STATE OF TEXAS § TWDB Contract No. 1800012268

COUNTY OF TRAVIS §

INTERAGENCY COOPERATION CONTRACT
BETWEEN
THE TEXAS WATER DEVELOPMENT BOARD
AND
TEXAS A&M UNIVERSITY – CORPUS CHRISTI

THIS INTERAGENCY COOPERATION CONTRACT (CONTRACT) is entered into by and between the State agencies shown below as the parties, pursuant to the authority granted and in compliance with the provisions of the Interagency Cooperation Act, Chapter 771, TEX. GOV'T CODE.

SECTION I. CONTRACTING PARTIES

Receiving Agency: Texas Water Development Board (TWDB)
1700 North Congress, Agency Code 580
Austin, Texas 78701
(512) 463-7981

Performing Agency: Texas A&M University – Corpus Christi (TAMUCC)
Harte Research Institute for Gulf of Mexico Studies
6300 Ocean Drive, Unit 5869
Corpus Christi, TX 78412
Email: Paul.Montagna@tamucc.edu

SECTION II. STATEMENT OF SERVICES TO BE PERFORMED

The PERFORMING AGENCY (TAMUCC), will undertake an assessment of the relationship between freshwater inflow and biological indicators in Lavaca Bay according to the Scope of Work in Exhibit A and deliverable requirements in Exhibit C.

SECTION III. PAYMENT

1. BASIS FOR COMPUTING REIMBURSABLE COSTS. The TWDB shall pay the TAMUCC for work performed in Exhibit A upon the submittal of invoice(s) of sufficient detail to determine work performed and in accordance with the Task and Expense Budget detailed in Exhibit B. All payments will be made in accordance with TEX. GOV'T CODE, § 771.008, Exhibit E, Reimbursement Requirements.

2. TOTAL PAYMENTS. The maximum total amount payable under this CONTRACT shall not exceed Seventy – Five Thousand Dollars and No/100 ($75,000.00). The TWDB agrees to compensate and reimburse CONTRACTOR in a total amount not to exceed $75,000.00 for costs incurred and paid by the TAMUCC pursuant to performance of this CONTRACT. The TWDB shall reimburse the TAMUCC for ninety percent (90%) of the total of each invoice submittal. Upon the TAMUCC performance and completion of the project and acceptance by the TWDB, the TWDB shall pay the retained ten percent (10%) to the TAMUCC. For all reimbursement billings including any subcontractor's expenses, the TWDB must have provided written approval of any required interlocal agreements, contracts or agreements between the TAMUCC and the subcontractor. The TAMUCC is fully responsible for paying all charges by subcontractors prior to reimbursement by the TWDB.

SECTION IV. PAYMENT FOR SERVICES

The TAMUCC will provide the TWDB with quarterly invoices according to Exhibit E with specific cost details for each task or specific item of work to be performed by the TAMUCC or its subcontractor and for each category of reimbursable expenses for the services provided under this CONTRACT in accordance with Exhibit A. The TWDB shall timely reimburse the TAMUCC for all invoices in accordance with TEX. GOV'T CODE ANN. § 771.008 (Supp. 2013). Reimbursements with funds outside the State Treasury shall be made by the TWDB issuing warrants for payment to the TAMUCC.

Interagency payments for deposit outside of the state treasury (into local bank accounts) will be processed in Uniform Statewide Accounting System (USAS) generating a Warrant for payment.

This is a State Pass-Through Grant and will be treated as such for state financial reporting. It will need to be included on the Schedule of State Grant Pass-Throughs From/To State Agencies in the Annual Financial Report. Parties to the CONTRACT will need to coordinate at year-end to ensure that the amounts reported in the respective AFRs as Pass-Through From and Pass-Through To agree.

SECTION V. TERM OF CONTRACT

This CONTRACT takes effect on October 1, 2018. This CONTRACT shall terminate on December 31, 2019, unless terminated earlier by written agreement of the parties.

SECTION VI. AMENDMENT, TERMINATION AND STOP ORDERS

1. This CONTRACT may be altered or amended by mutual written consent or terminated by the EXECUTIVE ADMINISTRATOR of the TWDB at any time by

written notice to the TAMUCC. Upon receipt of such termination notice, the TAMUCC shall, unless the notice directs otherwise, immediately discontinue all work in connection with the performance of this CONTRACT and shall proceed to cancel promptly all existing orders insofar as such orders are chargeable to this CONTRACT. The TAMUCC shall submit a statement showing in detail the work performed under this CONTRACT to the date of termination. The TWDB shall then pay the TAMUCC promptly that proportion of the prescribed fee, which applies to the work actually performed under this CONTRACT, less all payments that have been previously made. Thereupon, copies of all work accomplished under this CONTRACT shall be delivered to the TWDB.

2. The EXECUTIVE ADMINISTRATOR may issue a Stop Work Order to the TAMUCC at any time. Upon receipt of such order, the TAMUCC shall discontinue all work under this CONTRACT and cancel all orders pursuant to this CONTRACT, unless the order directs otherwise. If the EXECUTIVE ADMINISTRATOR does not issue a Restart Order within 60 days after receipt by the TAMUCC of the Stop Work Order, the TAMUCC shall regard this CONTRACT terminated in accordance with the foregoing provisions.

SECTION VII. MISCELLANEOUS PROVISIONS

Force Majeure: The TAMUCC or the TWDB may be excused from performance under this CONTRACT for any period when performance is prevented as the result of an act of God, strike, war, civil disturbance, epidemic, or court order, provided that the party experiencing the event of Force Majeure has prudently and promptly acted to take any and all steps that are within the party's control to ensure performance and to shorten the duration of the event of Force Majeure. The party suffering an event of Force Majeure shall provide notice of the event to the other parties as soon as practicable but not later than 36 hours. Subject to this provision, such nonperformance shall not be deemed a default or a ground for termination.

SECTION VIII. CORRESPONDENCE

For the **TWDB**:

Contract Issues:
Texas Water Development Board
Attention: Contract Administration
P.O. Box 13231
Austin, Texas 78711-3231
Email: contracts@twdb.texas.gov

For the **TAMUCC:**

Contract Issues:
Paul A. Montagna, Ph.D.
Texas A&M University – Corpus Christi
Harte Research Institute for Gulf of Mexico Studies
6300 Ocean Drive, Unit 5869
Corpus Christi, TX 78412
Email: Paul.Montagna@tamucc.edu

Payment Request Submission:
Texas Water Development Board
Attention: Accounts Payable
P.O. Box 13231
Austin, Texas 78711-3231
Email: invoice@twdb.texas.gov

Physical Address:
Stephen F. Austin State Office Building
1700 N. Congress Avenue
Austin, Texas 78701

Payment Request Submission:
Mayra A. Hough, Ed. D., C.R.A.
Director, Office of Sponsored Research Administration
Texas A&M University–Corpus Christi
6300 Ocean Drive, Unit 5844
Corpus Christi, TX 78412-5844
Email: mayra.hough@tamucc.edu

Physical Address:
Texas A&M University – Corpus Christi
Harte Research Institute for Gulf of Mexico Studies
6300 Ocean Drive, Unit 5869
Corpus Christi, TX 78412

SECTION IX. CERTIFICATIONS

The PARTIES hereby certify that,

A. The services specified above are necessary and essential and are properly within the statutory functions and programs of the affected agencies of State Government;

B. The proposed arrangements serve the interest of efficient and economical administration of State Government;

C. The services, supplies or materials contracted for are not required by Section 21 of Article 16 of the Constitution of Texas to be supplied under contract given to the lowest responsible bidder nor is this CONTRACT prohibited by TEX. GOV'T CODE ANN. §§ 771.003 (b) or (c) (Supp. 2013); and

D. The services provided herein do not constitute information resources technologies.

The TWDB further certifies that it has the authority to receive the services contracted for pursuant to the authority of TEX. WATER CODE ANN, § 6.190 and the current Appropriations Act.

IN WITNESS WHEREOF, the parties have caused this CONTRACT to be duly executed in multiple originals.

RECEIVING AGENCY:

TEXAS WATER DEVELOPMENT BOARD

Jeff Walker
Executive Administrator

Date: 11/15/18

PERFORMING AGENCY:

TEXAS A&M UNIVERSITY-CORPUS CHRISTI

Mayra A. Hough, Ed. D., C.R.A.

Date: 11-13-18

Exhibit A
Scope of Work

Assessment of the Relationship Between Freshwater Inflow And Biological Indicators in Lavaca Bay

Introduction

A previous study evaluating the estuarine health of Lavaca Bay relied on work performed in the eastern arm of Matagorda Bay as part of the 2008 Lower Colorado River Authority-San Antonio Water System Matagorda Bay Health Evaluation (Colorado-Lavaca Basin and Bay Expert Science Team, 2011). The bay health evaluation study determined the seasonal volumes of freshwater inflow needed to produce specific salinity conditions at locations downstream of the river mouth. The design salinities were determined based on an analysis of responses to salinity by several bioindicator species including finfish (Atlantic Croaker and Gulf Menhaden), shellfish (Brown Shrimp White Shrimp and Blue Crab), and estuarine mash plant communities (Low Estuarine Marsh and High Estuarine Marsh). A simplified version of this approach was applied to Lavaca Bay by the Colorado-Lavaca Basin and Bay Expert Science Team (CL-BBEST). In that process, design salinities and location in Lavaca Bay were assumed using best professional judgment, and the relationship between freshwater inflow and salinity was derived through a simple statistical relationship. In another study completed as a requirement of TWDB Contract No. 1400011715, the salinity and circulation model for Lavaca Bay was updated and analysis was undertaken to make the flow-salinity relationships more consistent with the approach previously adopted for Matagorda Bay (Anchor QEA *et al.*, 2015). However, neither the 2015 study nor the original 2011 CL-BBEST report included a rigorous and comprehensive analysis of the biological indicators in Lavaca Bay, as has been done in many other Texas Bays, nor the specific confounding factors that may be important in Lavaca Bay.

There are several confounding factors that can obscure the effects of inflow alone. For example: the presence of a major industrial outfall from the Formosa Plastics plant directly into the Lavaca River, the mercury superfund site and dredge spoil island off of the Alcoa Aluminum plant in Lavaca Bay, an active fishery that can deplete living marine resources in Lavaca Bay, and long-term climate change effects that drive salinity, temperature and dissolved oxygen conditions throughout the ecosystem.

The elements of the environment related to freshwater inflow that support species or a community can be identified through the analysis of long-term inflow and biological data series. This approach has been pioneered by the Principal Investigator, Paul Montagna, in many similar peer reviewed studies in the past (Arismendez et al. 2009; Montagna et al. 2008; Palmer et al. 2016; Turner et al. 2014; Turner and Montagna 2016) and in Lavaca Bay in particular (Hu et al. 2015;

Montagna and Kalke 1995; Montagna and Li 2010; Kim and Montagna 2009, 2012; Palmer and Montagna 2015; Pollack et al. 2009; 2011; Van Diggelen and Montagna 2016).

A conceptual model has emerged the helps us identify inflow effects on estuary resources. The relationship between biology and hydrology is complex and embedded in the food web and material flow dynamics of estuaries. For example, one cannot grow fish by simply adding water to a fish tank. Ultimately, biological resources in estuaries are affected by salinity more than inflow by itself, but salinity is affected by inflow (Fig. 1). Because of the links between flow, salinity, and biology; determining the relationship between inflow and resources is a multi-step approach. First, the resource to be protected is identified. Second, the salinity range or requirements of that resource are identified in both space and time. Third, the flow regime needed to support the required distribution of salinity is identified, usually using hydrodynamic and salinity transport models. These experiences led to a generic framework that inflow hydrology drives estuarine condition and estuarine condition drives biological resources (Fig. 1).

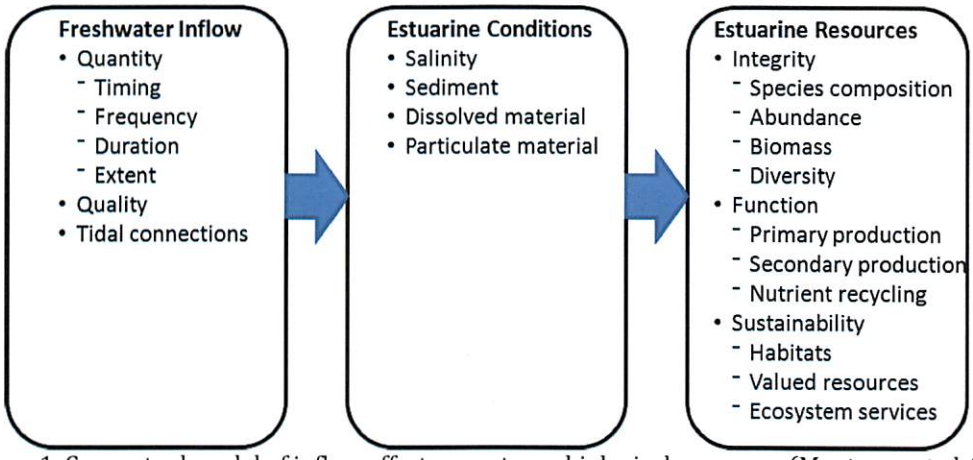

Figure 1. Conceptual model of inflow effects on estuary biological resources (Montagna et al. 2013).

Study objective

The objective of this study is to analyze long-term data sets to assess the relationship between freshwater inflow and biological indicators in Lavaca Bay as part of the Senate Bill 3 adaptive management process (80th Texas Legislature).

Technical approach

1. Data collection

Long-term data will be obtained from at least 7 major sources (Fig. 2):

1.1. Texas Parks and Wildlife Department (TPWD), Coastal Fisheries program. This consists of data collected in trawls, bag seines, gill nets, and oyster dredges. In addition to the biological data, TPWD collects salinity, temperature, dissolved oxygen, and turbidity measurements. The data series began in 1977.

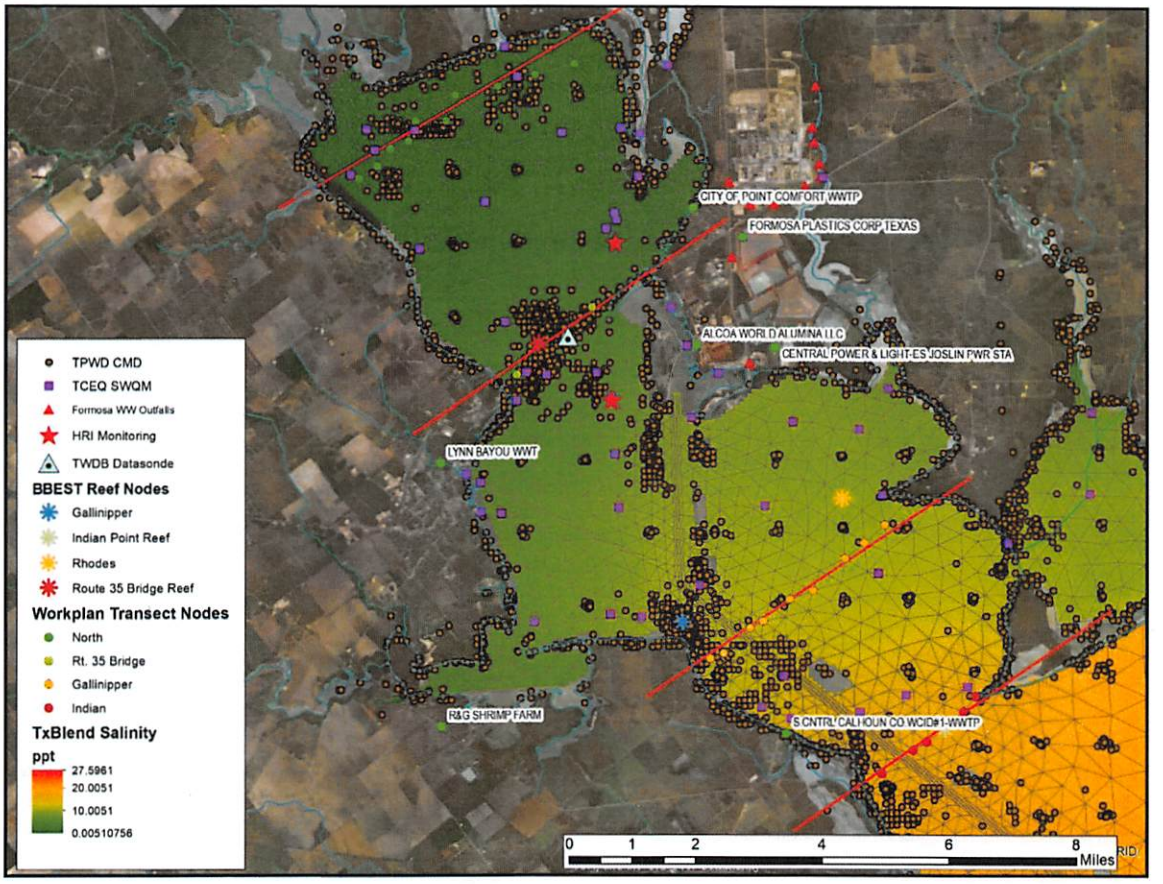

Figure 2. Locations of the datasets 1-5 above and the locations of data used in the 2010 CL BBEST report (BBEST Reef Nodes) and the 2015 Senate Bill 3 (80th Texas Legislature) Workplan (Workplan Transect Nodes).

TCEQ Surface Water Quality Monitoring data. This consists of regular water quality monitoring, as well as discharge data from the Formosa plant. While this is available to the public via a Public Viewer located at: https://www80.tceq.texas.gov/SwqmisPublic/public/default.htm, the data will be requested in a database form.

1.2. Formosa data. This consists of long-term water quality (water and sediment pore water) and biological sampling (benthos, plankton, gill nets for fish). This data was collected as part of TCEQ discharge permit requirements and is available from TCEQ by request. The data is being collected by Freese and Nichols (formerly it was collected by PBSJ and Atkins), and will be requested from them directly or via Formosa.

1.3. Harte Research Institute (HRI) long-term monitoring data. This data set goes back to 1984 and was collected specifically to identify freshwater inflow effects on water quality (salinity, temperature, dissolved oxygen, pH, turbidity, nutrients, and chlorophyll) and benthos communities. Benthos are integrators of long-term effects in the overlying water column because they cannot move when conditions are poor. Benthos are also secondary consumers and thus linked to primary production more closely than tertiary consumers (such as fish). The data set belongs to Paul Montagna, principal investigator, so we already have it.

1.4. Texas Water Development Board (TWDB) hydrological data. This is monthly data going back to 1941. Salinity transport and circulation model (TxBLEND) is used predict spatially explicit salinity based on daily meteorological and hydrologic input for the period from (1986-2013). We already have the flow data and the model.

1.5. Texas Department of Health (TDH). This series of data was collected to evaluate the effects of mercury in finfish of Lavaca Bay. Elevated levels of mercury were detected in Lava Bay, Texas and this caused the EPA to close a one-mile area to the harvesting of finfish and crabs in 1988. The source of contamination was determined to be a chlor-alkali plant operated at the Alcoa site in Point Comfort, Texas. In 2001 the EPA issued a Record of Decision (ROD) for the site. This ROD included that action be taken to address the contaminated sediments in Lavaca bay, to prevent unpermitted discharges into the bay and, to remove contaminated soils on shore. While the sources have been mitigated long-term monitoring of mercury levels in fish and shellfish has continued. Some of this data may reside with EPA or NOAA. Some exists at HRI.

1.6. National Oceanic and Atmospheric Administration (NOAA), Climate Prediction Center (CPC) data for the monthly Ocean Niño Index (ONI), North

Atlantic Oscillation (NAO), and North Pacific Index (NPI), which are used to related inflow with global climatic conditions.

2. Analysis methodology

The analytical methods essentially follow the sequence of drivers identified in Fig. 1, but in reverse: 1) bioindicators are identified, 2) habitat conditions supporting those indicators are calculated, and 3) flow required to maintain those conditions are calculated. A good example on how this has been done in the past by is found in Palmer et al. (2016). Montagna will lead the first two, and Trungale the third.

2.1 Bioindicator identification: Analyses will be performed on three levels of biological organization, which is already well developed: 1) habitat (e.g., oyster reef, open bay bottom, and nekton), 2) community structure (e.g., infaunal benthos, epifaunal benthos, and nekton), and 3) key or indicator species. Key species are those deemed ecologically, commercially, or recreationally important (e.g., redfish, seatrout, flounder, blue crab, shrimp, etc.). Indicator species are those that are known to respond to inflow in their adult life stages, this includes primary suspension feeding benthos that are bivalve mollusks (e.g., eastern oyster Crassostrea, Rangia, Mulina, etc.), but also some crustaceans and polychaete worms. Oysters are one of the few species that are both key and indicator species. A mathematical technique to identify preferred salinity ranges was developed by Montagna (Montagna et al. 2002, 2008), which is used to identify indicator species. This method was later refined and is now called the MaxBin regression method (Turner and Montagna 2016). New indicator species will be identified using the MaxBin method.

2.2 Diversity indices (richness, Shannon H′, Hill's N1, and Pielou's J′) will be calculated. Community structure and habitat classification is identified using a non-metric multidimensional scaling (MDS) method. The similarities of species present in samples is calculated, and then a MDS plot is created using PRIMER-e software (Clarke and Gorely 2015). Community structure differences within the bay are highlighted using a cluster analysis.

2.3 Condition identification: Freshwater inflow drives changes in estuary condition, which includes salinity, nutrient concentrations, chlorophyll, and turbidity (Fig. 1). Thus, an indicator of water column condition as it relates to inflow can be calculated using multivariate analysis. Principal Components Analysis (PCA) is a variable reduction technique that the Montagna group has used to create a "freshwater inflow condition index" in many studies (Arismendez et al. 2009; Pollack et al. 2009, 2011; Palmer et al. 2011, 2016; Paudel and Montagna 2014).

2.4 Inflow identification: After the conditions that support bioindicators is determined using the two steps above, it is possible to calculate the inflow levels needed to maintain the conditions in an acceptable range. This approach has been used by the Nueces Basin and Bay Expert Science Team (Nueces Basin and Bay Expert Science Team 2011), the Trinity and San Jacinto Rivers and Galveston Bay Basin and Bay Expert Science Team BBEST (Trinity and San Jacinto Rivers and Galveston Bay Basin and Bay Expert Science Team BBEST 2009), and in Matagorda Bay (Anchor QEA et al. 2015) in their reports, and it has been used by the Montagna group to develop inflow criteria for the Caloosahatchee River estuary in Florida (Palmer et al. 2016). This analysis is based on non-linear regression, so it is also possible to calculate the bounds of error for the biological responses to inflow, as was done for the Caloosahatchee River.

2.5 Time series, autocorrelation, and confounding factors identification: The fundamental assumption when using long-term data is that changes over time in the drivers (i.e. freshwater inflow rates here) are affecting the response variables (i.e. the biological indicators here). However, there are several aspects of time series data that must be addressed because change of the response variables from one time step to the next is dependent on the preceding environmental conditions and community state. Thus, autocorrelation is a key factor in time series data. Additionally, biological responses are not necessarily instantaneous, and there are usually lags in response to change because of the life cycles and growth rates of the organisms effected. To examine and identify the time series, lag, and autocorrelation responses, we will use the multivariate autoregressive state space (MARSS) modeling framework (Holmes et al. 2012a, 2012b). This approach has been used successfully to identify flow needs to maintain fishery harvest in the Mekong River (Sabo et al. 2017), and has been used examine blue crab response to inflow in Mission-Aransas and Guadalupe Estuaries (Buskey et al. 2015). The multivariate technique can also be used to investigate the effects of other abiotic and biotic variables that could be driving the biological responses (Hampton et al. 2013). Confounding factors such as concentrations of toxic materials, low dissolved oxygen, or low pH can thus be identified as having a role in the response. In this way, we will identify response complexities, inter-connectedness, and factors that could confound the relationship between inflow and biological responses.

2.6 Event identification. The hydrology of estuaries is complex, but along the Texas central coast it is clearly driven by the periodic onset of large rain events associated by thunderstorms and seasonal disturbances (Montagna et al. 2011). The timing of these larger rain events co-occur during El Niño periods (Tolan 2007) and this is particularly true in Lavaca Bay (Pollack et al. 2011). Therefore, we will assess biological responses by wet, average, and

dry conditions. In the past, we have defined these by quartiles, i.e., low <25%, average is between 25 and 75%, and high is >75% (Palmer and Montagna 2015). For the current study we will use the definition in the RFQ and define low flow as <20%, high is >75%, and average is between 20% and 75%.

2.7 Linking inflow events and communities: Community structure will be linked with environmental variables using the non-metric multivariate BIO-ENV procedure calculated with PRIMER software (Clarke and Gorley 2015). The BIO-ENV procedure calculates weighted Spearman rank correlations (ρw) between sample ordinations from all of the environmental variables and an ordination of biotic variables. Correlations are then compared to determine the best match.

3. Interpretation and study recommendations

The point of this exercise is to create information from data that can be used to inform the adaptive management process of existing TCEQ freshwater inflow standards for Lavaca Bay. The results of the analyses will identify flows required to maintain the habitats, communities, and key species identified by this study. These results will be compared and contrasted with the adopted standards. Any contrast will be evaluated in the context of the standards to determine if changes should be pursued. These findings will be presented to the Colorado-Lavaca Basin and Bay Area Stakeholder Committee (CL-BBASC).

This study will also make recommendations in an area of on-going concern to the CL-BBASC stakeholders. If the study finds that changes to the recommended volume of seasonal freshwater inflows are warranted, then we will present an analysis of updated long-term frequency targets for both the "Modeled Annual Frequency," which is the long term attainment frequency based on the WAM that was in place when the rules were adopted and is the target from a water rights permitting perspective, and the "Annual Strategy Frequency," which is derived based on historical inflows and is intended to be a goal from an environmental protection viewpoint. To the extent possible, the authors will provide a qualitative discussion of the implications of potential changes to both the magnitudes and frequencies of recommended freshwater inflows.

Additionally, the study will include recommendations related to monitoring and adaptive management. An adaptive management plan should address three issues consistent with Fig. 1. First, a determination as to whether the recommended flows occur at acceptable frequencies both from a long-term perspective, based on WAM simulations, and short-term perspective, based on TxBLEND inflows derived from recent gage data. Second, the study will recommend a monitoring framework to assess whether the recommended flows produce conditions (primarily salinity but may include other constituents) that the studies have predicted. This may include a

recommendation for deployment of salinity sondes at appropriate spatial scales, densities, and for sufficient time periods. Third, the efficacy of the recommendations will ultimately be assessed based on how the ecological health the system responds over the long term. We will recommend appropriate biological indicators that should be monitored to allow for this determination.

4. Meetings

A minimum of two meetings are planned: 1) a project initiation meeting where we will discuss the project methodology and technical approach, 2) near completion, a final report of the project findings, and a formal presentation on the results. It is anticipated that members of the TWDB and Colorado-Lavaca BBASC will attend both meetings. The meeting time and venue will be established with consultation with the TWDB and BBASC. Additional technical meetings may be scheduled to discuss project progress and issues.

5. Deliverables

1. Quarterly Progress reports, no more than 30 days following each State fiscal quarter: 1 September - 30 November, 1 December - 28 February, 1 March - 31 May, and 1 June - 31 August (Table 1).

2. Draft Report by 31 October 2019. The Draft Report will include figures and tables to illustrate the effects of freshwater inflow on benthos over the entire study period and will include introduction, methods, results, and discussion sections.

3. Final Report with revisions as requested by TWDB within 30 days of receiving comments. The Final report will be accompanied by a transmittal letter as well as an electronic copy of the raw data collected as part of this study and is due 31 December 2019. All products, and metadata, used in the study will be provided to the TWDB. Data will be provided as *.txt files, maps will be provided as *.tiff files with the associated GIS shapefiles. All analysis programming code used in the study will be provided as electronic .txt files.

4. Oral reports to Colorado-Lavaca BBASC and the TWDB. Two are anticipated: 1) An initial and report on the project plan within 45 days of project initiation. 2) Meeting to report findings within 60 days of the project end date.

5. All data to accompany the Final Report.

References

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Trinity and San Jacinto Rivers and Galveston Bay Basin and Bay Expert Science Team. 2009. Environmental Flows Recommendation Report. https://www.tceq.texas.gov/assets/public/permitting/watersupply/water_r

ights/eflows/trinity_sanjacinto_bbestrecommendationsreport.pdf
Tolan, J. 2007. El Niño-Southern Oscillation impacts translated to the watershed scale: estuarine salinity patterns along the Texas Gulf Coast, 1982 to 2004. *Estuarine Coastal Shelf Science* 72: 247–260.
Turner, E.L., D.A. Bruesewitz, R.F. Mooney, P.A. Montagna, J.W. McClelland, A. Sadovski, E.J. Buskey. 2014. Comparing performance of five nutrient phytoplankton zooplankton (NPZ) models in coastal lagoons. *Ecological Modelling* 277: 13–26.
Turner, E.L. and P.A. Montagna. 2016. The max bin regression method to identify maximum bioindicators responses to ecological drivers. *Ecological Informatics* 36:118–125.
Van Diggelen, A.D. and P.A. Montagna. 2016. Is salinity variability a benthic disturbance in estuaries? *Estuaries and Coasts* 39:967-980.

Exhibit B
Task and Expense Budgets

TASK BUDGET

TASK	DESCRIPTION	AMOUNT
1	Assessment of the relationship between freshwater inflow and biological indicators in Lavaca Bay	$75,000.00
TOTAL		**$75,000.00**

EXPENSE BUDGET

CATEGORY	CONTRACTOR
Salaries & Wages[1]	$24,485.00
Fringe[2]	$5,606.00
Travel[3]	$465.00
Other Expenses[4]	$0
Subcontract Services	$25,000.00
Overhead/Indirect[5]	$19,444.00
Profit	$0
TOTAL	**$75,000.00**

[1] Salaries and Wages is defined as the cost of salaries of engineers, draftsmen, stenographers, surveymen, clerks, laborers, etc., for time directly chargeable to this CONTRACT.
[2] Fringe is defined as the cost of social security contributions, unemployment, excise, and payroll taxes, workers' compensation insurance, retirement benefits, medical and insurance benefits, sick leave, vacation, and holiday pay applicable thereto.
[3] Travel is limited to the maximum amounts authorized for state employees by the General Appropriations Act, Tex. Leg. Regular Session, 2017, Article IX, Part 5, as amended or superseded
[4] Other Expenses is defined to include expendable supplies, communications, reproduction, postage, and costs of public meetings directly chargeable to this CONTRACT.
[5] Overhead is defined as the costs incurred in maintaining a place of business and performing professional services similar to those specified in this CONTRACT. NOTE; Overhead/Indirect will not be reimbursed when a CONTRACT is awarded in a non-competitive process.

EXHIBIT C

Draft and Final Report Requirements

1. The TAMUCC will complete the Scope of Work and will deliver four (4) double-sided copies of a draft final report to the TWDB no later than the sixty (60) days prior to the expiration date of this CONTRACT. The draft final report will include the scope of work; a description of the research performed; the methodology and materials used; any diagrams or graphics used to explain the procedures related to the study; any data collected; an electronic copy of any computer programs, maps, or models along with an operations manual and any sample data set(s) developed under the terms of this CONTRACT; analysis of the research results; conclusions and recommendations; a list of references, a Table of Contents, List of Figures, List of Tables, an Executive Summary, and any other pertinent information. After a 30-day review period, the TWDB will return review comments to the TAMUCC.

2. The TAMUCC will consider incorporating comments from the TWDB and other commenters on the draft final report into a final report. The TAMUCC will include a copy of the TWDB's comments in the final report. The TAMUCC will submit one (1) electronic copy of the entire Final Report in Portable Document Format (PDF) and six (6) bound double-sided copies of the final report to the TWDB no later than the expiration date of the CONTRACT. The TAMUCC will also submit one (1) electronic copy of any computer programs or models and an operations manual developed under the terms of this CONTRACT. In compliance with Texas Administrative Code Chapters 206 and 213 (related to Accessibility and Usability of State Web Sites), the digital copy of the final report will comply with the requirements and standards specified in statute. After a 30-day review period, the TWDB will either accept or reject the final report. If the final report is rejected, the rejection letter sent to the TAMUCC shall state the reasons for rejection and the steps the TAMUCC plans to take to have the final report accepted.

3. The TAMUCC will submit a brief progress report with submittal of payments according to Exhibit D, Reimbursement Requirements. Progress reports shall be in written form and shall include a brief statement of the overall progress made since the last status report; a brief description of any problems that have been encountered during the previous reporting period that will affect the study, delay the timely completion of any portion of this CONTRACT, inhibit the completion of or cause a change in any of the study's products or objectives; and a description of any action the TAMUCC plans to take to correct any problems that have been encountered.

GUIDELINES FOR AUTHORS SUBMITTING CONTRACT REPORTS TO THE TEXAS WATER DEVELOPMENT BOARD

1.0 Introduction

The purpose of this document is to describe the required format of contract reports submitted to the Texas Water Development Board (TWDB). Our reason for standardizing the format of contract reports is to provide our customers a consistent, and therefore familiar, format for contract reports (which we post online for public access). Another reason for standardizing the format is so that we can more easily turn a contract report into a TWDB numbered report if we so choose. Remember that your report will not only be seen by TWDB staff, but also by any person interested in the results of your study. A professional and high quality report will reflect well on you, your employer, and the TWDB.

Available upon request, we will provide a Microsoft Word template (used to write these instructions) that gives the fonts, spacing, and other specifications for the headings and text of the report. Please follow this template as closely as possible.

2.0 Formatting your report

The TWDB format is designed for simplicity. For example, we use Times New Roman for all text. We use 12 point, single-spaced text, left justification for paragraph text, 18 point bold for first-level headings, and 14 point bold for second-level headings. Page numbers are centered at the bottom of the page. Other than page numbers, please refrain from adding content to the document header or footer. Page setup should use one-inch margins on all four sides.

2.1 Text

The best way to format your document is to use the styles described and embedded in the template document (Authors_Template.dot) that is available on request from the TWDB. To use the Authors_Template.dot file, open it in Word (make sure *.dot is listed under Files of type) and save it as a .doc file. Advanced users can add the .dot file to their computers as a template. Make sure the formatting bar is on the desktop (to open, go to View→Toolbars→Formatting) or, to view all of the formatting at once, go to Format→Styles and Formatting and select Available Styles from the dropdown box at the bottom of the window. The formatting in the template document provides styles (such as font type, spacing, and indents) for each piece of your report. Each style is named to describe what it should be used for (for example, style names include Chapter Title, Body Text, Heading 1, References, and Figure or Table Caption). As you add to your report, use the dropdown list on the Formatting Toolbar or the list in the Styles and Formatting window to adjust the text to the correct style. The Authors_Template.dot file shows and lists the specifications for each style.

2.1.1 Title

Give your report a title that gives the reader an idea of the topic of your report but is not terribly long. In addition to the general subject (for example, "Droughts"), you may include a few additional words to describe a place, methodology, or other detail focused on throughout the paper (for example, "Droughts in the High Plains of Texas" or "Evaluating the effects of drought using groundwater flow modeling"). Please capitalize only the first letter of each word except 'minor' words such as 'and' and 'of'. Never use all caps.

Use headings to help the reader follow you through the main sections of your report and to make it easier for readers to skim through your report to find sections that might be the most interesting or useful to them. The text of the report should include an executive summary and sections outlined in 4.4 of Attachment 1. Headings for up to five levels of subdivision are provided in the template; however, we suggest not using more than three or four levels of subdivision except where absolutely necessary. Please avoid stacked headings (for example, a Heading 1 followed immediately by a Heading 2) and capitalize only the first letter of headings or words where appropriate—never use all caps.

2.2 Figures and photographs

To publish professional-looking graphics, **we need all originals to be saved at 300 dots-per-inch** (dpi) and in grayscale, if possible, or in the CMYK color format if color is necessary. Excessive use of color, especially color graphics that do not also work in grayscale, will prevent us from publishing your report as a TWDB numbered report (color reproduction costs can be prohibitive). Preferred file formats for your original graphics are Adobe Illustrator (.ai), Photoshop (.psd), EPS with .tiff preview, .jpg, .png, or .tiff files. Refrain from using low resolution .jpg or .gif files. Internet images at 72 dpi are unacceptable for use in reports.
All graphics shall be submitted in two forms:

1. Inserted into the Microsoft Word document before you submit your report. Ideally, inserted graphics should be centered on the page. Format the picture to downsize to 6 inches wide if necessary. Please do not upsize a graphic in Word.

Saved in one of the formats listed above.

2.2.1 Other graphics specifications

It is easiest to design your figures separately and add them in after the text of your report is more or less complete. Graphics should remain within the 1-inch page margins of the template (6.5 inches maximum graphic width). Be sure that the graphics (as well as tables) are numbered in the same order that they are mentioned in the text. Figures should appear embedded in the report after being called out in the text. Also, remember to include a caption for each graphic in Word, not as part of the graphic. We are not able to edit or format figure captions that are part of the figure. For figures and photographs, the caption should appear below the graphic. For tables, the caption should appear above.

2.2.2 Creating publication-quality graphics

When designing a graphic, make sure that the graphic (1) emphasizes the important information and does not show unnecessary data, lines, or labels; (2) includes the needed support material for the reader to understand what you are showing; and (3) is readable (see Figures 1 and 2 for examples). Edward R. Tufte's books on presenting information (Tufte, 1983; 1990; 1997) are great references on good graphic design. Figures 1 through 3 are examples of properly formatted, easy to understand graphics. Do not include fonts that are less than 6 points.
For good-looking graphics, the resolution needs to be high enough to provide a clear image at the size you make them within the report. In general, 300 dpi will make a clear image—200 dpi is a minimum. Try to create your figures at the same size they will be in the report, as resizing them in Word greatly reduces image quality. Photographs taken with at least a two-megapixel camera (if

using digital) and with good contrast will make the best images. Save the original, and then adjust color levels and size in a renamed image copy. Print a draft copy of your report to double-check that your figures and photographs have clear lines and show all the features that you want them to have.

Figures and photographs should be in grayscale. Color greatly adds to the cost of printing, so we are trying to keep it to a minimum. Also remember that your report may be photocopied, scanned, or downloaded and printed in black and white. For this reason, you should use symbols or patterns, or make sure that colors print as different shades in black and white. All interval or ratio data (data measuring continuous phenomena, with each color representing an equal interval) need to be displayed in a graded scale of a single color (Figure 3). This way your figures will be useful even as a photocopy.

If you need help with your graphics or have questions, please contact the TWDB graphics department at (512) 936-0129.

2.2.3 Using other people's graphics

Figures and photographs (and tables) need to be your own unless you have written permission from the publisher that allows us to reprint them (we will need a copy of this permission for our records). Avoid using any figures or photographs taken off the Internet or from newspapers or magazines—these sources are difficult to cite, and it is often time-consuming and expensive to gain permission to reproduce them.

2.3 Tables

Tables should be created in Microsoft Word (see Table 1). Tables should include a minimal amount of outlining or bold font to emphasize headings, totals, or other important points. Tables should be numbered separately from figures, and captions should appear above the text of the table.

Table 1: A sample table. Note caption above table.

	Table text heading*						
Table text	1940	1950	1960	1970	1980	1990	2000	%GW
Table text	15	441	340	926	196	522	83	97.4
Table text	64	944	626	173	356	171	516	99.9
Total	79	1385	966	1099	552	693	599	

* A footnote should look like this using 10 point Times New Roman.
%GW = percent groundwater
Be sure to describe any abbreviations or symbols, and, unlike in this table, be sure to note the units!

3.0 Units

Measurements should be in English units. Metric units may be included in parentheses after the English units.

All units of geologic time should conform to the most recent geologic timescale (Gradstein and others, 2004). A summary of this timescale is available from the International Commission on Stratigraphy's website at http://stratigraphy.org/chus.pdf.

4.0 Citations and references

It is important to give credit where credit is due. Therefore, be sure to use the appropriate citations and include references in your paper.

4.1 In-text citations

Each piece of information you use in your report that comes from an outside source must be cited within the text using the author's last name and the year of publication. If there are two authors, list the last name of each followed by the year, and if there are more than two authors, list the last name of the first author followed by "and others" and the year. For example: the end of the Jurassic Period occurred approximately 145.5 million years ago (Gradstein and others, 2004).

4.2 References

All sources that are cited within the report should be listed at the end of the paper under the heading References. The references should follow the guidelines in "Suggestions to Authors of the Reports of the United States Geological Survey" (Hansen, 1991). These are available online at http://www.nwrc.usgs.gov/lib/lib_sta.html (a link to the chapter "Preparing references for Survey reports," p. 234-241, is found here). Several examples of complete reference citations are listed at the end of these guidelines. Be sure that any citations that appear in tables or figures are included in the reference list. Also, before submitting the report, please check that all the citations in the report are included in the reference list and all references in the reference list are cited in the report. If at all possible, avoid web-based citations. These materials are often transient and therefore useless to future readers.

5.0 Submitting your report

Before you submit your report, proofread it. Look for spelling and grammatical errors. Also, check to see that you have structured the headings, paragraphs, and sentences in your paper so that it is easy to follow and understand (imagine you are a reader who does not already know the information you are presenting!).

6.0 Conclusions

Following the instructions above and providing accurate and readable text, tables, figures, and citations will help to make your report useful to readers. Scientists may read your report, as well as water planners, utility providers, and interested citizens. If your report successfully conveys accurate scientific information and explanations to these readers, we can help to create more informed decisions about the use, development, and management of water in the state.

7.0 Acknowledgments

Be sure to acknowledge the people and entities that assisted you in your study and report. For example:

We would like to thank the Keck Geology Consortium, the American Society of Civil Engineers, and the Texas Bar CLE for providing examples to use in developing these guidelines. In addition, we

appreciate Mike Parcher for providing information on how to create publication-quality graphics, Shirley Wade for creating the data used in sample Figure 1, and Ian Jones for providing sample Figure 3.

8.0 References

Gradstein, F.M., J.G. Ogg, and A.G. Smith, eds., 2005, A geologic time scale 2004: Cambridge, Cambridge University Press, 610 p.

Hansen, W.R., ed., 1991, Suggestions to authors of the reports of the United States Geological Survey (7th ed.): Washington, D.C., U.S. Government Printing Office, 289 p.

Tufte, E. R., 1983, The visual display of quantitative information: Cheshire, C.T., Graphics Press, 197 p.

Tufte, E. R., 1990, Envisioning information: Cheshire, C.T., Graphics Press, 126 p.

Tufte, E. R., 1997, Visual explanations: Cheshire, C.T., Graphics Press, 156 p.

9.0 Examples of references

Arroyo, J. A., and Mullican, III, W. F., 2004, Desalination: *in* Mace, R. E., Angle, E. S., and Mullican, W. F., III, editors, Aquifers of the Edwards Plateau: Texas Water Development Board Report 360, p. 293-302.

Bates, R. L., and Jackson, J. A., 1984, Dictionary of geological terms: Anchor Press/Doubleday, Garden City, New York, 571 p.

Blandford, T. N., Blazer, D. J., Calhoun, K. C., Dutton, A. R., Naing, T., Reedy, R. C., and Scanlon, B. R., 2003, Groundwater availability of the southern Ogallala aquifer in Texas and New Mexico–Numerical simulations through 2050: contract report by Daniel B. Stephens and Associates, Inc., and the Bureau of Economic Geology, The University of Texas at Austin to the Texas Water Development Board, variably paginated.

Fenneman, N. M., 1931, Physiography of Western United States (1st edition): New York, McGraw-Hill, 534 p.

Hubert, M., 1999, Senate Bill 1–The first big bold step toward meeting Texas's future water needs: Texas Tech Law Review, v. 30, no. 1, p. 53-70.

Kunianski, E. L., 1989, Precipitation, streamflow, and baseflow in West-Central Texas, December 1974 through March 1977: U. S. Geological Survey Water-Resources Investigations Report 89-4208, 2 sheets.

Mace, R. E., Chowdhury, A. H., Anaya, R., and Way, S.-C., 2000, A numerical groundwater flow model of the Upper and Middle Trinity aquifer, Hill Country area: Texas Water Development Board Open File Report 00-02, 62 p.

Maclay, R. W., and Land, L. F., 1988, Simulation of flow in the Edwards aquifer, San Antonio Region, Texas, and refinements of storage and flow concepts: U. S. Geological Survey Water-Supply Paper 2336, 48 p.

For more examples of references, see p. 239-241 of "Suggestions to Authors of the Reports of the United States Geological Survey" at http://www.nwrc.usgs.gov/lib/lib_sta.html.

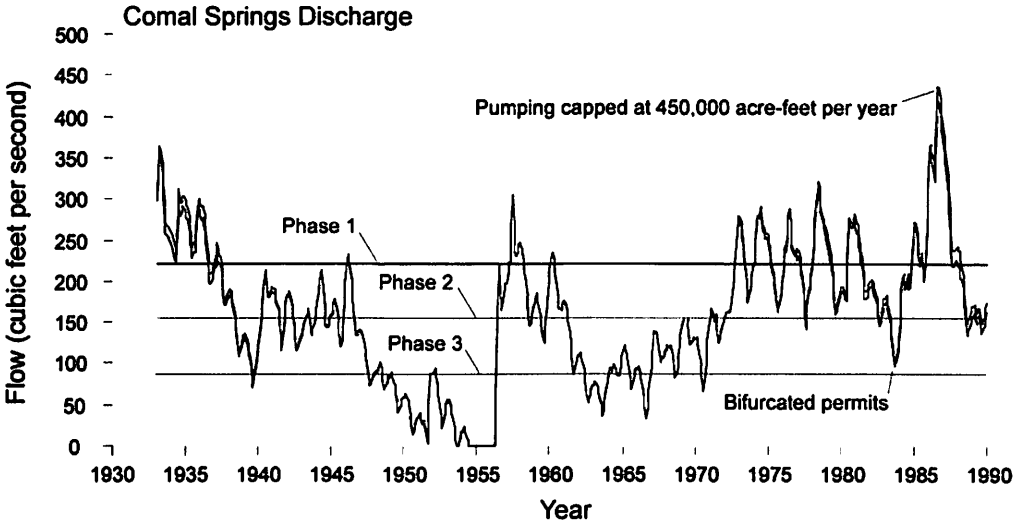

Figure 1. A sample figure showing only the information needed to help the reader understand the data. Font size for figure callouts or labels should never be less than 6 point.

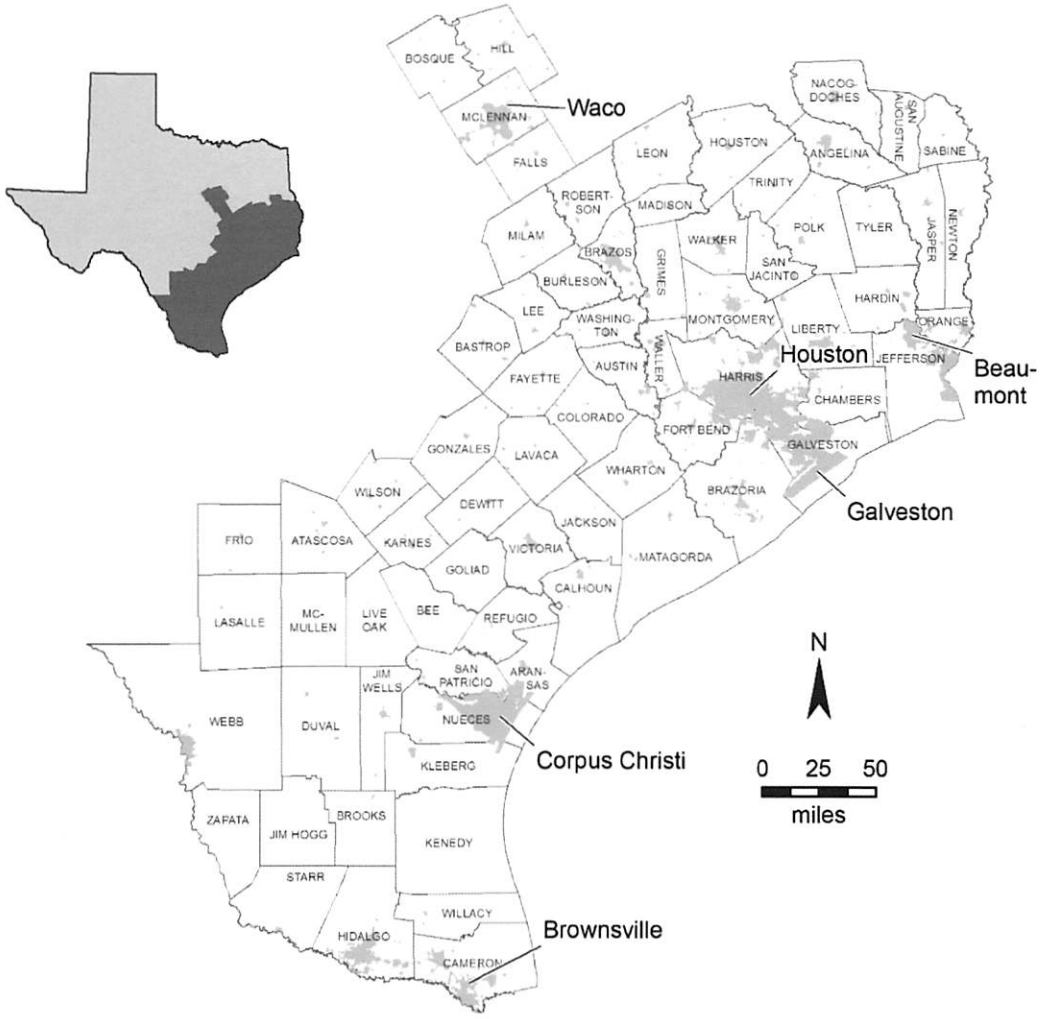

Figure 2. A sample subject area map, giving the reader enough information to understand the location being discussed in this conference. For map figures, be sure to include a north arrow to orient the reader, a scale, and, if needed, a submap that places the figure in greater geographic context. Be sure that text is readable and that any citations listed on the figure or in the figure caption are included in the reference list. Font size should never be less than 6 pt.

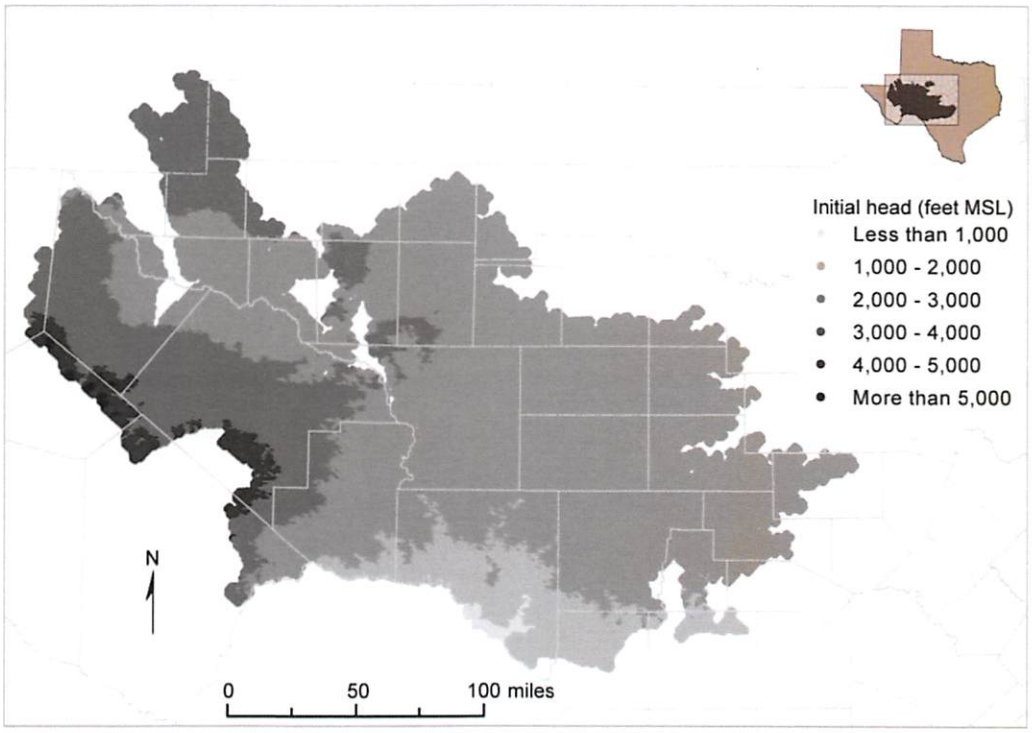

Figure 3. Initial hydraulic heads used in model simulations for layer 1. Note the use of grayscale shading to show differences.

EXHIBIT D

TWDB Guidelines for a Progress Report

Texas Water Development Board Contractors are required by their contracts to provide Progress Reports usually with the submission of an invoice/payment request.

The progress report should contain the following standard elements:

- Date: Date the memo is sent
- To: Name and position of the reader
- From: Name and position of the writer
- Subject: TWDB Contract Number and a clear phrase that focuses the reader's attention on the subject of the memo

Work Completed: *(The next section of a progress report explains what work has been done during the reporting period. Specify the dates of the reporting period and use active voice verbs to give the impression that you or you and your team have been busy). For Example:*

Task 1: Completed 3 draft chapters and all appendices. Met with sub consultants on their chapters.
Task 2: Completed sample collection throughout river reach.
Task 3: No work completed in reporting period.

Problems:
If the reader is likely to be interested in the glitches you have encountered along the way, mention the problems you have encountered and explain how you have solved them. If there are problems you have not yet been able to solve, explain your strategy for solving them and give tell the reader when you think you will have them solved.

EXHIBIT E

Reimbursement Requirements

1. The TAMUCC shall submit payments and documentation for reimbursement billing according to the SECTION IV, PAYMENT FOR SERVICING and in accordance with the approved task and expense budgets contained in Exhibit C to this CONTRACT. The TAMUCC has budget flexibility within task and expense budget categories to the extent that the resulting change in amount in any one task or expense category does not exceed 35% of the total authorized amount by this CONTRACT for the task or category. Larger deviations shall require approval by executive administrator or designee which will be documented through an Approved Budget Memorandum to the TWDB contract file. The TAMUCC will be required to provide written explanation for the overage and reallocation of the task and expense amount.

   For all reimbursement billings including any subcontractor's expenses, the executive administrator must have determined that the required interlocal agreement and contracts or agreements between the TAMUCC and the subcontractor are consistent with the terms of this CONTRACT. The TAMUCC is fully responsible for paying all charges by subcontractors prior to reimbursement by the TWDB.

2. The TAMUCC and its subcontractors shall maintain satisfactory financial accounting documents and records, including copies of invoices and receipts, and shall make them available for examination and audit by the executive administrator. Accounting by the TAMUCC and its subcontractors shall be in a manner consistent with Generally Accepted Accounting Principles.

3. By executing this CONTRACT, the TAMUCC accepts the authority of the State Auditor's Office, under direction of the legislative audit committee, to conduct audits and investigations in connection with any and all state funds received pursuant to this CONTRACT. The TAMUCC shall comply with and cooperate in any such investigation or audit. The TAMUCC agrees to provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit. The TAMUCC also agrees to include a provision in any subcontract related to this CONTRACT that requires the subcontractor to submit to audits and investigation by the State Auditor's Office in connection with any and all state funds received pursuant to the subcontract.

The CONTRACTOR shall submit a signed and completed payment request using the current spreadsheet located at: : http://www.twdb.texas.gov/about/contract_admin/index.asp or you can contact Contracts@twdb.texas.gov for a personalized payment request

spreadsheet and along with a progress report as described in Article II, Item 3.

In addition, the following documentation which documents the TOTAL STUDY COSTS for the reporting period even if the TOTAL STUDY COSTS are zero for reimbursement by the TWDB to the CONTRACTOR for the TWDB's SHARE OF THE TOTAL STUDY COSTS shall be submitted by the CONTRACTOR to the EXECUTIVE ADMINISTRATOR for reimbursement billing:

A. A completed "Current Reimbursement Worksheet" Payment Request Checklist tab, or an invoice which includes the following information:
   (1) TWDB Contract Number;
   (2) Billing period; beginning (date) to ending (date);
   (3) Total Expenses for this period;
   (4) Total In-kind services, if applicable;
   (5) Less Local Share of the total study costs for the billing period, if applicable;
   (6) Total TWDB's share of the total study costs for the billing period;
   (7) Total costs to be reimbursed by the TWDB for the billing period; and
   (8) Certification, signed by the CONTRACTOR authorized representative, that the expenses submitted for the billing period are a true and correct representation of amounts paid for work performed directly related to this CONTRACT.

B. Using the "Current Reimbursement" Worksheet, post all expenses for the period on the Invoice Ledger tab and Task Ledger tab for direct expenses incurred by the CONTRACTOR.
   (1) Salaries and Wages, Fringe, Overhead, and Profit.
   (2) Other Expenses: Copies of detailed, itemized invoices/receipts for other expenses (credit card summary receipts or statements are not acceptable).
   (3) Travel Expenses: Names, dates, work locations, time periods at work locations, itemization of subsistence expenses of each employee, limited, however, to travel expenses authorized for state employees by the General Appropriations Act, Tex. Leg. Regular Session, 2015, Article IX, Part 5, as amended or superceded. Receipts required for lodging; as well as copies of invoices or tickets for transportation costs or, if not available, names, dates, and points of travel of individuals.

C. Using the "Current Reimbursement" Worksheet, post all expenses for the period on the Invoice Ledger tab and Task Ledger tab for direct expenses incurred by all subcontractors.

(1) Salaries and Wages, Fringe, Overhead, and Profit.
(2) Other Expenses: Copies of detailed, itemized invoices/receipts for other expenses (credit card summary receipts or statements are not acceptable).
(3) Travel Expenses: Names, dates, work locations, time periods at work locations, itemization of subsistence expenses of each employee, limited, however, to travel expenses authorized for state employees by the General Appropriations Act, Tex. Leg. Regular Session, 2015, Article IX, Part 5, as amended or superceded. Receipts required for lodging; as well as copies of invoices or tickets for transportation costs or, if not available, names, dates, and points of travel of individuals.

4. Incomplete requests will be returned to the TAMUCC if deficiencies are not resolved within ten (10) business days.

5. If for some reason the reimbursement request cannot be processed due to the need for an amendment to the CONTRACT, the TAMUCC will be required to resubmit the Payment Request Checklist dated after the execution of the amendment.

6. The TAMUCC is responsible for any food or entertainment expenses incurred by its own organization or that of its subcontractors, outside that of the travel expenses authorized and approved by the State of Texas under this CONTRACT.

7. The TAMUCC is responsible for submitting any final payment request and documentation for reimbursement, along with a request to release any retained funds, no later than 120 days following the expiration date as described in SECTION V of this CONTRACT.

8. Failure to submit a timely final payment request may result in TWDB not releasing the retained funds to the TAMUCC and a lapse and closure of any other remaining funding under this CONTRACT.