
D111-00-00_0001	6520.549	2PCT_50yr	1115.20	35.64	45.62	42.94	46.23	0.000774	6.29	179.85	43.09	0.44
D111-00-00_0001	6520.549	1PCT_100yr	1277.10	35.64	46.23	43.37	46.89	0.000741	6.55	197.94	75.36	0.44
D111-00-00_0001	6520.549	0.2PCT_500yr	1686.40	35.64	47.79	44.19	48.53	0.000658	6.99	276.04	283.79	0.43
D111-00-00_0001	6320.234	10PCT_10yr	790.70	35.43	44.06	41.02	44.46	0.000646	5.07	156.07	34.79	0.39
D111-00-00_0001	6320.234	2PCT_50yr	1115.20	35.43	45.58	42.02	46.06	0.000551	5.51	202.40	49.83	0.38
D111-00-00_0001	6320.234	1PCT_100yr	1277.10	35.43	46.21	42.47	46.72	0.000539	5.77	221.32	88.73	0.38
D111-00-00_0001	6320.234	0.2PCT_500yr	1686.40	35.43	47.76	43.45	48.37	0.000508	6.27	270.37	524.74	0.38
D111-00-00_0001	6119.156	10PCT_10yr	790.70	35.32	43.82	41.37	44.30	0.000884	5.55	144.26	45.17	0.45
D111-00-00_0001	6119.156	2PCT_50yr	1115.20	35.32	45.41	42.37	45.93	0.000668	5.83	198.01	54.89	0.41
D111-00-00_0001	6119.156	1PCT_100yr	1277.10	35.32	46.04	42.79	46.60	0.000635	6.06	219.54	62.32	0.40
D111-00-00_0001	6119.156	0.2PCT_500yr	1686.40	35.32	47.63	43.71	48.26	0.000554	6.48	278.38	296.36	0.39
D111-00-00_0001	5818.864	10PCT_10yr	790.70	35.11	43.52	41.13	44.02	0.000980	5.66	139.76	31.67	0.46
D111-00-00_0001	5818.864	2PCT_50yr	1115.20	35.11	45.13	42.12	45.67	0.001181	5.91	188.80	41.71	0.42
D111-00-00_0001	5818.864	1PCT_100yr	1277.10	35.11	45.77	42.51	46.36	0.001110	6.12	208.63	46.96	0.41
D111-00-00_0001	5818.864	0.2PCT_500yr	1686.40	35.11	47.42	43.42	48.04	0.001029	6.36	271.35	124.62	0.41
D111-00-00_0001	5717.684	10PCT_10yr	790.70	35.01	43.45	40.71	43.88	0.001588	5.23	151.19	35.27	0.42
D111-00-00_0001	5717.684	2PCT_50yr	1115.20	35.01	45.05	41.72	45.53	0.001220	5.55	201.11	45.89	0.38
D111-00-00_0001	5717.684	1PCT_100yr	1277.10	35.01	45.71	42.15	46.22	0.001160	5.77	221.50	49.85	0.38
D111-00-00_0001	5717.684	0.2PCT_500yr	1686.40	35.01	47.34	43.09	47.92	0.001099	6.16	277.30	126.54	0.38
D111-00-00_0001	5663.459	10PCT_10yr	790.70	34.97	43.40	40.02	43.80	0.000817	5.07	155.85	35.80	0.41
D111-00-00_0001	5663.459	2PCT_50yr	1115.20	34.97	45.04	41.39	45.46	0.000643	5.25	212.38	46.92	0.38
D111-00-00_0001	5663.459	1PCT_100yr	1277.10	34.97	45.70	41.89	46.16	0.000589	5.40	237.19	51.50	0.37
D111-00-00_0001	5663.459	0.2PCT_500yr	1686.40	34.97	47.37	42.96	47.84	0.000587	5.54	312.57	103.38	0.38
D111-00-00_0001	5563.926	10PCT_10yr	790.70	34.82	43.59	37.52	43.66	0.000076	2.20	358.91	49.48	0.14
D111-00-00_0001	5563.926	2PCT_50yr	1115.20	34.82	45.23	38.14	45.33	0.000083	2.52	442.57	52.36	0.15

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	5563.926	1PCT_100yr	1277.10	34.82	45.91	38.43	46.02	0.000088	2.67	478.51	53.56	0.16
D111-00-00_0001	5563.926	0.2PCT_500yr	1686.40	34.82	47.57	39.10	47.71	0.000090	2.96	581.22	195.03	0.16
D111-00-00_0001	5540.284	10PCT_10yr	981.90	34.84	43.50	37.91	43.64	0.000060	3.01	326.62	49.09	0.18
D111-00-00_0001	5540.284	2PCT_50yr	1379.60	34.84	45.10	38.61	45.30	0.000066	3.54	390.07	51.92	0.20
D111-00-00_0001	5540.284	1PCT_100yr	1570.10	34.84	45.76	38.90	45.98	0.000069	3.77	416.18	53.08	0.21
D111-00-00_0001	5540.284	0.2PCT_500yr	2064.00	34.84	47.37	39.64	47.66	0.000074	4.30	479.97	211.02	0.22
D111-00-00_0001	5430	Belaire Blvd										
			Bridge									
D111-00-00_0001	5414.522	10PCT_10yr	981.90	34.60	43.42	37.67	43.58	0.000058	3.17	309.88	72.01	0.19
D111-00-00_0001	5414.522	2PCT_50yr	1379.60	34.60	44.91	38.39	45.14	0.000067	3.80	363.47	156.35	0.21
D111-00-00_0001	5414.522	1PCT_100yr	1570.10	34.60	45.49	38.71	45.75	0.000072	4.09	384.28	175.14	0.22
D111-00-00_0001	5414.522	0.2PCT_500yr	2064.00	34.60	46.83	39.49	47.18	0.000084	4.77	432.38	883.37	0.24
D111-00-00_0001	5319.974	10PCT_10yr	1102.80	34.60	43.06	39.96	43.49	0.000768	5.23	211.05	46.55	0.43
D111-00-00_0001	5319.974	2PCT_50yr	1554.60	34.60	44.62	41.16	45.06	0.000987	5.32	291.99	153.45	0.42
D111-00-00_0001	5319.974	1PCT_100yr	1773.00	34.60	45.22	41.63	45.68	0.001046	5.40	328.27	173.93	0.41
D111-00-00_0001	5319.974	0.2PCT_500yr	2344.10	34.60	46.69	42.73	47.14	0.001062	5.40	565.14	537.27	0.39
D111-00-00_0001	5031.747	10PCT_10yr	1102.80	34.11	42.36		43.12	0.002352	7.00	157.55	43.79	0.65
D111-00-00_0001	5031.747	2PCT_50yr	1554.60	34.11	43.99		44.64	0.002285	6.49	239.61	57.13	0.56
D111-00-00_0001	5031.747	1PCT_100yr	1773.00	34.11	44.61		45.25	0.002217	6.40	277.13	62.28	0.53
D111-00-00_0001	5031.747	0.2PCT_500yr	2344.10	34.11	46.14		46.73	0.001937	6.14	381.94	74.81	0.48
D111-00-00_0001	4984.889	10PCT_10yr	1102.80	33.69	42.39		42.97	0.001656	6.16	179.12	44.95	0.54
D111-00-00_0001	4984.889	2PCT_50yr	1554.60	33.69	43.96		44.52	0.001736	6.00	258.94	56.63	0.50
D111-00-00_0001	4984.889	1PCT_100yr	1773.00	33.69	44.57		45.13	0.001736	6.00	295.31	61.22	0.48
D111-00-00_0001	4984.889	0.2PCT_500yr	2344.10	33.69	46.09		46.63	0.001578	5.91	397.33	75.86	0.44
D111-00-00_0001	4921.495	10PCT_10yr	1102.80	33.84	42.28		42.85	0.002296	6.05	182.33	53.78	0.58
D111-00-00_0001	4921.495	2PCT_50yr	1554.60	33.84	43.90		44.38	0.001887	5.52	281.45	68.75	0.48
D111-00-00_0001	4921.495	1PCT_100yr	1773.00	33.84	44.53		44.99	0.001818	5.42	326.87	75.76	0.46
D111-00-00_0001	4921.495	0.2PCT_500yr	2344.10	33.84	46.09		46.49	0.001604	5.09	460.91	96.84	0.41
D111-00-00_0001	4738.757	10PCT_10yr	1102.80	33.35	41.52		42.36	0.002775	7.37	149.65	41.93	0.69
D111-00-00_0001	4738.757	2PCT_50yr	1554.60	33.35	43.30		43.97	0.002461	6.55	237.52	56.49	0.56
D111-00-00_0001	4738.757	1PCT_100yr	1773.00	33.35	43.96		44.60	0.002340	6.41	276.47	61.85	0.53
D111-00-00_0001	4738.757	0.2PCT_500yr	2344.10	33.35	45.58		46.15	0.001945	6.05	387.58	75.08	0.47
D111-00-00_0001	4394.391	10PCT_10yr	1102.80	32.67	40.63		41.53	0.002038	7.60	145.06	38.55	0.69
D111-00-00_0001	4394.391	2PCT_50yr	1554.60	32.67	42.40		43.14	0.002329	6.86	226.55	53.35	0.59
D111-00-00_0001	4394.391	1PCT_100yr	1773.00	32.67	43.12		43.80	0.002247	6.65	266.74	59.30	0.55
D111-00-00_0001	4394.391	0.2PCT_500yr	2344.10	32.67	44.94		45.50	0.001804	6.03	388.59	74.48	0.47
D111-00-00_0001	4348.580	10PCT_10yr	1102.80	32.59	40.54	39.28	41.42	0.002131	7.54	146.27	37.51	0.67
D111-00-00_0001	4348.580	2PCT_50yr	1554.60	32.59	42.22	40.36	43.01	0.002254	7.12	218.20	48.00	0.59
D111-00-00_0001	4348.580	1PCT_100yr	1773.00	32.59	42.91	40.80	43.68	0.002209	7.01	252.76	52.29	0.56
D111-00-00_0001	4348.580	0.2PCT_500yr	2344.10	32.59	44.72	41.77	45.39	0.001862	6.56	357.42	63.52	0.49
D111-00-00_0001	4330	Ped Bridge										
			Bridge									
D111-00-00_0001	4317.548	10PCT_10yr	1102.80	32.53	40.29	39.18	41.19	0.002341	7.63	144.55	39.67	0.70
D111-00-00_0001	4317.548	2PCT_50yr	1554.60	32.53	41.97	40.27	42.73	0.002375	7.00	222.15	52.54	0.60
D111-00-00_0001	4317.548	1PCT_100yr	1773.00	32.53	42.65	40.68	43.37	0.002294	6.83	259.50	57.62	0.57
D111-00-00_0001	4317.548	0.2PCT_500yr	2344.10	32.53	44.39	41.61	45.01	0.001885	6.31	371.53	70.70	0.49
D111-00-00_0001	4223.081	10PCT_10yr	1102.80	32.21	40.17		40.98	0.001104	7.21	152.91	42.06	0.67
D111-00-00_0001	4223.081	2PCT_50yr	1554.60	32.21	41.87		42.53	0.000692	6.51	238.91	58.95	0.57
D111-00-00_0001	4223.081	1PCT_100yr	1773.00	32.21	42.56		43.18	0.000611	6.28	282.33	66.84	0.54
D111-00-00_0001	4223.081	0.2PCT_500yr	2344.10	32.21	44.35		44.83	0.000447	5.59	418.98	86.50	0.45
D111-00-00_0001	3920.974	10PCT_10yr	1102.80	31.19	39.80		40.50	0.002255	6.73	163.94	46.14	0.63
D111-00-00_0001	3920.974	2PCT_50yr	1554.60	31.19	41.66		42.18	0.001961	5.82	267.32	65.70	0.51
D111-00-00_0001	3920.974	1PCT_100yr	1773.00	31.19	42.38		42.86	0.001883	5.58	317.72	74.68	0.48
D111-00-00_0001	3920.974	0.2PCT_500yr	2344.10	31.19	44.22		44.59	0.001429	4.92	476.62	97.76	0.39
D111-00-00_0001	3739.383	10PCT_10yr	1102.80	30.51	39.47		40.16	0.001461	6.64	166.12	39.26	0.57
D111-00-00_0001	3739.383	2PCT_50yr	1554.60	30.51	41.22		41.84	0.001719	6.33	245.54	51.81	0.51
D111-00-00_0001	3739.383	1PCT_100yr	1773.00	30.51	41.91		42.52	0.001722	6.26	283.39	56.83	0.49
D111-00-00_0001	3739.383	0.2PCT_500yr	2344.10	30.51	43.79		44.31	0.001546	5.80	404.23	72.82	0.43
D111-00-00_0001	3484.569	10PCT_10yr	1102.80	30.22	39.25		39.78	0.001126	5.84	188.70	45.06	0.50
D111-00-00_0001	3484.569	2PCT_50yr	1554.60	30.22	40.93		41.43	0.001218	5.69	273.02	55.62	0.45
D111-00-00_0001	3484.569	1PCT_100yr	1773.00	30.22	41.62		42.11	0.001217	5.67	312.92	59.98	0.44
D111-00-00_0001	3484.569	0.2PCT_500yr	2344.10	30.22	43.50		43.94	0.001126	5.34	439.22	74.84	0.39
D111-00-00_0001	3381.998	10PCT_10yr	1102.80	30.01	39.16	36.85	39.65	0.000956	5.62	196.38	45.92	0.48
D111-00-00_0001	3381.998	2PCT_50yr	1554.60	30.01	40.83	37.86	41.31	0.000882	5.53	281.08	56.21	0.44
D111-00-00_0001	3381.998	1PCT_100yr	1773.00	30.01	41.52	38.28	41.99	0.000870	5.52	321.44	60.97	0.42
D111-00-00_0001	3381.998	0.2PCT_500yr	2344.10	30.01	43.41	39.22	43.83	0.000893	5.19	451.36	76.69	0.38
D111-00-00_0001	3350	Belfontaine										
			Bridge									
D111-00-00_0001	3333.050	10PCT_10yr	1102.80	29.92	39.04	36.79	39.57	0.001508	5.81	189.73	47.03	0.51
D111-00-00_0001	3333.050	2PCT_50yr	1554.60	29.92	40.72	37.89	41.21	0.001396	5.59	278.34	57.33	0.45
D111-00-00_0001	3333.050	1PCT_100yr	1773.00	29.92	41.40	38.35	41.89	0.001344	5.56	318.83	61.19	0.43
D111-00-00_0001	3333.050	0.2PCT_500yr	2344.10	29.92	43.28	39.33	43.71	0.001215	5.23	448.37	77.38	0.38

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	3234.850	10PCT_10yr	1170.70	29.72	38.68		39.36	0.001896	6.59	177.77	42.35	0.57
D111-00-00_0001	3234.850	2PCT_50yr	1661.10	29.72	40.35		41.00	0.001967	6.46	256.99	53.28	0.52
D111-00-00_0001	3234.850	1PCT_100yr	1899.20	29.72	41.04		41.68	0.001964	6.42	295.63	58.38	0.50
D111-00-00_0001	3234.850	0.2PCT_500yr	2516.90	29.72	42.98		43.53	0.001617	5.95	423.00	72.70	0.43
D111-00-00_0001	2862.337	10PCT_10yr	1170.70	28.25	38.23		38.72	0.001241	5.60	209.09	49.17	0.48
D111-00-00_0001	2862.337	2PCT_50yr	1661.10	28.25	39.85		40.33	0.001326	5.57	298.19	60.78	0.44
D111-00-00_0001	2862.337	1PCT_100yr	1899.20	28.25	40.52		41.01	0.001398	5.57	341.19	67.49	0.44
D111-00-00_0001	2862.337	0.2PCT_500yr	2516.90	28.25	42.55		42.93	0.001330	4.95	508.35	97.42	0.38
D111-00-00_0001	2793.765	10PCT_10yr	1170.70	28.30	38.10	35.83	38.62	0.001194	5.82	201.26	48.29	0.50
D111-00-00_0001	2793.765	2PCT_50yr	1661.10	28.30	39.72	36.97	40.23	0.001336	5.74	289.48	61.28	0.47
D111-00-00_0001	2793.765	1PCT_100yr	1899.20	28.30	40.40	37.40	40.90	0.001431	5.69	333.84	68.80	0.46
D111-00-00_0001	2793.765	0.2PCT_500yr	2516.90	28.30	42.43	38.37	42.85	0.000900	5.19	485.19	91.19	0.36
D111-00-00_0001	2750	Glen Haven	Bridge									
D111-00-00_0001	2743.431	10PCT_10yr	1170.70	28.34	37.98	35.89	38.55	0.001185	6.04	193.75	47.77	0.53
D111-00-00_0001	2743.431	2PCT_50yr	1661.10	28.34	39.62	37.01	40.16	0.001242	5.87	282.74	60.83	0.48
D111-00-00_0001	2743.431	1PCT_100yr	1899.20	28.34	40.30	37.46	40.83	0.001277	5.83	325.80	66.34	0.46
D111-00-00_0001	2743.431	0.2PCT_500yr	2516.90	28.34	41.81	38.43	42.33	0.001277	5.78	435.57	79.56	0.43
D111-00-00_0001	2593.610	10PCT_10yr	1170.70	28.45	37.83		38.30	0.001565	5.47	213.88	52.79	0.48
D111-00-00_0001	2593.610	2PCT_50yr	1661.10	28.45	39.47		39.92	0.001381	5.39	308.43	62.52	0.43
D111-00-00_0001	2593.610	1PCT_100yr	1899.20	28.45	40.14		40.60	0.001336	5.40	351.83	66.66	0.41
D111-00-00_0001	2593.610	0.2PCT_500yr	2516.90	28.45	41.64		42.11	0.001265	5.48	458.88	76.08	0.39
D111-00-00_0001	2088.410	10PCT_10yr	1170.70	27.38	36.87		37.37	0.002204	5.66	206.95	48.61	0.48
D111-00-00_0001	2088.410	2PCT_50yr	1661.10	27.38	38.52		39.01	0.002582	5.60	296.78	60.24	0.44
D111-00-00_0001	2088.410	1PCT_100yr	1899.20	27.38	39.21		39.70	0.002622	5.58	340.15	65.11	0.43
D111-00-00_0001	2088.410	0.2PCT_500yr	2516.90	27.38	40.76		41.25	0.002625	5.61	449.02	75.98	0.41
D111-00-00_0001	1673.719	10PCT_10yr	1170.70	26.48	36.05		36.56	0.001681	5.72	204.84	48.65	0.49
D111-00-00_0001	1673.719	2PCT_50yr	1661.10	26.48	37.61		38.12	0.001675	5.75	288.69	59.24	0.46
D111-00-00_0001	1673.719	1PCT_100yr	1899.20	26.48	38.31		38.82	0.001614	5.72	331.80	64.00	0.44
D111-00-00_0001	1673.719	0.2PCT_500yr	2516.90	26.48	39.89		40.39	0.001481	5.70	441.32	74.76	0.41
D111-00-00_0001	1337.589	10PCT_10yr	1232.50	25.57	35.30		35.80	0.003419	5.69	216.76	44.53	0.45
D111-00-00_0001	1337.589	2PCT_50yr	1758.10	25.57	36.76		37.35	0.003637	6.13	286.70	51.13	0.46
D111-00-00_0001	1337.589	1PCT_100yr	2014.00	25.57	37.46		38.06	0.003571	6.23	323.31	53.94	0.45
D111-00-00_0001	1337.589	0.2PCT_500yr	2674.10	25.57	39.00		39.65	0.003926	6.48	412.42	63.08	0.45
D111-00-00_0001	1287.091	10PCT_10yr	1232.50	25.48	35.17	32.50	35.59	0.003411	5.24	234.99	54.38	0.44
D111-00-00_0001	1287.091	2PCT_50yr	1758.10	25.48	36.64	33.61	37.10	0.003493	5.45	322.84	64.57	0.43
D111-00-00_0001	1287.091	1PCT_100yr	2014.00	25.48	37.35	34.05	37.81	0.003384	5.43	370.60	69.69	0.42
D111-00-00_0001	1287.091	0.2PCT_500yr	2674.10	25.48	38.92	35.02	39.38	0.003139	5.48	487.81	80.70	0.39
D111-00-00_0001	1250	Buffalo Speedway	Bridge									
D111-00-00_0001	1204.789	10PCT_10yr	1232.50	25.32	34.63	32.35	35.18	0.000815	5.94	207.57	45.95	0.49
D111-00-00_0001	1204.789	2PCT_50yr	1758.10	25.32	36.15	33.43	36.75	0.000914	6.20	283.53	54.26	0.48
D111-00-00_0001	1204.789	1PCT_100yr	2014.00	25.32	36.86	33.87	37.46	0.001254	6.23	323.51	59.27	0.47
D111-00-00_0001	1204.789	0.2PCT_500yr	2674.10	25.32	38.40	34.87	39.02	0.001902	6.29	424.88	71.40	0.45
D111-00-00_0001	1104.982	10PCT_10yr	1232.50	25.14	34.23		34.99	0.003588	6.95	177.22	44.19	0.61
D111-00-00_0001	1104.982	2PCT_50yr	1758.10	25.14	35.82		36.56	0.004168	6.89	255.18	54.68	0.56
D111-00-00_0001	1104.982	1PCT_100yr	2014.00	25.14	36.50		37.22	0.004501	6.85	294.19	60.45	0.55
D111-00-00_0001	1104.982	0.2PCT_500yr	2674.10	25.14	38.01		38.72	0.004650	6.77	395.05	73.04	0.51
D111-00-00_0001	892.759	10PCT_10yr	1232.50	24.74	33.46		34.24	0.003459	7.06	174.51	43.24	0.62
D111-00-00_0001	892.759	2PCT_50yr	1758.10	24.74	34.86		35.70	0.003850	7.35	239.31	49.62	0.59
D111-00-00_0001	892.759	1PCT_100yr	2014.00	24.74	35.44		36.31	0.003977	7.49	268.97	52.29	0.58
D111-00-00_0001	892.759	0.2PCT_500yr	2674.10	24.74	36.81		37.74	0.004366	7.75	345.07	59.53	0.57
D111-00-00_0001	485.205	10PCT_10yr	1232.50	23.53	31.13	30.90	32.60	0.004355	9.71	126.99	36.79	0.92
D111-00-00_0001	485.205	2PCT_50yr	1758.10	23.53	32.89		34.07	0.003933	8.72	201.64	47.97	0.75
D111-00-00_0001	485.205	1PCT_100yr	2014.00	23.53	33.59		34.71	0.003725	8.52	236.43	52.38	0.71
D111-00-00_0001	485.205	0.2PCT_500yr	2674.10	23.53	35.08		36.16	0.003354	8.31	321.91	61.87	0.64
D111-00-00_0001	311.156	10PCT_10yr	1232.50	21.17	30.84		31.92	0.002061	8.36	147.36	36.12	0.73
D111-00-00_0001	311.156	2PCT_50yr	1758.10	21.17	32.40		33.49	0.002515	8.36	210.35	44.33	0.68
D111-00-00_0001	311.156	1PCT_100yr	2014.00	21.17	33.07		34.15	0.002562	8.35	241.10	47.69	0.65
D111-00-00_0001	311.156	0.2PCT_500yr	2674.10	21.17	34.51		35.63	0.002638	8.49	314.93	54.93	0.63
D111-00-00_0001	257.119	10PCT_10yr	1232.50	21.06	30.73	29.69	31.81	0.002052	8.36	147.41	36.09	0.73
D111-00-00_0001	257.119	2PCT_50yr	1758.10	21.06	32.24	30.86	33.35	0.002564	8.45	208.04	44.06	0.69
D111-00-00_0001	257.119	1PCT_100yr	2014.00	21.06	32.90	31.33	34.01	0.002621	8.45	238.23	47.38	0.66
D111-00-00_0001	257.119	0.2PCT_500yr	2674.10	21.06	34.33	32.40	35.48	0.002707	8.60	311.02	54.56	0.63
D111-00-00_0001	200	Braeswood	Bridge									
D111-00-00_0001	147.878	10PCT_10yr	1232.50	20.84	29.47	29.47	31.32	0.002876	10.93	112.80	30.40	1.00
D111-00-00_0001	147.878	2PCT_50yr	1758.10	20.84	30.64	30.64	32.71	0.004031	11.53	152.42	36.82	1.00
D111-00-00_0001	147.878	1PCT_100yr	2014.00	20.84	31.12	31.12	33.29	0.004592	11.81	170.49	39.32	1.00
D111-00-00_0001	147.878	0.2PCT_500yr	2674.10	20.84	32.18	32.18	34.58	0.005580	12.42	215.26	44.88	1.00
D111-00-00_0001	51.269	10PCT_10yr	1274.40	20.65	28.88	27.57	29.04	0.000400	4.95	648.69	284.06	0.38

HEC-RAS Plan: CE\_MP River: D111 Reach: D111-00-00\_0001 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	51.269	2PCT_50yr	1823.80	20.65	29.59	28.02	29.76	0.000400	5.38	858.11	305.55	0.39
D111-00-00_0001	51.269	1PCT_100yr	2091.80	20.65	29.90	28.19	30.07	0.000400	5.56	952.28	312.67	0.39
D111-00-00_0001	51.269	0.2PCT_500yr	2780.70	20.65	30.59	28.68	30.78	0.000400	5.96	1176.21	326.79	0.40

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	12411.01	10PCT_10yr	263.20	42.78	49.36	45.72	49.47	0.000136	2.66	98.84	22.67	0.22
D111-00-00_0001	12411.01	2PCT_50yr	368.00	42.78	50.70	46.33	50.82	0.000133	2.80	131.47	27.83	0.23
D111-00-00_0001	12411.01	1PCT_100yr	422.00	42.78	51.42	46.60	51.54	0.000148	2.70	179.42	211.79	0.24
D111-00-00_0001	12411.01	0.2PCT_500yr	566.30	42.78	52.48	47.27	52.48	0.000004	0.51	9409.14	4679.73	0.04
D111-00-00_0001	12357.62	10PCT_10yr	263.20	42.70	49.34	45.85	49.46	0.000169	2.78	94.69	23.68	0.25
D111-00-00_0001	12357.62	2PCT_50yr	368.00	42.70	50.68	46.52	50.81	0.000144	2.84	132.23	48.23	0.23
D111-00-00_0001	12357.62	1PCT_100yr	422.00	42.70	51.41	46.82	51.53	0.000115	2.79	175.03	183.70	0.21
D111-00-00_0001	12357.62	0.2PCT_500yr	566.30	42.70	52.31	47.52	52.46	0.000118	3.14	243.51	789.71	0.22
D111-00-00_0001	12215.95	10PCT_10yr	263.20	42.68	49.31	45.81	49.43	0.000202	2.79	94.45	23.62	0.25
D111-00-00_0001	12215.95	2PCT_50yr	368.00	42.68	50.65	46.49	50.78	0.000341	2.85	130.00	110.07	0.23
D111-00-00_0001	12215.95	1PCT_100yr	422.00	42.68	51.40	46.79	51.50	0.000259	2.66	256.87	236.92	0.20
D111-00-00_0001	12215.95	0.2PCT_500yr	566.30	42.68	52.32	47.49	52.43	0.000234	2.81	418.35	525.89	0.20
D111-00-00_0001	12173.38	10PCT_10yr	291.60	42.65	49.26	46.01	49.42	0.000219	3.16	92.28	23.05	0.28
D111-00-00_0001	12173.38	2PCT_50yr	408.40	42.65	50.60	46.72	50.77	0.000187	3.25	126.07	117.74	0.27
D111-00-00_0001	12173.38	1PCT_100yr	468.60	42.65	51.33	47.04	51.49	0.000154	3.18	170.40	221.78	0.25
D111-00-00_0001	12173.38	0.2PCT_500yr	627.50	42.65	52.22	47.77	52.41	0.000156	3.55	242.23	512.52	0.25
D111-00-00_0001	11661.96	10PCT_10yr	352.90	42.11	49.10	45.91	49.29	0.000265	3.54	99.73	24.19	0.31
D111-00-00_0001	11661.96	2PCT_50yr	495.70	42.11	50.44	46.70	50.65	0.000284	3.67	141.17	61.91	0.29
D111-00-00_0001	11661.96	1PCT_100yr	569.10	42.11	51.19	47.04	51.39	0.000223	3.58	209.20	160.64	0.27
D111-00-00_0001	11661.96	0.2PCT_500yr	759.50	42.11	52.08	47.83	52.31	0.000227	3.99	309.91	324.36	0.28
D111-00-00_0001	11626.60	10PCT_10yr	352.90	42.16	49.09	45.92	49.28	0.000244	3.46	101.97	24.91	0.30
D111-00-00_0001	11626.60	2PCT_50yr	495.70	42.16	50.43	46.68	50.64	0.000190	3.68	137.26	127.38	0.28
D111-00-00_0001	11626.60	1PCT_100yr	569.10	42.16	51.17	47.02	51.38	0.000162	3.69	185.70	414.38	0.26
D111-00-00_0001	11626.60	0.2PCT_500yr	759.50	42.16	52.04	47.78	52.29	0.000173	4.16	367.34	1260.80	0.27
D111-00-00_0001	11600 Sunset Blvd	Bridge										
D111-00-00_0001	11574.81	10PCT_10yr	352.90	42.11	48.64	45.87	48.87	0.000326	3.82	92.30	23.67	0.34
D111-00-00_0001	11574.81	2PCT_50yr	495.70	42.11	50.01	46.64	50.25	0.000244	3.93	126.08	494.30	0.31
D111-00-00_0001	11574.81	1PCT_100yr	569.10	42.11	50.83	46.97	51.07	0.000194	3.88	152.27	995.67	0.28
D111-00-00_0001	11574.81	0.2PCT_500yr	759.50	42.11	52.21	47.73	52.25	0.000042	2.09	2735.38	1735.34	0.14
D111-00-00_0001	11466.71	10PCT_10yr	376.30	41.99	48.58	45.90	48.83	0.000358	4.02	93.49	23.83	0.36
D111-00-00_0001	11466.71	2PCT_50yr	529.00	41.99	49.95	46.67	50.21	0.000311	4.08	131.37	50.84	0.34
D111-00-00_0001	11466.71	1PCT_100yr	607.40	41.99	50.84	47.01	51.02	0.000188	3.58	203.84	97.66	0.28
D111-00-00_0001	11466.71	0.2PCT_500yr	809.90	41.99	52.08	47.79	52.21	0.000115	3.23	343.02	334.40	0.22
D111-00-00_0001	10989.81	10PCT_10yr	433.40	41.49	48.35	45.70	48.64	0.000394	4.33	100.20	24.67	0.38
D111-00-00_0001	10989.81	2PCT_50yr	610.30	41.49	49.82	46.53	50.07	0.000271	4.12	265.37	340.82	0.33
D111-00-00_0001	10989.81	1PCT_100yr	701.00	41.49	50.81	46.89	50.93	0.000129	3.20	706.24	559.66	0.23
D111-00-00_0001	10989.81	0.2PCT_500yr	933.00	41.49	52.08	47.71	52.15	0.000070	2.69	1640.87	1434.60	0.18
D111-00-00_0001	10924.99	10PCT_10yr	433.40	41.42	48.33	45.61	48.61	0.000373	4.23	102.48	25.15	0.37
D111-00-00_0001	10924.99	2PCT_50yr	610.30	41.42	49.75	46.43	50.04	0.000635	4.32	141.59	89.12	0.35
D111-00-00_0001	10924.99	1PCT_100yr	701.00	41.42	50.59	46.80	50.87	0.000492	4.22	166.47	117.85	0.31
D111-00-00_0001	10924.99	0.2PCT_500yr	933.00	41.42	52.09	47.61	52.12	0.000454	1.70	1785.77	5322.79	0.13
D111-00-00_0001	10900 Ped Bridge	Bridge										
D111-00-00_0001	10871.51	10PCT_10yr	433.40	41.32	48.32	45.50	48.59	0.000354	4.14	104.56	25.40	0.36
D111-00-00_0001	10871.51	2PCT_50yr	610.30	41.32	49.67	46.34	49.95	0.000290	4.27	146.79	146.76	0.34
D111-00-00_0001	10871.51	1PCT_100yr	701.00	41.32	50.41	46.70	50.67	0.000229	4.16	176.30	273.68	0.31
D111-00-00_0001	10871.51	0.2PCT_500yr	933.00	41.32	51.56	47.52	51.67	0.000104	3.18	702.38	790.70	0.21
D111-00-00_0001	10748.91	10PCT_10yr	433.40	41.08	48.29	45.27	48.53	0.000309	3.94	110.01	26.08	0.34
D111-00-00_0001	10748.91	2PCT_50yr	610.30	41.08	49.66	46.09	49.89	0.000225	3.91	177.89	77.21	0.30
D111-00-00_0001	10748.91	1PCT_100yr	701.00	41.08	50.43	46.46	50.61	0.000159	3.61	244.39	109.70	0.26
D111-00-00_0001	10748.91	0.2PCT_500yr	933.00	41.08	51.48	47.28	51.64	0.000129	3.61	389.03	628.48	0.24
D111-00-00_0001	10561.45	10PCT_10yr	484.70	40.72	48.21	45.17	48.47	0.000325	4.13	117.35	26.96	0.35
D111-00-00_0001	10561.45	2PCT_50yr	683.40	40.72	49.60	46.03	49.84	0.000230	4.09	203.74	94.51	0.31
D111-00-00_0001	10561.45	1PCT_100yr	785.10	40.72	50.36	46.41	50.57	0.000175	3.89	289.59	303.11	0.27
D111-00-00_0001	10561.45	0.2PCT_500yr	1043.50	40.72	51.56	47.26	51.58	0.000029	1.77	5400.28	3717.27	0.11
D111-00-00_0001	10511.71	10PCT_10yr	484.70	40.62	48.26	45.20	48.39	0.000214	2.82	172.03	59.60	0.24
D111-00-00_0001	10511.71	2PCT_50yr	683.40	40.62	49.64	45.89	49.78	0.000179	2.99	228.53	241.85	0.22
D111-00-00_0001	10511.71	1PCT_100yr	785.10	40.62	50.40	46.17	50.52	0.000143	2.68	319.82	358.92	0.21
D111-00-00_0001	10511.71	0.2PCT_500yr	1043.50	40.62	51.56	46.74	51.58	0.000040	1.31	4605.88	3736.87	0.10
D111-00-00_0001	10500 Ped Bridge	Bridge										
D111-00-00_0001	10463.42	10PCT_10yr	484.70	40.56	48.04	44.95	48.33	0.000340	4.27	113.63	25.06	0.35
D111-00-00_0001	10463.42	2PCT_50yr	683.40	40.56	49.40	45.83	49.71	0.000302	4.49	165.21	81.07	0.34
D111-00-00_0001	10463.42	1PCT_100yr	785.10	40.56	50.16	46.22	50.45	0.000242	4.39	224.23	151.27	0.32
D111-00-00_0001	10463.42	0.2PCT_500yr	1043.50	40.56	51.53	47.10	51.56	0.000046	2.19	4453.47	4792.08	0.14
D111-00-00_0001	10368.23	10PCT_10yr	507.90	40.45	47.98	44.96	48.29	0.000345	4.44	114.98	25.61	0.36
D111-00-00_0001	10368.23	2PCT_50yr	716.30	40.45	49.37	45.86	49.68	0.000272	4.60	178.78	365.00	0.33
D111-00-00_0001	10368.23	1PCT_100yr	823.10	40.45	50.17	46.26	50.40	0.000190	4.17	244.04	658.13	0.28
D111-00-00_0001	10368.23	0.2PCT_500yr	1093.30	40.45	51.54	47.14	51.55	0.000019	1.49	7403.51	4654.00	0.09
D111-00-00_0001	10280.76	10PCT_10yr	507.90	40.34	47.94	45.00	48.25	0.000375	4.47	113.64	25.35	0.37
D111-00-00_0001	10280.76	2PCT_50yr	716.30	40.34	49.35	45.90	49.66	0.000291	4.53	177.94	79.82	0.34

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	10280.76	1PCT_100yr	823.10	40.34	50.15	46.30	50.39	0.000201	4.13	248.42	145.73	0.29
D111-00-00_0001	10280.76	0.2PCT_500yr	1093.30	40.34	51.51	47.18	51.54	0.000045	2.22	4387.28	3911.20	0.14
D111-00-00_0001	10225.63	10PCT_10yr	507.90	40.28	47.93	44.94	48.23	0.000365	4.43	114.72	25.48	0.37
D111-00-00_0001	10225.63	2PCT_50yr	716.30	40.28	49.28	45.84	49.63	0.000750	4.70	157.75	53.74	0.36
D111-00-00_0001	10225.63	1PCT_100yr	823.10	40.28	50.00	46.23	50.34	0.000636	4.70	202.52	129.89	0.34
D111-00-00_0001	10225.63	0.2PCT_500yr	1093.30	40.28	51.10	47.12	51.44	0.000560	4.93	485.90	824.47	0.32
D111-00-00_0001	10200 Ped Bridge	Bridge										
D111-00-00_0001	10164.78	10PCT_10yr	507.90	40.04	47.91	44.83	48.20	0.000353	4.37	116.19	25.52	0.36
D111-00-00_0001	10164.78	2PCT_50yr	716.30	40.04	49.25	45.74	49.59	0.000306	4.69	162.33	266.77	0.35
D111-00-00_0001	10164.78	1PCT_100yr	823.10	40.04	49.96	46.13	50.30	0.000267	4.73	209.13	327.23	0.33
D111-00-00_0001	10164.78	0.2PCT_500yr	1093.30	40.04	51.05	47.03	51.27	0.000174	4.23	934.77	1168.76	0.28
D111-00-00_0001	10069.75	10PCT_10yr	543.60	39.94	47.81	44.90	48.15	0.000404	4.67	116.29	25.52	0.39
D111-00-00_0001	10069.75	2PCT_50yr	767.20	39.94	49.22	45.84	49.56	0.000336	4.78	204.05	208.70	0.37
D111-00-00_0001	10069.75	1PCT_100yr	881.70	39.94	49.98	46.25	50.23	0.000232	4.33	392.94	333.71	0.31
D111-00-00_0001	10069.75	0.2PCT_500yr	1170.30	39.94	51.05	47.16	51.24	0.000166	4.09	834.13	772.63	0.27
D111-00-00_0001	9511.942	10PCT_10yr	610.40	39.38	47.41	44.64	47.78	0.001787	4.92	124.04	27.08	0.41
D111-00-00_0001	9511.942	2PCT_50yr	862.30	39.38	48.84	45.61	49.25	0.001424	5.19	190.35	168.64	0.38
D111-00-00_0001	9511.942	1PCT_100yr	991.20	39.38	49.70	46.04	50.02	0.000997	4.75	397.07	357.29	0.32
D111-00-00_0001	9511.942	0.2PCT_500yr	1314.20	39.38	50.90	46.96	51.09	0.000628	4.20	999.03	1873.70	0.26
D111-00-00_0001	9463.775	10PCT_10yr	610.40	39.38	47.34	44.51	47.71	0.001298	4.88	125.12	27.60	0.40
D111-00-00_0001	9463.775	2PCT_50yr	862.30	39.38	48.79	45.48	49.18	0.001040	5.04	190.14	285.43	0.37
D111-00-00_0001	9463.775	1PCT_100yr	991.20	39.38	49.70	45.90	49.93	0.000597	4.21	510.86	540.44	0.29
D111-00-00_0001	9463.775	0.2PCT_500yr	1314.20	39.38	50.92	46.84	51.02	0.000312	3.40	1420.75	2282.00	0.21
D111-00-00_0001	9450 Rice Blvd	Bridge										
D111-00-00_0001	9411.652	10PCT_10yr	610.40	39.32	47.29	44.45	47.66	0.000428	4.86	125.60	27.66	0.40
D111-00-00_0001	9411.652	2PCT_50yr	862.30	39.32	48.72	45.42	49.12	0.000345	5.12	196.51	236.44	0.38
D111-00-00_0001	9411.652	1PCT_100yr	991.20	39.32	49.29	45.84	49.69	0.000317	5.22	308.61	348.02	0.37
D111-00-00_0001	9411.652	0.2PCT_500yr	1314.20	39.32	50.81	46.77	50.97	0.000133	3.91	2178.67	2386.94	0.25
D111-00-00_0001	9307.397	10PCT_10yr	634.90	39.26	47.19	44.49	47.59	0.000724	5.11	124.24	27.49	0.42
D111-00-00_0001	9307.397	2PCT_50yr	897.20	39.26	48.68	45.48	49.06	0.000754	5.05	191.63	118.95	0.37
D111-00-00_0001	9307.397	1PCT_100yr	1031.30	39.26	49.26	45.92	49.63	0.000674	5.08	227.77	258.53	0.36
D111-00-00_0001	9307.397	0.2PCT_500yr	1367.00	39.26	50.81	46.85	50.94	0.000257	3.63	1891.50	2138.61	0.23
D111-00-00_0001	8805.521	10PCT_10yr	634.90	38.56	47.04	42.35	47.25	0.000392	3.64	174.44	27.52	0.25
D111-00-00_0001	8805.521	2PCT_50yr	897.20	38.56	48.34	43.22	48.62	0.000895	4.24	212.94	270.20	0.28
D111-00-00_0001	8805.521	1PCT_100yr	1031.30	38.56	48.90	43.63	49.21	0.000995	4.51	238.22	952.60	0.29
D111-00-00_0001	8805.521	0.2PCT_500yr	1367.00	38.56	50.64	44.55	50.77	0.000458	3.51	1032.60	2356.78	0.20
D111-00-00_0001	8752.369	10PCT_10yr	701.40	38.54	47.06	41.41	47.22	0.000090	3.23	217.26	30.41	0.20
D111-00-00_0001	8752.369	2PCT_50yr	991.80	38.54	48.35	42.15	48.58	0.000165	3.91	351.84	315.71	0.23
D111-00-00_0001	8752.369	1PCT_100yr	1140.30	38.54	48.91	42.50	49.16	0.000171	4.13	509.76	679.03	0.23
D111-00-00_0001	8752.369	0.2PCT_500yr	1510.20	38.54	50.53	43.32	50.75	0.000137	4.10	1200.21	2697.48	0.21
D111-00-00_0001	8677 University Blvd	Culvert										
D111-00-00_0001	8674.259	10PCT_10yr	701.40	38.48	46.90	41.34	47.06	0.000124	3.26	215.33	70.53	0.20
D111-00-00_0001	8674.259	2PCT_50yr	991.80	38.48	48.26	42.09	48.47	0.000148	3.78	555.05	807.70	0.21
D111-00-00_0001	8674.259	1PCT_100yr	1140.30	38.48	48.93	42.44	49.12	0.000133	3.75	916.36	1391.58	0.20
D111-00-00_0001	8674.259	0.2PCT_500yr	1510.20	38.48	50.61	43.25	50.73	0.000084	3.29	2249.10	5142.73	0.17
D111-00-00_0001	8645.981	10PCT_10yr	710.70	38.30	46.89	41.28	47.06	0.000218	3.28	216.68	26.09	0.20
D111-00-00_0001	8645.981	2PCT_50yr	1004.60	38.30	48.21	42.05	48.45	0.000289	3.99	251.64	250.15	0.23
D111-00-00_0001	8645.981	1PCT_100yr	1154.50	38.30	48.80	42.40	49.09	0.000314	4.29	271.18	502.98	0.25
D111-00-00_0001	8645.981	0.2PCT_500yr	1528.50	38.30	50.29	43.23	50.65	0.000341	4.84	329.14	2720.09	0.27
D111-00-00_0001	8545.785	10PCT_10yr	710.70	38.01	46.63	43.39	46.97	0.000615	4.70	151.06	30.41	0.37
D111-00-00_0001	8545.785	2PCT_50yr	1004.60	38.01	47.95	44.37	48.36	0.000626	5.17	194.41	123.23	0.39
D111-00-00_0001	8545.785	1PCT_100yr	1154.50	38.01	48.55	44.80	49.00	0.000612	5.35	215.84	177.01	0.39
D111-00-00_0001	8545.785	0.2PCT_500yr	1528.50	38.01	50.09	45.76	50.57	0.000508	5.58	275.15	1935.22	0.36
D111-00-00_0001	8421.371	10PCT_10yr	710.70	37.76	46.54	43.25	46.89	0.000586	4.77	149.89	45.28	0.36
D111-00-00_0001	8421.371	2PCT_50yr	1004.60	37.76	47.84	44.27	48.29	0.000561	5.39	188.67	158.20	0.37
D111-00-00_0001	8421.371	1PCT_100yr	1154.50	37.76	48.42	44.71	48.92	0.000556	5.67	206.26	219.89	0.37
D111-00-00_0001	8421.371	0.2PCT_500yr	1528.50	37.76	49.92	45.69	50.50	0.000512	6.17	255.35	2034.89	0.37
D111-00-00_0001	8220.54	10PCT_10yr	710.70	37.38	46.46	42.79	46.76	0.000626	4.38	162.24	96.80	0.33
D111-00-00_0001	8220.54	2PCT_50yr	1004.60	37.38	47.76	43.79	48.15	0.000620	5.02	200.21	195.49	0.34
D111-00-00_0001	8220.54	1PCT_100yr	1154.50	37.38	48.34	44.24	48.78	0.000623	5.31	217.31	252.80	0.34
D111-00-00_0001	8220.54	0.2PCT_500yr	1528.50	37.38	49.85	45.21	50.37	0.000591	5.84	283.56	4692.26	0.34
D111-00-00_0001	7919.857	10PCT_10yr	710.70	37.03	46.29	42.52	46.57	0.000592	4.27	166.31	56.31	0.32
D111-00-00_0001	7919.857	2PCT_50yr	1004.60	37.03	47.59	43.52	47.96	0.000587	4.90	205.70	181.04	0.33
D111-00-00_0001	7919.857	1PCT_100yr	1154.50	37.03	48.18	43.97	48.59	0.000590	5.19	223.61	381.50	0.33
D111-00-00_0001	7919.857	0.2PCT_500yr	1528.50	37.03	49.68	44.93	50.19	0.000583	5.71	276.86	4639.91	0.34
D111-00-00_0001	7730.220	10PCT_10yr	790.70	37.28	46.02	43.06	46.43	0.000628	5.14	154.17	54.57	0.39
D111-00-00_0001	7730.220	2PCT_50yr	1115.20	37.28	47.30	44.06	47.83	0.000611	5.85	191.38	333.60	0.40
D111-00-00_0001	7730.220	1PCT_100yr	1277.10	37.28	47.87	44.49	48.46	0.000607	6.16	208.11	911.65	0.41
D111-00-00_0001	7730.220	0.2PCT_500yr	1686.40	37.28	49.35	45.43	50.06	0.000566	6.74	255.48	2177.95	0.40

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	7619.578	10PCT_10yr	790.70	37.31	45.91	43.16	46.36	0.000966	5.35	147.66	39.59	0.42
D111-00-00_0001	7619.578	2PCT_50yr	1115.20	37.31	47.19	44.18	47.75	0.000901	6.02	185.34	168.89	0.42
D111-00-00_0001	7619.578	1PCT_100yr	1277.10	37.31	47.76	44.62	48.38	0.000883	6.31	202.26	240.79	0.42
D111-00-00_0001	7619.578	0.2PCT_500yr	1686.40	37.31	49.26	45.53	49.99	0.000866	6.81	247.50	1513.70	0.43
D111-00-00_0001	7520.923	10PCT_10yr	790.70	37.11	45.77	43.13	46.25	0.000998	5.59	141.39	33.06	0.44
D111-00-00_0001	7520.923	2PCT_50yr	1115.20	37.11	47.04	44.18	47.66	0.000945	6.31	176.67	138.37	0.44
D111-00-00_0001	7520.923	1PCT_100yr	1277.10	37.11	47.60	44.63	48.29	0.000932	6.64	192.45	188.96	0.44
D111-00-00_0001	7520.923	0.2PCT_500yr	1686.40	37.11	49.08	45.54	49.89	0.000872	7.21	237.20	940.53	0.44
D111-00-00_0001	7320.456	10PCT_10yr	790.70	37.05	45.48	43.30	46.04	0.001113	5.96	132.57	33.67	0.48
D111-00-00_0001	7320.456	2PCT_50yr	1115.20	37.05	46.76	44.34	47.45	0.001021	6.67	167.20	157.19	0.47
D111-00-00_0001	7320.456	1PCT_100yr	1277.10	37.05	47.33	44.70	48.09	0.000999	7.00	182.56	311.78	0.48
D111-00-00_0001	7320.456	0.2PCT_500yr	1686.40	37.05	48.84	45.53	49.69	0.001127	7.40	231.91	1272.94	0.51
D111-00-00_0001	7119.101	10PCT_10yr	790.70	36.60	45.16	42.67	45.65	0.005064	5.58	141.69	35.63	0.45
D111-00-00_0001	7119.101	2PCT_50yr	1115.20	36.60	46.50	43.70	47.09	0.004371	6.13	182.02	47.92	0.44
D111-00-00_0001	7119.101	1PCT_100yr	1277.10	36.60	47.09	44.14	47.72	0.004210	6.40	199.68	124.00	0.44
D111-00-00_0001	7119.101	0.2PCT_500yr	1686.40	36.60	48.57	45.07	49.31	0.003752	6.91	244.23	591.57	0.43
D111-00-00_0001	7019.39	10PCT_10yr	790.70	36.35	44.90	42.28	45.31	0.001333	5.15	158.25	43.10	0.40
D111-00-00_0001	7019.39	2PCT_50yr	1115.20	36.35	46.31	43.23	46.78	0.001128	5.57	214.12	78.35	0.38
D111-00-00_0001	7019.39	1PCT_100yr	1277.10	36.35	46.92	43.63	47.42	0.001071	5.76	239.04	230.93	0.38
D111-00-00_0001	7019.39	0.2PCT_500yr	1686.40	36.35	48.49	44.47	49.01	0.000892	6.00	350.19	966.11	0.36
D111-00-00_0001	6918.914	10PCT_10yr	790.70	36.23	44.69	42.29	45.18	0.000958	5.66	140.50	38.28	0.46
D111-00-00_0001	6918.914	2PCT_50yr	1115.20	36.23	46.08	43.31	46.67	0.000795	6.14	184.41	72.56	0.44
D111-00-00_0001	6918.914	1PCT_100yr	1277.10	36.23	46.68	43.78	47.31	0.000764	6.40	203.03	131.37	0.44
D111-00-00_0001	6918.914	0.2PCT_500yr	1686.40	36.23	48.17	44.64	48.91	0.000676	6.89	255.70	885.77	0.42
D111-00-00_0001	6819.645	10PCT_10yr	790.70	36.24	44.51	42.31	45.07	0.001144	6.03	131.28	32.08	0.51
D111-00-00_0001	6819.645	2PCT_50yr	1115.20	36.24	45.97	43.35	46.58	0.000902	6.33	179.51	42.52	0.46
D111-00-00_0001	6819.645	1PCT_100yr	1277.10	36.24	46.58	43.80	47.23	0.000852	6.53	201.68	79.68	0.45
D111-00-00_0001	6819.645	0.2PCT_500yr	1686.40	36.24	48.12	44.78	48.83	0.000725	6.86	262.48	334.89	0.43
D111-00-00_0001	6718.587	10PCT_10yr	790.70	36.09	44.35	42.30	44.95	0.001282	6.20	127.58	31.85	0.53
D111-00-00_0001	6718.587	2PCT_50yr	1115.20	36.09	45.83	43.33	46.48	0.000968	6.49	171.76	59.02	0.48
D111-00-00_0001	6718.587	1PCT_100yr	1277.10	36.09	46.43	43.78	47.14	0.000915	6.73	189.83	87.20	0.47
D111-00-00_0001	6718.587	0.2PCT_500yr	1686.40	36.09	47.95	44.71	48.75	0.000789	7.17	235.24	350.54	0.45
D111-00-00_0001	6679.703	10PCT_10yr	790.70	36.00	44.31	42.22	44.90	0.001251	6.18	127.88	28.93	0.51
D111-00-00_0001	6679.703	2PCT_50yr	1115.20	36.00	45.78	43.25	46.45	0.000967	6.54	171.23	42.98	0.47
D111-00-00_0001	6679.703	1PCT_100yr	1277.10	36.00	46.39	43.70	47.10	0.000915	6.79	189.37	83.60	0.47
D111-00-00_0001	6679.703	0.2PCT_500yr	1686.40	36.00	47.91	44.60	48.72	0.000786	7.23	235.08	604.47	0.45
D111-00-00_0001	6639.971	10PCT_10yr	790.70	35.85	44.25	41.92	44.84	0.001958	6.14	128.71	27.46	0.50
D111-00-00_0001	6639.971	2PCT_50yr	1115.20	35.85	45.74	43.00	46.39	0.002044	6.47	172.35	58.95	0.48
D111-00-00_0001	6639.971	1PCT_100yr	1277.10	35.85	46.35	43.46	47.05	0.001915	6.70	190.63	224.71	0.47
D111-00-00_0001	6639.971	0.2PCT_500yr	1686.40	35.85	47.89	44.52	48.67	0.001638	7.10	256.36	1013.60	0.45
D111-00-00_0001	6559.903	10PCT_10yr	790.70	35.69	44.17	41.98	44.70	0.000962	5.83	135.79	31.73	0.47
D111-00-00_0001	6559.903	2PCT_50yr	1115.20	35.69	45.66	42.96	46.26	0.000757	6.21	180.28	40.57	0.44
D111-00-00_0001	6559.903	1PCT_100yr	1277.10	35.69	46.28	43.37	46.92	0.000721	6.46	198.67	87.01	0.44
D111-00-00_0001	6559.903	0.2PCT_500yr	1686.40	35.69	47.83	44.23	48.56	0.000645	6.87	272.80	452.86	0.43
D111-00-00_0001	6520.549	10PCT_10yr	790.70	35.64	44.13	41.95	44.66	0.000971	5.88	135.87	36.43	0.47
D111-00-00_0001	6520.549	2PCT_50yr	1115.20	35.64	45.62	42.94	46.23	0.000774	6.29	179.85	43.09	0.44
D111-00-00_0001	6520.549	1PCT_100yr	1277.10	35.64	46.23	43.37	46.89	0.000741	6.55	197.94	75.36	0.44
D111-00-00_0001	6520.549	0.2PCT_500yr	1686.40	35.64	47.79	44.19	48.53	0.000658	6.99	276.04	283.79	0.43
D111-00-00_0001	6320.234	10PCT_10yr	790.70	35.43	44.06	41.02	44.46	0.000646	5.07	156.07	34.79	0.39
D111-00-00_0001	6320.234	2PCT_50yr	1115.20	35.43	45.58	42.02	46.06	0.000551	5.51	202.40	49.83	0.38
D111-00-00_0001	6320.234	1PCT_100yr	1277.10	35.43	46.21	42.47	46.72	0.000539	5.77	221.32	88.73	0.38
D111-00-00_0001	6320.234	0.2PCT_500yr	1686.40	35.43	47.76	43.45	48.37	0.000508	6.27	270.37	524.74	0.38
D111-00-00_0001	6119.156	10PCT_10yr	790.70	35.32	43.82	41.37	44.30	0.000884	5.55	144.26	45.17	0.45
D111-00-00_0001	6119.156	2PCT_50yr	1115.20	35.32	45.41	42.37	45.93	0.000668	5.83	198.01	54.89	0.41
D111-00-00_0001	6119.156	1PCT_100yr	1277.10	35.32	46.04	42.79	46.60	0.000635	6.06	219.54	62.32	0.40
D111-00-00_0001	6119.156	0.2PCT_500yr	1686.40	35.32	47.63	43.71	48.26	0.000554	6.48	278.38	296.36	0.39
D111-00-00_0001	5818.864	10PCT_10yr	790.70	35.11	43.52	41.13	44.02	0.000980	5.66	139.76	31.67	0.46
D111-00-00_0001	5818.864	2PCT_50yr	1115.20	35.11	45.13	42.12	45.67	0.001181	5.91	188.80	41.71	0.42
D111-00-00_0001	5818.864	1PCT_100yr	1277.10	35.11	45.77	42.51	46.36	0.001110	6.12	208.63	46.96	0.41
D111-00-00_0001	5818.864	0.2PCT_500yr	1686.40	35.11	47.42	43.42	48.04	0.001029	6.36	271.35	124.62	0.41
D111-00-00_0001	5717.684	10PCT_10yr	790.70	35.01	43.45	40.71	43.88	0.001588	5.23	151.19	35.27	0.42
D111-00-00_0001	5717.684	2PCT_50yr	1115.20	35.01	45.05	41.72	45.53	0.001220	5.55	201.11	45.89	0.38
D111-00-00_0001	5717.684	1PCT_100yr	1277.10	35.01	45.71	42.15	46.22	0.001160	5.77	221.50	49.85	0.38
D111-00-00_0001	5717.684	0.2PCT_500yr	1686.40	35.01	47.34	43.09	47.92	0.001099	6.16	277.30	126.54	0.38
D111-00-00_0001	5663.459	10PCT_10yr	790.70	34.97	43.40	40.02	43.80	0.000817	5.07	155.85	35.80	0.41
D111-00-00_0001	5663.459	2PCT_50yr	1115.20	34.97	45.04	41.39	45.46	0.000643	5.25	212.38	46.92	0.38
D111-00-00_0001	5663.459	1PCT_100yr	1277.10	34.97	45.70	41.89	46.16	0.000589	5.40	237.19	51.50	0.37
D111-00-00_0001	5663.459	0.2PCT_500yr	1686.40	34.97	47.37	42.96	47.84	0.000587	5.54	312.57	103.38	0.38
D111-00-00_0001	5563.926	10PCT_10yr	790.70	34.82	43.59	37.52	43.66	0.000076	2.20	358.91	49.48	0.14
D111-00-00_0001	5563.926	2PCT_50yr	1115.20	34.82	45.23	38.14	45.33	0.000083	2.52	442.57	52.36	0.15

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	5563.926	1PCT_100yr	1277.10	34.82	45.91	38.43	46.02	0.000088	2.67	478.51	53.56	0.16
D111-00-00_0001	5563.926	0.2PCT_500yr	1686.40	34.82	47.57	39.10	47.71	0.000090	2.96	581.22	195.03	0.16
D111-00-00_0001	5540.284	10PCT_10yr	981.90	34.84	43.50	37.91	43.64	0.000060	3.01	326.62	49.09	0.18
D111-00-00_0001	5540.284	2PCT_50yr	1379.60	34.84	45.10	38.61	45.30	0.000066	3.54	390.07	51.92	0.20
D111-00-00_0001	5540.284	1PCT_100yr	1570.10	34.84	45.76	38.90	45.98	0.000069	3.77	416.18	53.08	0.21
D111-00-00_0001	5540.284	0.2PCT_500yr	2064.00	34.84	47.37	39.64	47.66	0.000074	4.30	479.97	211.02	0.22
D111-00-00_0001	5430	Belaire Blvd										
			Bridge									
D111-00-00_0001	5414.522	10PCT_10yr	981.90	34.60	43.42	37.67	43.58	0.000058	3.17	309.88	72.01	0.19
D111-00-00_0001	5414.522	2PCT_50yr	1379.60	34.60	44.91	38.39	45.14	0.000067	3.80	363.47	156.35	0.21
D111-00-00_0001	5414.522	1PCT_100yr	1570.10	34.60	45.49	38.71	45.75	0.000072	4.09	384.28	175.14	0.22
D111-00-00_0001	5414.522	0.2PCT_500yr	2064.00	34.60	46.83	39.49	47.18	0.000084	4.77	432.38	883.37	0.24
D111-00-00_0001	5319.974	10PCT_10yr	1102.80	34.60	43.06	39.96	43.49	0.000768	5.23	211.05	46.55	0.43
D111-00-00_0001	5319.974	2PCT_50yr	1554.60	34.60	44.62	41.16	45.06	0.000987	5.32	291.99	153.45	0.42
D111-00-00_0001	5319.974	1PCT_100yr	1773.00	34.60	45.22	41.63	45.68	0.001046	5.40	328.27	173.93	0.41
D111-00-00_0001	5319.974	0.2PCT_500yr	2344.10	34.60	46.69	42.73	47.14	0.001062	5.40	565.14	537.27	0.39
D111-00-00_0001	5031.747	10PCT_10yr	1102.80	34.11	42.36		43.12	0.002352	7.00	157.55	43.79	0.65
D111-00-00_0001	5031.747	2PCT_50yr	1554.60	34.11	43.99		44.64	0.002285	6.49	239.61	57.13	0.56
D111-00-00_0001	5031.747	1PCT_100yr	1773.00	34.11	44.61		45.25	0.002217	6.40	277.13	62.28	0.53
D111-00-00_0001	5031.747	0.2PCT_500yr	2344.10	34.11	46.14		46.73	0.001937	6.14	381.94	74.81	0.48
D111-00-00_0001	4984.889	10PCT_10yr	1102.80	33.69	42.39		42.97	0.001656	6.16	179.12	44.95	0.54
D111-00-00_0001	4984.889	2PCT_50yr	1554.60	33.69	43.96		44.52	0.001736	6.00	258.94	56.63	0.50
D111-00-00_0001	4984.889	1PCT_100yr	1773.00	33.69	44.57		45.13	0.001736	6.00	295.31	61.22	0.48
D111-00-00_0001	4984.889	0.2PCT_500yr	2344.10	33.69	46.09		46.63	0.001578	5.91	397.33	75.86	0.44
D111-00-00_0001	4921.495	10PCT_10yr	1102.80	33.84	42.28		42.85	0.002296	6.05	182.33	53.78	0.58
D111-00-00_0001	4921.495	2PCT_50yr	1554.60	33.84	43.90		44.38	0.001887	5.52	281.45	68.75	0.48
D111-00-00_0001	4921.495	1PCT_100yr	1773.00	33.84	44.53		44.99	0.001818	5.42	326.87	75.76	0.46
D111-00-00_0001	4921.495	0.2PCT_500yr	2344.10	33.84	46.09		46.49	0.001604	5.09	460.91	96.84	0.41
D111-00-00_0001	4738.757	10PCT_10yr	1102.80	33.35	41.52		42.36	0.002775	7.37	149.65	41.93	0.69
D111-00-00_0001	4738.757	2PCT_50yr	1554.60	33.35	43.30		43.97	0.002461	6.55	237.52	56.49	0.56
D111-00-00_0001	4738.757	1PCT_100yr	1773.00	33.35	43.96		44.60	0.002340	6.41	276.47	61.85	0.53
D111-00-00_0001	4738.757	0.2PCT_500yr	2344.10	33.35	45.58		46.15	0.001945	6.05	387.58	75.08	0.47
D111-00-00_0001	4394.391	10PCT_10yr	1102.80	32.67	40.63		41.53	0.002038	7.60	145.06	38.55	0.69
D111-00-00_0001	4394.391	2PCT_50yr	1554.60	32.67	42.40		43.14	0.002329	6.86	226.55	53.35	0.59
D111-00-00_0001	4394.391	1PCT_100yr	1773.00	32.67	43.12		43.80	0.002247	6.65	266.74	59.30	0.55
D111-00-00_0001	4394.391	0.2PCT_500yr	2344.10	32.67	44.94		45.50	0.001804	6.03	388.59	74.48	0.47
D111-00-00_0001	4348.580	10PCT_10yr	1102.80	32.59	40.54	39.28	41.42	0.002131	7.54	146.27	37.51	0.67
D111-00-00_0001	4348.580	2PCT_50yr	1554.60	32.59	42.22	40.36	43.01	0.002254	7.12	218.20	48.00	0.59
D111-00-00_0001	4348.580	1PCT_100yr	1773.00	32.59	42.91	40.80	43.68	0.002209	7.01	252.76	52.29	0.56
D111-00-00_0001	4348.580	0.2PCT_500yr	2344.10	32.59	44.72	41.77	45.39	0.001862	6.56	357.42	63.52	0.49
D111-00-00_0001	4330	Ped Bridge										
			Bridge									
D111-00-00_0001	4317.548	10PCT_10yr	1102.80	32.53	40.29	39.18	41.19	0.002341	7.63	144.55	39.67	0.70
D111-00-00_0001	4317.548	2PCT_50yr	1554.60	32.53	41.97	40.27	42.73	0.002375	7.00	222.15	52.54	0.60
D111-00-00_0001	4317.548	1PCT_100yr	1773.00	32.53	42.65	40.68	43.37	0.002294	6.83	259.50	57.62	0.57
D111-00-00_0001	4317.548	0.2PCT_500yr	2344.10	32.53	44.39	41.61	45.01	0.001885	6.31	371.53	70.70	0.49
D111-00-00_0001	4223.081	10PCT_10yr	1102.80	32.21	40.17		40.98	0.001104	7.21	152.91	42.06	0.67
D111-00-00_0001	4223.081	2PCT_50yr	1554.60	32.21	41.87		42.53	0.000692	6.51	238.91	58.95	0.57
D111-00-00_0001	4223.081	1PCT_100yr	1773.00	32.21	42.56		43.18	0.000611	6.28	282.33	66.84	0.54
D111-00-00_0001	4223.081	0.2PCT_500yr	2344.10	32.21	44.35		44.83	0.000447	5.59	418.98	86.50	0.45
D111-00-00_0001	3920.974	10PCT_10yr	1102.80	31.19	39.80		40.50	0.002255	6.73	163.94	46.14	0.63
D111-00-00_0001	3920.974	2PCT_50yr	1554.60	31.19	41.66		42.18	0.001961	5.82	267.32	65.70	0.51
D111-00-00_0001	3920.974	1PCT_100yr	1773.00	31.19	42.38		42.86	0.001883	5.58	317.72	74.68	0.48
D111-00-00_0001	3920.974	0.2PCT_500yr	2344.10	31.19	44.22		44.59	0.001429	4.92	476.62	97.76	0.39
D111-00-00_0001	3739.383	10PCT_10yr	1102.80	30.51	39.47		40.16	0.001461	6.64	166.12	39.26	0.57
D111-00-00_0001	3739.383	2PCT_50yr	1554.60	30.51	41.22		41.84	0.001719	6.33	245.54	51.81	0.51
D111-00-00_0001	3739.383	1PCT_100yr	1773.00	30.51	41.91		42.52	0.001722	6.26	283.39	56.83	0.49
D111-00-00_0001	3739.383	0.2PCT_500yr	2344.10	30.51	43.79		44.31	0.001546	5.80	404.23	72.82	0.43
D111-00-00_0001	3484.569	10PCT_10yr	1102.80	30.22	39.25		39.78	0.001126	5.84	188.70	45.06	0.50
D111-00-00_0001	3484.569	2PCT_50yr	1554.60	30.22	40.93		41.43	0.001218	5.69	273.02	55.62	0.45
D111-00-00_0001	3484.569	1PCT_100yr	1773.00	30.22	41.62		42.11	0.001217	5.67	312.92	59.98	0.44
D111-00-00_0001	3484.569	0.2PCT_500yr	2344.10	30.22	43.50		43.94	0.001126	5.34	439.22	74.84	0.39
D111-00-00_0001	3381.998	10PCT_10yr	1102.80	30.01	39.16	36.85	39.65	0.000956	5.62	196.38	45.92	0.48
D111-00-00_0001	3381.998	2PCT_50yr	1554.60	30.01	40.83	37.86	41.31	0.000882	5.53	281.08	56.21	0.44
D111-00-00_0001	3381.998	1PCT_100yr	1773.00	30.01	41.52	38.28	41.99	0.000870	5.52	321.44	60.97	0.42
D111-00-00_0001	3381.998	0.2PCT_500yr	2344.10	30.01	43.41	39.22	43.83	0.000893	5.19	451.36	76.69	0.38
D111-00-00_0001	3350	Belfontaine										
			Bridge									
D111-00-00_0001	3333.050	10PCT_10yr	1102.80	29.92	39.04	36.79	39.57	0.001508	5.81	189.73	47.03	0.51
D111-00-00_0001	3333.050	2PCT_50yr	1554.60	29.92	40.72	37.89	41.21	0.001396	5.59	278.34	57.33	0.45
D111-00-00_0001	3333.050	1PCT_100yr	1773.00	29.92	41.40	38.35	41.89	0.001344	5.56	318.83	61.19	0.43
D111-00-00_0001	3333.050	0.2PCT_500yr	2344.10	29.92	43.28	39.33	43.71	0.001215	5.23	448.37	77.38	0.38

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	3234.850	10PCT_10yr	1170.70	29.72	38.68		39.36	0.001896	6.59	177.77	42.35	0.57
D111-00-00_0001	3234.850	2PCT_50yr	1661.10	29.72	40.35		41.00	0.001967	6.46	256.99	53.28	0.52
D111-00-00_0001	3234.850	1PCT_100yr	1899.20	29.72	41.04		41.68	0.001964	6.42	295.63	58.38	0.50
D111-00-00_0001	3234.850	0.2PCT_500yr	2516.90	29.72	42.98		43.53	0.001617	5.95	423.00	72.70	0.43
D111-00-00_0001	2862.337	10PCT_10yr	1170.70	28.25	38.23		38.72	0.001241	5.60	209.09	49.17	0.48
D111-00-00_0001	2862.337	2PCT_50yr	1661.10	28.25	39.85		40.33	0.001326	5.57	298.19	60.78	0.44
D111-00-00_0001	2862.337	1PCT_100yr	1899.20	28.25	40.52		41.01	0.001398	5.57	341.19	67.49	0.44
D111-00-00_0001	2862.337	0.2PCT_500yr	2516.90	28.25	42.55		42.93	0.001330	4.95	508.35	97.42	0.38
D111-00-00_0001	2793.765	10PCT_10yr	1170.70	28.30	38.10	35.83	38.62	0.001194	5.82	201.26	48.29	0.50
D111-00-00_0001	2793.765	2PCT_50yr	1661.10	28.30	39.72	36.97	40.23	0.001336	5.74	289.48	61.28	0.47
D111-00-00_0001	2793.765	1PCT_100yr	1899.20	28.30	40.40	37.40	40.90	0.001431	5.69	333.84	68.80	0.46
D111-00-00_0001	2793.765	0.2PCT_500yr	2516.90	28.30	42.43	38.37	42.85	0.000900	5.19	485.19	91.19	0.36
D111-00-00_0001	2750	Glen Haven	Bridge									
D111-00-00_0001	2743.431	10PCT_10yr	1170.70	28.34	37.98	35.89	38.55	0.001185	6.04	193.75	47.77	0.53
D111-00-00_0001	2743.431	2PCT_50yr	1661.10	28.34	39.62	37.01	40.16	0.001242	5.87	282.74	60.83	0.48
D111-00-00_0001	2743.431	1PCT_100yr	1899.20	28.34	40.30	37.46	40.83	0.001277	5.83	325.80	66.34	0.46
D111-00-00_0001	2743.431	0.2PCT_500yr	2516.90	28.34	41.81	38.43	42.33	0.001277	5.78	435.57	79.56	0.43
D111-00-00_0001	2593.610	10PCT_10yr	1170.70	28.45	37.83		38.30	0.001565	5.47	213.88	52.79	0.48
D111-00-00_0001	2593.610	2PCT_50yr	1661.10	28.45	39.47		39.92	0.001381	5.39	308.43	62.52	0.43
D111-00-00_0001	2593.610	1PCT_100yr	1899.20	28.45	40.14		40.60	0.001336	5.40	351.83	66.66	0.41
D111-00-00_0001	2593.610	0.2PCT_500yr	2516.90	28.45	41.64		42.11	0.001265	5.48	458.88	76.08	0.39
D111-00-00_0001	2088.410	10PCT_10yr	1170.70	27.38	36.87		37.37	0.002204	5.66	206.95	48.61	0.48
D111-00-00_0001	2088.410	2PCT_50yr	1661.10	27.38	38.52		39.01	0.002582	5.60	296.78	60.24	0.44
D111-00-00_0001	2088.410	1PCT_100yr	1899.20	27.38	39.21		39.70	0.002622	5.58	340.15	65.11	0.43
D111-00-00_0001	2088.410	0.2PCT_500yr	2516.90	27.38	40.76		41.25	0.002625	5.61	449.02	75.98	0.41
D111-00-00_0001	1673.719	10PCT_10yr	1170.70	26.48	36.05		36.56	0.001681	5.72	204.84	48.65	0.49
D111-00-00_0001	1673.719	2PCT_50yr	1661.10	26.48	37.61		38.12	0.001675	5.75	288.69	59.24	0.46
D111-00-00_0001	1673.719	1PCT_100yr	1899.20	26.48	38.31		38.82	0.001614	5.72	331.80	64.00	0.44
D111-00-00_0001	1673.719	0.2PCT_500yr	2516.90	26.48	39.89		40.39	0.001481	5.70	441.32	74.76	0.41
D111-00-00_0001	1337.589	10PCT_10yr	1232.50	25.57	35.30		35.80	0.003419	5.69	216.76	44.53	0.45
D111-00-00_0001	1337.589	2PCT_50yr	1758.10	25.57	36.76		37.35	0.003637	6.13	286.70	51.13	0.46
D111-00-00_0001	1337.589	1PCT_100yr	2014.00	25.57	37.46		38.06	0.003571	6.23	323.31	53.94	0.45
D111-00-00_0001	1337.589	0.2PCT_500yr	2674.10	25.57	39.00		39.65	0.003926	6.48	412.42	63.08	0.45
D111-00-00_0001	1287.091	10PCT_10yr	1232.50	25.48	35.17	32.50	35.59	0.003411	5.24	234.99	54.38	0.44
D111-00-00_0001	1287.091	2PCT_50yr	1758.10	25.48	36.64	33.61	37.10	0.003493	5.45	322.84	64.57	0.43
D111-00-00_0001	1287.091	1PCT_100yr	2014.00	25.48	37.35	34.05	37.81	0.003384	5.43	370.60	69.69	0.42
D111-00-00_0001	1287.091	0.2PCT_500yr	2674.10	25.48	38.92	35.02	39.38	0.003139	5.48	487.81	80.70	0.39
D111-00-00_0001	1250	Buffalo Speedway	Bridge									
D111-00-00_0001	1204.789	10PCT_10yr	1232.50	25.32	34.63	32.35	35.18	0.000815	5.94	207.57	45.95	0.49
D111-00-00_0001	1204.789	2PCT_50yr	1758.10	25.32	36.15	33.43	36.75	0.000914	6.20	283.53	54.26	0.48
D111-00-00_0001	1204.789	1PCT_100yr	2014.00	25.32	36.86	33.87	37.46	0.001254	6.23	323.51	59.27	0.47
D111-00-00_0001	1204.789	0.2PCT_500yr	2674.10	25.32	38.40	34.87	39.02	0.001902	6.29	424.88	71.40	0.45
D111-00-00_0001	1104.982	10PCT_10yr	1232.50	25.14	34.23		34.99	0.003588	6.95	177.22	44.19	0.61
D111-00-00_0001	1104.982	2PCT_50yr	1758.10	25.14	35.82		36.56	0.004168	6.89	255.18	54.68	0.56
D111-00-00_0001	1104.982	1PCT_100yr	2014.00	25.14	36.50		37.22	0.004501	6.85	294.19	60.45	0.55
D111-00-00_0001	1104.982	0.2PCT_500yr	2674.10	25.14	38.01		38.72	0.004650	6.77	395.05	73.04	0.51
D111-00-00_0001	892.759	10PCT_10yr	1232.50	24.74	33.46		34.24	0.003459	7.06	174.51	43.24	0.62
D111-00-00_0001	892.759	2PCT_50yr	1758.10	24.74	34.86		35.70	0.003850	7.35	239.31	49.62	0.59
D111-00-00_0001	892.759	1PCT_100yr	2014.00	24.74	35.44		36.31	0.003977	7.49	268.97	52.29	0.58
D111-00-00_0001	892.759	0.2PCT_500yr	2674.10	24.74	36.81		37.74	0.004366	7.75	345.07	59.53	0.57
D111-00-00_0001	485.205	10PCT_10yr	1232.50	23.53	31.13	30.90	32.60	0.004355	9.71	126.99	36.79	0.92
D111-00-00_0001	485.205	2PCT_50yr	1758.10	23.53	32.89		34.07	0.003933	8.72	201.64	47.97	0.75
D111-00-00_0001	485.205	1PCT_100yr	2014.00	23.53	33.59		34.71	0.003725	8.52	236.43	52.38	0.71
D111-00-00_0001	485.205	0.2PCT_500yr	2674.10	23.53	35.08		36.16	0.003354	8.31	321.91	61.87	0.64
D111-00-00_0001	311.156	10PCT_10yr	1232.50	21.17	30.84		31.92	0.002061	8.36	147.36	36.12	0.73
D111-00-00_0001	311.156	2PCT_50yr	1758.10	21.17	32.40		33.49	0.002515	8.36	210.35	44.33	0.68
D111-00-00_0001	311.156	1PCT_100yr	2014.00	21.17	33.07		34.15	0.002562	8.35	241.10	47.69	0.65
D111-00-00_0001	311.156	0.2PCT_500yr	2674.10	21.17	34.51		35.63	0.002638	8.49	314.93	54.93	0.63
D111-00-00_0001	257.119	10PCT_10yr	1232.50	21.06	30.73	29.69	31.81	0.002052	8.36	147.41	36.09	0.73
D111-00-00_0001	257.119	2PCT_50yr	1758.10	21.06	32.24	30.86	33.35	0.002564	8.45	208.04	44.06	0.69
D111-00-00_0001	257.119	1PCT_100yr	2014.00	21.06	32.90	31.33	34.01	0.002621	8.45	238.23	47.38	0.66
D111-00-00_0001	257.119	0.2PCT_500yr	2674.10	21.06	34.33	32.40	35.48	0.002707	8.60	311.02	54.56	0.63
D111-00-00_0001	200	Braeswood	Bridge									
D111-00-00_0001	147.878	10PCT_10yr	1232.50	20.84	29.47	29.47	31.32	0.002876	10.93	112.80	30.40	1.00
D111-00-00_0001	147.878	2PCT_50yr	1758.10	20.84	30.64	30.64	32.71	0.004031	11.53	152.42	36.82	1.00
D111-00-00_0001	147.878	1PCT_100yr	2014.00	20.84	31.12	31.12	33.29	0.004592	11.81	170.49	39.32	1.00
D111-00-00_0001	147.878	0.2PCT_500yr	2674.10	20.84	32.18	32.18	34.58	0.005580	12.42	215.26	44.88	1.00
D111-00-00_0001	51.269	10PCT_10yr	1274.40	20.65	28.88	27.57	29.04	0.000400	4.95	648.69	284.06	0.38

HEC-RAS Plan: CE\_MP River: D111 Reach: D111-00-00\_0001 (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D111-00-00_0001	51.269	2PCT_50yr	1823.80	20.65	29.59	28.02	29.76	0.000400	5.38	858.11	305.55	0.39
D111-00-00_0001	51.269	1PCT_100yr	2091.80	20.65	29.90	28.19	30.07	0.000400	5.56	952.28	312.67	0.39
D111-00-00_0001	51.269	0.2PCT_500yr	2780.70	20.65	30.59	28.68	30.78	0.000400	5.96	1176.21	326.79	0.40

**APPENDIX C**  
**Digital Data**

# Subgrant Project Application

**Application Title:** Poor Farm Ditch Conveyance Improvements

**Subgrant Applicant:** Harris County Judge's Office

**Application Number:**

**Application Year:** 2023

**Grant Type:** Project Application

**Address:** 1001 Preston, Suite 911, Houston, TX 77002-0000

## Subapplicant Information

Name of Subapplicant

Harris County Flood Control District

State

TX

Type of Subapplicant

Special Governmental District

Legal status, function, and facilities owned:

The Harris County Flood Control District is a special purpose district created by the Texas Legislature in 1937 and governed by Harris County Commissioners Court. It was created in response to devastating floods that struck the region in 1929 and 1935. The Flood Control District's jurisdictional boundaries are set to coincide with Harris County, a community of more than 4.5 million people (2015) that includes the City of Houston. The other boundaries in which we operate those provided by nature are the 23 primary watersheds within Harris County's 1,777 square miles. The District's mission is to provide flood damage reduction projects that work, with appropriate regard for community and natural values. The District accomplishes its mission by Devising flood damage reduction plans, Implementing the plans, and Maintaining the resulting infrastructure of detention basins, channels and other structures.

State Tax Number:

Federal Tax Number:

74-6019452

Other type name:

Federal Employer Identification (EIN)

74-6019452

What is your DUNS Number?

174079756 -

Is Subapplication subject to review by Executive Order 12372 Process?

No. Program has not been selected by state for review

Is the Subapplicant delinquent on any Federal debt?

No

Explanation:

Contact  
Authorized Subgrant Agent

Title	Ms.
First Name	Lina
Middle Initial	
Last Name	Hidalgo
Title	County Judge - Harris County, TX
Agency/Organization	Harris County Judge's Office
Address 1	1001 Preston, Suite 911
Address 2	
City	Houston
State	TX
ZIP	77002
Phone	713-755-4000 Ext.
Fax	
Email	cjgrantsnotification@hctx.net

Point of Contact

Title	Mr.
First Name	Scott
Middle Initial	
Last Name	Elmer, PE
Title	Deputy Director Engineering and Construction
Agency/Organization	Harris County Flood Control District
Address 1	9900 Northwest Freeway
Address 2	
City	Houston
State	TX
ZIP	77092
Phone	346-286-3756 Ext.
Fax	
Email	scott.elmer@hcfcd.hctx.net

### Community Information

Please provide the name of each community that will benefit from this mitigation activity by clicking on the Find Community button. You shall modify Congressional District for each community by directly editing the textbox(es) provided. You should also notify your state NFIP coordinator so that it can be updated in the Community Information System database. When you are finished, click the *Save and Continue* button below.

State	County Code	Community Name	CID Number	CRS Community	CRS Rating	State Legislative District	US Congressional District
TX	480287_QBM0Z0DKZ	<a href="#">HARRIS COUNTY*</a>	480287	Y	7	480287	2

Comments

Attachments

Name

File Size (KB)

### Community Details

The details for the community you selected are provided below. In case the congressional district number for your community is not showing up correctly then please contact your state NFIP coordinator.

State

Community Name

County Name

County Code

City Code

[FIPS Code](#)

[Help](#)

[CID Number](#)

[Help](#)

[CRS Community](#)

[CRS Rating](#)

State Legislative District

US Congressional District

2

[FIRM](#) or [FHBM](#) available?

Community participates in [NFIP](#)?

Date entered in NFIP

Date of most recent [Community Assistance Visit \(CAV\)](#)?

[Help](#)

Mitigation Plan

Is the entity that will benefit from the proposed activity covered by a current FEMA-approved multi-hazard mitigation plan in compliance with 44 CFR Part 201? **Yes**

If Yes, please answer the following:

What is the name of the plan?

Harris County Multi Hazard Mitigation Plan

What is the type of plan?

Local MultiJurisdictional Multihazard Mitigation Plan

When was the current multihazard mitigation plan approved by FEMA?

07-27-2015

Describe how the proposed activity relates to or is consistent with the FEMA-approved mitigation plan.

Page 280 Section 21-4 : Alternatives to Mitigate the Flooding Hazard "Manipulating the Hazard: ... Maintain drainage system; Dredging, Levee Construction, and providing regional retention areas; structural flood control, levees."

If No or Not Known, please answer the following:

Does the entity have any other mitigation plans adopted?

**Yes**

If Yes, please provide the following information.

Plan Name	Plan Type	Date Adopted	Attachment (File Size)
Harris County Multi-Hazard Mitigation Action Plan	FMA or CRS Plan	04-27-2020	<a href="#">HarrisCounty-Vol2_Planning_Partner_Annexes.pdf</a> (54544 KB)

Does the State/Tribe in which the entity is located have a current FEMA-approved mitigation plan in compliance with 44 CFR Part 201? **Yes**

If Yes, please answer the following:

What is the name of the plan?

Texas Standard Mitigation Plan

What is the type of plan?

Standard State Multi-hazard Mitigation Plan

When was the current multihazard mitigation plan approved by FEMA?

10-22-2013

Describe how the proposed activity relates to or is consistent with the State/Tribe's FEMA-approved mitigation plan.

Page 291 "Prioritization of Mitigation Actions: Identified Actions" - "The needs and risks of the community determine the prioritization of the states action and project types. The states priorities for project types include: Drainage projects (detention ponds, storm sewer improvement)..."

If you would like to make any comments, please enter them below.

To attach documents, click the *Attachments* button below.

[Texas-SHMP-FINAL-Revised-5.14.2021\(1\).pdf](#) (22151 KB)

Title of your proposed activity (should include the type of activity and location):

Poor Farm Ditch Conveyance Improvements

Hazard(s) Identified to be mitigated:

Flood

Proposed types of Mitigation Activity(ies):

Activity Code	Activity Name
403.1	Stormwater Management - Culverts

If Other or Miscellaneous selected above, please specify:

Provide a clear and detailed description of your proposed activity:

The Poor Farm Ditch project (HCFCD unit D111-00-00) consists of channel improvements to an existing concrete-lined channel to mitigate future flooding from major storm events. The Harris County Flood Control District (HCFCD) right-of-way within the project area varies from 45 feet to 80 feet wide. Encroachments have been constructed within HCFCD's right-of-way along this reach, which have induced loading conditions to the channel structure not accounted for in the original design. Consequently, the primary goal of the project is to mitigate the risk of a failure of the existing channel by constructing an entirely new channel structure in its place. Additionally, the proposed project will provide an improved level of service. The reach of channel in the project footprint currently provides a 10-Year level of service). The reach upstream of the University Boulevard crossing is hydraulically adequate for 50-year storm. The channel reach downstream of the Bellaire Boulevard crossing is hydraulically adequate for 100-year storm. A generalized summary of work to be performed by the contractor is described as follows: The contractor will implement traffic control along University Boulevard, Bellaire Boulevard, and residential streets that interface the project work area. The contractor will establish and maintain construction access routes to the site. The variable width and limited space associated with HCFCD's right of way along the project reach may warrant the use of specialized equipment (e.g., small backhoes and dozers) to construct the proposed channel improvements. The contractor will demolish and remove the entirety of the existing channel concrete pavement and sub-grade features along the project reach in a phased sequence in order to maintain channel service. The contractor will construct a new reinforced concrete channel in accordance with the design. A significant amount of earthwork is associated with constructing the new channel. The native material on-site is not deemed suitable for re-use. Consequently, all material within the limits of excavation shall be removed and disposed of off-site. The contractor will place and compact imported fill to replace the material removed and to establish proposed grades. The overbanks of the existing channel vary significantly in elevation along the project reach, as several homeowners have erected earth retaining features of variable material and height at the interface of their backyard and the channel. The contractor shall be responsible for verifying existing conditions prior to construction to have a comprehensive understanding of the overbank grading activities required to tie-in the new concrete channel to adjacent grades. All overbank grading must be performed such as to not adversely impact the positive drainage from beyond the channel banks. The contractor will construct permanent maintenance access ramps at the upstream and downstream limits of the channel for HCFCD's future use after construction is complete.

Is there construction in this project?

Y

Provide a detailed description of the proposed project's location (e.g. municipality, street address, major intersecting streets and other important landmarks). Supporting documentation such as maps that clearly identify the location and critical features to the project such as topography, waterways, adjacent community boundaries, etc., should be attached:

Poor Farm Ditch is a tributary to Brays Bayou providing drainage to approximately 1,330 acres of developed watershed. The project reach is situated between the cities of Southside Place on the west side of the channel and West University Place on the east side of the channel between University Boulevard and Bellaire Boulevard.

Latitude:

29.714751

Longitude:

-95.433242

Describe the need for this activity. Why should this mitigation activity be completed?

The primary goal of the project is to avoid a failure of the existing channel by constructing an entirely new channel structure. The existing channel displays significant signs of degradation due to additional loading and soil mechanics not accounted for in the initial design. Key areas of concern along the existing channel are at locations where adjacent yards have been built up as high as 5 feet immediately above the western channel top of bank. Such yards are currently held in place by earth retaining features of variable material and height (rail road ties, concrete, masonry blocks, rock rubble, etc.). Historical site observations (dating back to summer of 2015) have indicated that some homeowners have repaired and/or otherwise replaced these existing earth retaining features subsequent to storm events. The longevity of these earth retaining features along the existing channel is uncertain, as they were not constructed by HCFCD. The existing channel's hydraulic capacity is reduced by 50% along reaches where earth retaining features and concrete channel lining have failed and been displaced down into the low-flow pilot channel. Consequently, the design intent of the proposed channel is to construct a channel section and overbank which can accommodate current loading conditions and will include modular block retaining walls along areas with significant yard build ups.

Who will the mitigation activity benefit and/or impact?

Increased hydraulic capacity will reduce the chance of flooding in the localized area in which there are an estimated 2,114 structures.

How will the mitigation activity be implemented?

The Poor Farm Ditch project (HCFCD unit D111-00-00) consists of channel improvements to an existing concrete-lined channel to mitigate future flooding from major storm events. The Harris County Flood Control District (HCFCD) right-of-way within the project area varies from 45 feet to 80 feet wide. Encroachments have been constructed within HCFCD's right-of-way along this reach, which have induced loading conditions to the channel structure not accounted for in the original design. Consequently, the primary goal of the project is to mitigate the risk of a failure of the existing channel by constructing an entirely new channel structure in its place. Additionally, the proposed project will provide an improved level of service. The reach of channel in the project footprint currently provides a 10-Year level of service). The reach upstream of the University Boulevard crossing is hydraulically adequate for 50-year storm. The channel reach downstream of the Bellaire Boulevard crossing is hydraulically adequate for 100-year storm. A generalized summary of work to be performed by the contractor is described as follows: The contractor will implement traffic control along University Boulevard, Bellaire Boulevard, and residential streets that interface the project work area. The contractor will establish and maintain construction access routes to the site. The variable width and limited space associated with HCFCD's right of way along the project reach may warrant the use of specialized equipment (e.g., small backhoes and dozers) to construct the proposed channel improvements. The contractor will demolish and remove the entirety of the existing channel concrete pavement and sub-grade features along the project reach in a phased sequence in order to maintain channel service. The contractor will construct a new reinforced concrete channel in accordance with the design. A significant amount of earthwork is associated with constructing the new channel. The native material on-site is not deemed suitable for re-use. Consequently, all material within the limits of excavation shall be removed and disposed of off-site. The contractor will place and compact imported fill to replace the material removed and to establish proposed grades. The overbanks of the existing channel vary significantly in elevation along the project reach, as several homeowners have erected earth retaining features of variable material and height at the interface of their backyard and the channel. The contractor shall be responsible for verifying existing conditions prior to construction to have a comprehensive understanding of the overbank grading activities required to tie-in the new concrete channel to adjacent grades. All overbank grading must be performed such as to not adversely impact the positive drainage from beyond the channel banks. The contractor will construct permanent maintenance access ramps at the upstream and downstream limits of the channel for HCFCD's future use after construction is complete.

Describe how the project is technically feasible and will be effective in reducing the risk by reducing or eliminating damage to property and/or loss of life in the project area. Please include engineering design parameters and references to the following: preliminary schematic or engineering drawings/design; applicable building codes; engineering practices and/or best practices; level of protection (e.g., life safety, 100-yr floor protection with freeboard, 100-yr wind design, etc.):

Though the primary project objective is to mitigate the risk of an outright failure of the existing channel, the new channel structure will also improve the hydraulic performance of the channel. Hydraulic modeling performed for the project reach suggests that: - The existing channel is capable of conveying the 10-year event within channel banks; and - The proposed channel is capable of conveying the 50-year event within channel banks. Two-dimensional hydraulic modeling was performed to evaluate the Pre- and Post-Mitigation water surface elevations beyond the channel banks. Specific recurrence interval storms that were evaluated include: 10-year, 50-year, 100-year, and 500-year. For each storm, the respective Post-Mitigation scenario resulted in a reduction of water surface elevations beyond channel banks. Data collected from geotechnical investigation efforts suggests that the native soils along the project reach exhibit high potential for swell pressures to develop. Much consideration was given to swell pressures during the channel design, given multiple site-specific factors which could contribute to moisture content variation in the native soils. These factors include, but are not necessarily limited to: - Subsequent to clearing and grubbing activities, the native soil will no longer be competing with the root zone of the removed vegetation; - Swimming pools and faulty irrigation equipment are sources of water that can induce full swelling potential in localized areas; and - The relatively shallow groundwater table may fluctuate seasonally or with extreme weather patterns. Given the potential for swell pressures to develop, limits of excavation were identified for which native material would be entirely removed and replaced with imported fill. This

effectively shifts the point at which swell pressures from the native material would be applied to the new channel structure. Further, the proposed channel has been configured to be of a structural thickness sufficient to resist the anticipated swell pressures without the use of permanent tie-backs. Reference Preliminary Engineering Report (PER) attached.

Who will manage and complete the mitigation activity?

The construction activity will be completed by competitively selected contractors. The District will provide project management staff. Environmental oversight will be provided by the district. Grant management and closeout activities will be managed by either by District staff or by the District's grant consultant that was previously selected by competitive award.

#### Scope of Work (Page 3 of 3)

Will the project address the hazards identified and what risks will remain from all hazards after project implementation (residual risk)?

The new channel structure will improve the hydraulic performance of existing conditions. Hydraulic modeling performed for the project reach suggests that: The existing channel is capable of conveying the 10-year event within channel banks; and The proposed channel is capable of conveying the 50-year event within channel banks.

When will the mitigation activity take place?

Within the next three calendar years from grant award. The project designer has been selected and design is nearly complete. The District is actively completing design activities and will be preparing to commence construction after grant award, as shown on the project schedule.

Why is this project the best alternative. What alternatives were considered to address the Risk and why was the proposed activity considered the best alternative?

HCFCD contracted with Freese and Nichols, Inc. (FNI) to evaluate the conditions and develop alternatives to improve the conditions identified within the project reach of Poor Farm Ditch. The initial analysis identified 7 alternatives and 3B was recommended for acceptance. HCFCD agreed with the recommendation and authorized FNI to proceed with the design of Alternative 3B. To date, final engineering design is near completion and the project is awaiting authorization to advertise for construction bidding. Reference the PER attached for detailed explanation of alternatives considered.

Please identify the entity that will perform any long-term maintenance and provide a maintenance schedule and cost information. The subapplicant or owner of the area to be mitigated is responsible for maintenance (including costs of long-term care) after the project is completed:

The facility will be maintained by HCFCD as part of their ongoing maintenance procedures. HCFCD visually inspects all of their channels and detention basins on a rotating schedule. Any deficiencies identified through this visual inspection process, or reported through the resident hotline, will be evaluated and scheduled for corrective action based on priority.

If you would like to make any comments, please enter them below:

Attachments (File Size):

Description Of Task	Starting Point	Unit Of Time	Schedule		Work Complete By
			Duration	Unit Of Time	
Complete Design Phase & Confirm Permits & Environmental Clearances (Day 1 is 4/14/23)	1	DAYS	270	DAYS	Harris County Flood Control District & Design Engineer
FEMA LPDM Award Finalized (Anticipated July/Aug 2023)	80	DAYS	1	DAYS	FEMA
Bid Phase & Contract Award	270	DAYS	120	DAYS	Harris County Flood Control District
Construction	390	DAYS	740	DAYS	Construction Contractor
Closeout - Including Punchlist	1130	DAYS	45	DAYS	Construction Contractor & Harris County Flood Control District
Estimate the total duration of the proposed activity:			1175	DAYS	

Cost Estimate

403.1 - Stormwater Management - Culverts

Federal Share: \$ 9,886,000.00

Item Name	Cost Classification	Unit Quantity	Unit of Measure	Unit Cost (\$)	Cost Estimate (\$)
Pre-Award Prepare Application	Administrative Expense	1.00	Each	\$ 25,000.00	\$ 25,000.00
Pre-Award Administrative Cost	Administrative Expense	1.00	Each	\$ 140,000.00	\$ 140,000.00
Post-Award Administrative Cost	Administrative Expense	1.00	Each	\$ 500,000.00	\$ 500,000.00
Retaining Wall (Concrete Block)	Construction And Project Improvement	8,000.00	Square Foot	\$ 150.00	\$ 1,200,000.00
CenterPoint Energy Coordination	Construction And Project Improvement	1.00	Each	\$ 75,000.00	\$ 75,000.00
Traffic Control	Construction And Project Improvement	1.00	Each	\$ 50,000.00	\$ 50,000.00
Remove and Dispose of all Pipe	Demolition And Removal	1,070.00	Linear Foot	\$ 20.00	\$ 21,400.00
Remove and Dispose concrete channel lining and low	Demolition And Removal	119,400.00	Square Yard	\$ 20.00	\$ 2,388,000.00
Site Prep & Restoration	Construction And Project Improvement	1.00	Each	\$ 1,085,190.00	\$ 1,085,190.00
Care and Control of Water	Construction And Project Improvement	1.00	Each	\$ 260,000.00	\$ 260,000.00
Imported Fill	Construction And Project Improvement	400.00	Cubic Yard	\$ 45.00	\$ 18,000.00
Reinforced Silt Fence	Construction And Project Improvement	850.00	Linear Foot	\$ 5.00	\$ 4,250.00
Rock Filler Dam - Type 3	Construction And Project Improvement	50.00	Linear Foot	\$ 175.00	\$ 8,750.00
Stabilized Construction Access	Construction And Project Improvement	450.00	Square Yard	\$ 33.00	\$ 14,850.00
Inlet Protection Barrier	Construction And Project Improvement	12.00	Each	\$ 300.00	\$ 3,600.00
Concrete Channel Lining - 8"	Construction And Project Improvement	14,400.00	Square Yard	\$ 170.00	\$ 2,448,000.00
Concrete Channel Lining - 12"	Construction And Project Improvement	2,365.00	Square Yard	\$ 250.00	\$ 591,250.00
Reinforced Concrete Channel Trapezodial	Construction And Project Improvement	2,540.00	Linear Foot	\$ 2,750.00	\$ 6,985,000.00
Reinforced Concrete Channel Transition Zone	Construction And Project Improvement	590.00	Linear Foot	\$ 6,710.00	\$ 3,958,900.00
Steel Sheet Piling	Construction And Project Improvement	820.00	Linear Foot	\$ 2,900.00	\$ 2,378,000.00
24" RCP	Construction And Project Improvement	300.00	Linear Foot	\$ 165.00	\$ 49,500.00
12" RCP	Construction And Project Improvement	90.00	Linear Foot	\$ 132.00	\$ 11,880.00
Pipe Under Drain System, 4"	Construction And Project Improvement	2.00	Each	\$ 31,740.00	\$ 63,480.00
Geocomposite Drainage	Construction And Project Improvement	5,350.00	Square Yard	\$ 24.00	\$ 128,400.00
Concrete Collar	Construction And Project Improvement	30.00	Each	\$ 3,750.00	\$ 112,500.00
Asphalt Concrete Pavement Repair	Construction And Project Improvement	350.00	Square Yard	\$ 90.00	\$ 31,500.00
Permanent Markings, Signs & Striping	Construction And Project Improvement	1.00	Each	\$ 5,000.00	\$ 5,000.00
Concrete curb, 6"	Construction And Project Improvement	250.00	Linear Foot	\$ 70.00	\$ 17,500.00
Concrete Sidewalk	Construction And Project Improvement	760.00	Square Foot	\$ 9.50	\$ 7,220.00
Steel Pipe Gate	Construction And Project Improvement	3.00	Each	\$ 3,000.00	\$ 9,000.00
Steel Handrail	Construction And Project Improvement	5,300.00	Linear Foot	\$ 100.00	\$ 530,000.00
6' Chainlink Fence (New)	Construction And Project Improvement	6,300.00	Linear Foot	\$ 30.00	\$ 189,000.00
Concrete Retaining Wall, Cast-In-Place	Construction And Project Improvement	205.00	Linear Foot	\$ 500.00	\$ 102,500.00
Relocate Bus Shelter	Construction And Project Improvement	1.00	Each	\$ 10,000.00	\$ 10,000.00
Replace Existing Bridge	Construction And Project Improvement	1.00	Each	\$ 31,250.00	\$ 31,250.00
Contingency 15% on construction costs	Contingencies	1.00	Each	\$ 3,418,340.00	\$ 3,418,340.00
Construction Management Services (15%)	Architectural Engineering Basic Fees	1.00	Each	\$ 3,931,089.00	\$ 3,931,089.00
Construction Materials Testing	Miscellaneous	1.00	Each	\$ 800,000.00	\$ 800,000.00
				Total Cost	\$ 31,603,349.00

**Total Project Cost Estimate: \$ 31,603,349.00**

	Cost Share	
Activity Cost Estimate	\$ 31,603,349.00	
Federal Share Percentage	31.28149488%	
Non-Federal Share Percentage	68.71850512%	
	Dollars	Percentage
Proposed Federal Share	\$ 9,886,000.00	31.28149488%
Proposed Non-Federal Share	\$ 21,717,349.00	68.71850512%

Source Agency		Name of Source Agency	Funding Type	Amount (\$)	Action
Other (CDBG-MIT)		CDBG-MIT Grant Funds	Other (Grant Funding)	\$ 18,422,015.00	<a href="#">View Details</a>
Local Agency Funding		HCFCF Flood Resilient Trust Fund	Cash	\$ 3,295,334.00	<a href="#">View Details</a>
			<b>Grand Total</b>	<b>\$ 21,717,349.00</b>	

If you would like to make any comments, please enter them below.

Attachments

Name	File Size (KB)
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The details for the cost share you selected are listed below.

Funding Source	Other Agency Funding (CDBG-MIT)
Name of Funding Source	CDBG-MIT Grant Funds
Funding Type	Other (Grant Funding)
Amount	\$ 18,422,015.00
Date of availability	08-01-2023
Funds commitment letter date	03-08-2023
Attachment (File Size) (funds commitment letter)	

[Go Back](#)

The details for the cost share you selected are listed below.

Funding Source	Local Agency Funding
Name of Funding Source	HCFCF Flood Resilient Trust Fund
Funding Type	Cash
Amount	\$ 3,295,334.00
Date of availability	04-14-2023
Funds commitment letter date	03-08-2023
Attachment (File Size) (funds commitment letter)	

[Go Back](#)

Cost Effectiveness

Attach the Benefit Cost Analysis (BCA), if completed for this project

Name	File Size (KB)
<a href="#">PoorFarmD111_fema_bca_toolkit-6.0.xlsx</a>	51
<a href="#">PoorFarm_D111_DDFdamage_TableToExcel3.xlsx</a>	1430
<a href="#">PoorFarmDitchD111_BCA_Version 6.0.0_Build 20230103.1822.pdf</a>	559
Net Present Value of Project Benefits (A)	\$ 86942347
Total Project Cost Estimate (B)	\$ 31619901
What is the Benefit Cost Ratio for the entire project (A/B)?	2.75

If you would like to make any comments, please enter them below.

BCA depicts a future failed condition of the current concrete lined Channel D111-00-00, causing obstruction and flooding in the surrounding neighborhoods. WSEL at 500,100, 50, 25, and 10 year recurrence intervals for existing and future failed condition of the channel. 25 and 10 year recurrence intervals were not included in the BCA as only street flooding was predicted. FFE was subtracted from WSEL then applied to USACE DDF Curve for Single Story, Slab construction, No Basement for each recurrence interval. 2114 Structures affected in the Pre-project future failed condition of the channel at the 500 year interval. All structures were removed from risk in the 100 and 50 year interval following construction of the project. Population and working population is derived from the 500 yr recurrence interval area of benefit polygon using the ArcGIS Pro Data Enrichment tool from 2022 and 2021 ACS data.

Attachments

Name	File Size (KB)
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**A. National Historic Preservation Act - Historic Buildings and Structures**

\* 1. Does your project affect or is it in close proximity to any buildings or structures 50 years or more in age? Not Known

If Yes, you must confirm that you have provided the following:

- The property address and original date of construction for each property affected (unless this information is already noted in the Properties section),
- A minimum of two color photographs showing at least three sides of each structure (Please label the photos accordingly),
- A diagram or USGS 1:24,000 scale quadrangle map displaying the relationship of the property(s) to the project area.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

- Information gathered about potential historic properties in the project area, including any evidence indicating the age of the building or structure and presence of buildings or structures that are listed or eligible for listing on the National Register of Historic Places or within or near a National Register listed or eligible historic district. Sources for this information may include the State Historic Preservation Officer, and/or the Tribal Historic Preservation Officer (SHPO/THPO), your local planning office, historic preservation organization, or historical society.
- Consideration of how the project design will minimize adverse effects on known or potential historic buildings or structures, and any alternatives considered or implemented to avoid or minimize effects on historic buildings or structures. Please address and note associated costs in your project budget.
- For acquisition/demolition projects affecting historic buildings or structures, any data regarding the consideration and feasibility of elevation, relocation, or flood proofing as alternatives to demolition.
- Attached materials or additional comments.

Comments:

will require a desktop review

Attachments:

Name

File Size (KB)

**B. National Historic Preservation Act - Archeological Resources**

\* 1. Does your project involve disturbance of ground? Yes

If Yes, you must confirm that you have provided the following:

- A description of the ground disturbance by giving the dimensions (area, volume, depth, etc.) and location
- The past use of the area to be disturbed, noting the extent of previously disturbed ground.
- A USGS 1:24,000 scale or other site map showing the location and extent of ground disturbance.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

- Any information about potential historic properties, including archeological sites, in the project area. Sources of this information may include SHPO/THPO, and/or the Tribe's cultural resources contact if no THPO is designated. Include, if possible, a map showing the relation of any identified historic properties to the project area.
- Attached materials or additional comments.

Comments:

Reference Preliminary Engineering Report (PER) and map/photos attached in document titled "D111\_Poor\_Farm\_Map.pdf"

Attachments:

Name

File Size (KB)

[D111 Preliminary Engineering Report.pdf](#)

35477

[D111 Poor Farm Map.pdf](#)

41939

**C. Endangered Species Act and Fish and Wildlife Coordination Act**

\* 1. Are Federally listed threatened or endangered species or their critical habitat present in the area affected by the project? Not Known

If Yes, you must confirm that you have provided the following:

- Information you obtained to identify species in or near the project area. Provide the source and date of the information cited.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

- Any request for information and associated response from the USFWS, the National Marine Fisheries Service (NMFS) (for affected ocean-going fish), or your State Wildlife Agency, regarding potential listed species present and potential of the project to impact those species.
- Attached materials or additional comments.

Comments:

Project area is an existing concrete lined channel and no T&E impacts are anticipated

\* 2. Does your project remove or affect vegetation? Not Known

If Yes, you must confirm that you have provided the following:

- Description of the amount (area) and type of vegetation to be removed or affected.
- A site map showing the project area and the extent of vegetation affected.
- Photographs or digital images that show both the vegetation affected and the vegetation in context of its surroundings.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

Attached materials or additional comments.

Comments:

Attached PER, pages 19-26 includes photos of site condition including vegetation present circa 2017

\* 3. Is your project in, near (within 200 feet), or likely to affect any type of waterway or body of water? Yes

If Yes, and project is not within an existing building, you must confirm that you have provided the following:

- A USGS 1:24,000 scale quadrangle map showing the project activities in relation to all nearby water bodies (within 200 feet).
- Any information about the type of water body nearby including: its dimensions, the proximity of the project activity to the water body, and the expected and possible changes to the water body, if any. Identify all water bodies regardless whether you think there may be an effect
- A photograph or digital image of the site showing both the body of water and the project area.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

- Evidence of any discussions with the US Fish and Wildlife Service (USFWS), and/or your State Wildlife Agency concerning any potential impacts if there is the potential for the project to affect any water body.
- Attached materials or additional comments.

Comments:

See attached PER for dimensions of channel (Water body)

Attachments:

Name	File Size (KB)
<a href="#">TX_Bellaire_20230309_202044456000_TM_geo.pdf</a>	43418

**D. Clean Water Act, Rivers and Harbors Act, and Executive Order 11990 (Protection of Wetlands)**

\* 1. Will the project involve dredging or disposal of dredged material, excavation, adding fill material or result in any modification to water bodies or wetlands designated as "waters of the U.S" as identified by the US Army Corps of Engineers or on the National Wetland Inventory? No

If Yes, you must confirm that you have provided the following:

- Documentation of the project location on a USGS 1:24,000 scale topographic map or image and a copy of a National Wetlands Inventory map or other available wetlands mapping information.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

- Request for information and response letter from the US Army Corps of Engineers and/or State resource agencies regarding the potential for wetlands, and applicability of permitting requirements.
- Evidence of alternatives considered to eliminate or minimize impacts to wetlands.
- Attached materials or additional comments.

Comments:

See USACE AJD and PER attached

Attachments:

Name	File Size (KB)
<a href="#">Poor Farm Ditch SWG 2009-00591 AJD.pdf</a>	4766

**E. Executive Order 11988 (Floodplain Management)**

\* 1. Does a Flood Insurance Rate Map (FIRM), Flood Hazard Boundary Map (FHBM), hydrologic study, or some other source indicate that the project is located in or will affect a 1% annual chance floodplain, a 0.2% annual chance floodplain, a regulatory floodway, or an area prone to flooding? Yes

If Yes, please indicate in the text box below any documentation to identify the means or the alternatives considered to eliminate or minimize impacts to floodplains (See the 8 step process found in 44 CFR Part 9.6.) to help FEMA evaluate the impact of the project:

FIRM Panel Number: 48201C0860L

\* 2. Does the project alter a watercourse, water flow patterns, or a drainage way, regardless of its floodplain designation? Yes

If Yes, please indicate below any other information you are providing to help FEMA evaluate the impact of the project:

- Hydrologic/hydraulic information from a qualified engineer to demonstrate how drainage and flood flow patterns will be changed and to identify down and upstream effects.
- Evidence of any consultation with US Army Corps of Engineers (may be included under Part D of the Environmental Information).
- Request for information and response letter from the State water resource agency, if applicable, with jurisdiction over modification of waterways.
- Attached materials or additional comments.

Comments:

See PER attached from Hydraulic information, See AJD attached for consultation with USACE AND DFIRM panel attached

Attachments:

Name	File Size (KB)
<a href="#">DFIRM panel Poor Farm Ditch.pdf</a>	6702

**F. Coastal Zone Management Act**

\* 1. Is the project located in the State's designated coastal zone? No

If Yes, please indicate below any other information you are providing to help FEMA evaluate the impact of the project:

- Information resulting from contact with the appropriate State agency that implements the coastal zone management program regarding the likelihood of the project's consistency with the State's coastal zone plan and any potential requirements affecting the cost or design of the proposed activity.
- Attached materials or additional comments.

Comments:

Attachments:

Name

File Size (KB)

### G. Farmland Protection Policy Act

\* 1. Will the project convert more than 5 acres of "prime or unique" farmland outside city limits to a non-agricultural use? No

Comments:

Attachments:

Name

File Size (KB)

### H. RCRA and CERCLA (Hazardous and Toxic Materials)

\* 1. Is there a reason to suspect there are contaminants from a current or past use on the property associated with the proposed project? Not Known

If Yes, please indicate below any other information you are providing to help FEMA evaluate the impact of the project:

- Comments and any relevant documentation.
- Results of any consultations with State or local agency to obtain permit with requirements for handling, disposing of or addressing the effects of hazardous or toxic materials related to project implementation.
- Attached materials or additional comments.

Comments:

ESA Phase I not completed

\* 2. Are there any studies, investigations, or enforcement actions related to the property associated with the proposed project? No

If Yes, please indicate below any other information you are providing to help FEMA evaluate the impact of the project:

- Comments and any relevant documentation.
- Results of any consultations with State or local agency to obtain permit with requirements for handling, disposing of or addressing the effects of hazardous or toxic materials related to project implementation.
- Attached materials or additional comments.

Comments:

\* 4. Do you know if any of the current or past land-uses of the property affected by the proposed project or of the adjacent properties are associated with hazardous or toxic materials? No

If Yes, please indicate below any other information you are providing to help FEMA evaluate the impact of the project:

- Comments and any relevant documentation.
- Results of any consultations with State or local agency to obtain permit with requirements for handling, disposing of or addressing the effects of hazardous or toxic materials related to project implementation.
- Attached materials or additional comments.

Comments:

Attachments:

Name

File Size (KB)

### I. Executive Order 12898, Environmental Justice for Low Income and Minority Populations

\* 1. Are there low income or minority populations in the project's area of effect or adjacent to the project area? No

If Yes, you must confirm that you have provided the following:

- Description of any disproportionate and adverse effects to these populations.

To help FEMA evaluate the impact of the project, please indicate below any other information you are providing:

- Description of the population affected and the portion of the population that would be disproportionately and adversely affected. Please include specific efforts to address the adverse impacts in your proposal narrative and budget.
- Attached materials or additional comments.

Comments:

Attachments:

Name

File Size (KB)

**J. Other Environmental/Historic Preservation Laws or Issues**

\* 1. Are there other environmental/historic preservation requirements associated with this project that you are aware of? No

If Yes, please indicate in the text box below a description of the requirements, issues or public involvement effort.

\* 2. Are there controversial issues associated with this project? No

If Yes, please indicate in the text box below a description of the requirements, issues or public involvement effort.

\* 3. Have you conducted any public meeting or solicited public input or comments on your specific proposed mitigation project? No

If Yes, please indicate in the text box below a description of the requirements, issues or public involvement effort.

Attachments:

Name

File Size (KB)

**K. Summary and Cost of Potential Impacts**

\* 1. Having answered the questions in parts A. through J., have you identified any aspects of your proposed project that have the potential to impact environmental resources or historic properties? No

If Yes, you must confirm that you have:

- Evaluated these potential effects and provided the materials required in Parts A through J that identify the nature and extent of potential impacts to environmental resources and/or historic properties.
- Consulted with appropriate parties to identify any measures needed to avoid or minimize these impacts.
- Considered alternatives that could minimize both the impacts and the cost of the project.
- Made certain that the costs of any measures to treat adverse effects are realistically reflected in the project budget estimate.

Comments:

Actions adjacent to a water course always require additional scrutiny to ensure compliance with all state and federal environmental regulations. Phase I/II ESA and T & E have not been completed.

Attachments:

Name

File Size (KB)

Is the recipient participating in the <a href="#">Community Rating System (CRS)?</a>	Yes
If yes, what is their <a href="#">CRS rating?</a>	7
Is the recipient a <a href="#">Cooperating Technical Partner (CTP)?</a>	Yes
Is the recipient a <a href="#">Firewise Community?</a>	No
If yes, please provide their <a href="#">Firewise Community</a> number.	
Has the recipient adopted building codes consistent with the <a href="#">International Codes?</a>	Yes
Has the recipient adopted the <a href="#">National Fire Protection Association (NFPA) 5000 Code?</a>	No
Have the recipient's building codes been assessed on the <a href="#">Building Code Effectiveness Grading Schedule (BCEGS)?</a>	No
If yes, what is their <a href="#">BCEGS</a> rating?	

Evaluation (Page 2 of 2)

How will this mitigation activity leverage involvement of partners to enhance its outcome?

This project involves coordination with the neighboring municipalities West University Place and Southside Place and with Harris County for temporary traffic impacts during construction. HCFCD has been working closely with these agencies during the development of the design.

How will this mitigation activity offer long-term financial and social benefits or promote resiliency for the community?

This project will offer long-term financial and social benefits and promote community resiliency by reducing the risk of flooding by removing the risk of outright failure of the existing channel and improve hydraulic performance of existing conditions.

Please provide the percent of the population benefiting from this mitigation activity.

46.0

Please explain your response.

ACS 2021 Census Tracts 48201412300 48201412400 48201412500 48201413000 48201413100 48201411801 48201411802 48201411803 48201411804 total population is 28,086 people. Area of benefit at the highest interval (500yr) of the future failed condition within these tracts has an estimated population of 12,926 people.  $12,926/28,086 * 100 = 46.02\%$

Does this mitigation activity protect a critical facility?

No

If yes, please select the type of critical facilities to be protected

Comments:

Name

File Size (KB)

Date Attached

Assurances and Certifications

Please click the link in the status column to view forms.

Forms

Status

Part II: Assurances **Construction** Programs.

[Incomplete](#)

Part II: Certifications Regarding Lobbying; Debarment, Suspension and Other Responsibilities Matters; and Drug-Free Workplace Requirements.

[Incomplete](#)

Part III: SF-LLL, Disclosure of Lobbying Activities (Complete only if applying for a grant of more than \$100,000 and have lobbying activities using Non-Federal funds. See the Certifications Regarding Lobbying; Debarment, Suspension and Other Responsibilities Matters; and Drug-Free Workplace Requirements form for lobbying activities definition.)

[Incomplete](#)

Attachments

Name

File Size (KB)

Certifications Regarding Lobbying; Debarment, Suspension and Other Responsibility Matters; and Drug-Free Workplace Requirements.

Attachments

Name

File Size (KB)

Section 17.630 of the regulations provide that a grantee that is a State may elect to make one certification in each Federal fiscal year. A copy of which should be included with each application for FEMA funding. States and State agencies may elect to use a Statewide certification.

Attachments

Name

File Size (KB)

Name of Section	Comment	Comments and Attachments		File Size (K)
		Attachment		
Mitigation Plan		<a href="#">Texas-SHMP-FINAL-Revised-5.14.2021(1).pdf</a>	22151	
		<a href="#">HarrisCounty-Vol2_Planning_Partner_Annexes.pdf</a>	54544	
	<p>BCA depicts a future failed condition of the current concrete lined Channel D111-00-00, causing obstruction and flooding in the surrounding neighborhoods. WSEL at 500,100, 50, 25, and 10 year recurrence intervals for existing and future failed condition of the channel. 25 and 10 year recurrence intervals were not included in the BCA as only street flooding was predicted. FFE was subtracted from WSEL then applied to USACE DDF Curve for Single Story, Slab construction, No Basement for each recurrence interval. 2114 Structures affected in the Pre-project future failed condition of the channel at the 500 year interval. All structures were removed from risk in the 100 and 50 year interval following construction of the project. Population and working population is derived from the 500 yr recurrence interval area of benefit polygon using the ArcGIS Pro Data Enrichment tool from 2022 and 2021 ACS data.</p>	<a href="#">PoorFarmDitchD111_BCA_Version 6.0.0. Build 20230103.1822.pdf</a>	559	
Cost Effectiveness		<a href="#">PoorFarm_D111_DDFdamage_TableToExcel3.xlsx</a>	1430	
		<a href="#">PoorFarmD111_fema_bca_toolkit-6.0.xlsx</a>	51	
			<p>Reference Preliminary Engineering map/photos attached in document 1 "D111_Poor_Farm_Map.pdf"</p>	
		EHP - B - National Historic Preservation Act - Archeological Resources		
		EHP - C - Endangered Species Act and Fish and Wildlife Coordination Act	<p>Project area is an existing conc... no T&amp;E impacts are anticipated</p> <p>-----</p> <p>Attached PER, pages 19-26 include condition including vegetation pi</p>	
	will require a desktop review			See USACE AJD and PER attached
EHP - A - National Historic Preservation Act - Historic Buildings and Structures		EHP - D - Clean Water Act, Rivers and Harbors Act, and Executive Order 11990		
			FIRM Panel Number: 48201C0860L	
		EHP - E - Executive Order 11988 (Floodplain Management)	<p>See PER attached from Hydraulic : attached for consultation with U: attached</p>	
				ESA Phase I not completed
		EHP - H - RCRA and CERCLA (Hazardous and Toxic Materials)		

## ***FEMA Grants Application***

Attachments

Name

File Size (KB)