STATE OF TEXAS TWDB Contract No. 1600011952

COUNTY OF TRAVIS General Revenue
LBG-GUYTON ASSOCIATES

This Contract, (hereinafter "CONTRACT"), between the Texas Water Development Board (hereinafter "TWDB") and **LBG-GUYTON ASSOCIATES** (hereinafter "CONTRACTOR"), is composed of two parts, SECTION I. SPECIFIC CONDITIONS AND EXCEPTIONS TO THE STANDARD AGREEMENT and SECTION II. STANDARD AGREEMENT. The terms and conditions set forth in SECTION I will take precedence over terms and conditions in SECTION II.

SECTION I. SPECIFIC CONDITIONS AND EXCEPTIONS TO STANDARD AGREEMENT

ARTICLE l. DEFINITIONS

For the purposes of this CONTRACT, the following terms or phrases shall have the meaning ascribed therewith:

1. TWDB – The Texas Water Development Board, or its designated representative

2. CONTRACTOR – LBG-GUYTON ASSOCIATES

3. EXECUTIVE ADMINISTRATOR – The Executive Administrator of the TWDB or a designated representative

4. PARTICIPANT(S) – The University of Texas at Austin and Collier Consulting, Inc.

5. REQUIRED INTERLOCAL AGREEMENT(S) – None

6. RESEARCH PROJECT – Identification of Potential Brackish Groundwater Production Areas – Nacatoch Aquifer

7. TWDB APPROVAL DATE – January 6, 2016

8. DEADLINE FOR CONTRACT EXECUTION – N/A

9. CONTRACT INITIATION DATE – January 6, 2016

10. DEADLINE FOR IDENTIFICATION OF POTENTIAL BRACKISH GROUNDWATER

PRODUCTION AREAS: CONTRACTOR to provide a minimum of one-month advance notice to TWDB staff to setup and prepare for the meeting.

11. STUDY COMPLETION DATE – May 31, 2017

12. CONTRACT EXPIRATION DATE – August 31, 2017 (90 days after Study Completion Date)

13. TOTAL STUDY COSTS – $150,000.00

14. TWDB SHARE OF THE TOTAL STUDY COSTS – the lesser of $150,000.00 or 100.00 percent of the total study costs or individual payment submission

15. LOCAL SHARE OF THE TOTAL STUDY COSTS – $0 in cash or 0 percent of the total study costs or individual payment submission

16. PAYMENT SUBMISSION SCHEDULE – Monthly

17. OTHER SPECIAL CONDITIONS AND EXCEPTIONS TO STANDARD AGREEMENT OF THIS CONTRACT – See below

    a. Conflict of Interest: The CONTRACTOR agrees that it will not be involved in any new or existing contracts with persons or entities other than TWDB and regional water planning groups for brackish groundwater supply and availability studies involving the geographical study area of this CONTRACT (as detailed in Exhibit A and Exhibit I) while conducting the work required under this TWDB Contract without a prior no conflict of interest determination and written authorization by TWDB.

SECTION II. STANDARD AGREEMENT

ARTICLE I. RECITALS

Whereas, on TWDB APPROVAL DATE, the TWDB considered providing the CONTRACTOR a grant to conduct a RESEARCH PROJECT;

Whereas, the CONTRACTOR and PARTICIPANT will commit the LOCAL SHARE OF THE TOTAL STUDY COSTS, if applicable, in cash and/or in-kind services to pay for the LOCAL SHARE OF THE TOTAL STUDY COSTS of this RESEARCH PROJECT;

Whereas, the CONTRACTOR is the entity who will act as administrator of the TWDB's research grant and will be responsible for the execution of this contract;

Whereas, on the TWDB APPROVAL DATE, the TWDB approved a research grant to the CONTRACTOR;

Now, therefore, the TWDB and the CONTRACTOR, agree as follows:

ARTICLE II. PROJECT DESCRIPTION AND SERVICES TO BE PERFORMED

1. The TWDB enters into this CONTRACT pursuant to Water Code §16.012; Exhibit A, the original grant application, and Exhibit I, the original request for qualifications, which is incorporated herein and made a permanent part of this CONTRACT; and this CONTRACT.

2. The CONTRACTOR will conduct a RESEARCH PROJECT, as delineated and described in Exhibit A and Exhibit I, according to the Scope of Work contained in Exhibit B.

3. A progress report, including results to date, will be provided to the EXECUTIVE ADMINISTRATOR monthly, throughout the project. Special interim reports on special topics and/or results will be provided as appropriate. Instructions for the progress report are shown in Exhibit E, TWDB Guidelines for a Progress Report.

ARTICLE III. CONTRACT TERM, SCHEDULE, REPORTS, AND OTHER PRODUCTS

1. The CONTRACTOR has until the DEADLINE FOR CONTRACT EXECUTION to execute this CONTRACT and to provide acceptable evidence of any REQUIRED INTERLOCAL AGREEMENT(S) and the CONTRACTOR’s ability to provide the LOCAL SHARE OF THE TOTAL STUDY COSTS, if applicable, to the EXECUTIVE ADMINISTRATOR for approval or the TWDB's SHARE OF THE TOTAL STUDY COSTS will be rescinded.

2. The term of this CONTRACT shall begin and the CONTRACTOR shall begin performing its obligations hereunder on the CONTRACT INITIATION DATE and shall expire on the CONTRACT EXPIRATION DATE. Delivery of an acceptable final report prior to the CONTRACT EXPIRATION DATE shall constitute completion of the terms of this CONTRACT.

3. The CONTRACTOR will complete the Scope of Work and will deliver seven (7) double-sided copies of a draft final report to the EXECUTIVE ADMINISTRATOR no later than the STUDY COMPLETION DATE. 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 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. Each report shall have an authorship list of persons responsible for the studies: firm or agency names as authors are not acceptable. The reports shall be sealed as required by Texas Occupation Code, Title 6, Chapter 1002. All final reports should be prepared according to Exhibit D, Guidelines for Authors Submitting Contract Reports to the Texas Water Development Board, Exhibit G, Contract Data Requirements, and Exhibit H, Outline for Reports. After a 30-day review period, the EXECUTIVE ADMINISTRATOR will return review comments to the CONTRACTOR.

4. The CONTRACTOR will consider incorporating comments from the EXECUTIVE ADMINISTRATOR and other commenters on the draft final report into a final report. The CONTRACTOR will include a copy of the EXECUTIVE ADMINISTRATOR's comments in the final report. The CONTRACTOR will submit one (1) electronic copy of the entire final report in Portable Document Format (PDF) and seven (7) bound double-sided copies of the final report to the EXECUTIVE ADMINISTRATOR no later than sixty (60) days after the STUDY COMPLETION DATE. The CONTRACTOR will submit one (1) electronic copy of any computer programs or models 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 EXECUTIVE ADMINISTRATOR will either accept or reject the final report. If the final report is rejected, the rejection letter sent to the CONTRACTOR shall state the reasons for rejection and the steps the CONTRACTOR need to take to have the final report accepted and the retainage released.

5. The CONTRACTOR will submit the most recent progress report with submittal of payments according to the PAYMENT SUBMISSION SCHEDULE. 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 CONTRACTOR plans to take to correct any problems that have been encountered.

6. The EXECUTIVE ADMINISTRATOR cannot extend the STUDY COMPLETION DATE or the CONTRACT EXPIRATION DATE. The CONTRACTOR shall notify the EXECUTIVE ADMINISTRATOR in writing and the CONTRACT MANAGER in person immediately if any problems encountered during the study will delay the timely completion of any portion of this CONTRACT.

ARTICLE IV. COMPENSATION AND REIMBURSEMENT

1. The TWDB agrees to compensate and reimburse the CONTRACTOR in a total amount not to exceed the TWDB's SHARE OF THE TOTAL STUDY COSTS for costs incurred and paid by the CONTRACTOR pursuant to performance of this CONTRACT. The CONTRACTOR will contribute local matching funds, if applicable, in sources and amounts defined as the LOCAL SHARE OF THE TOTAL STUDY COSTS. The TWDB shall reimburse the CONTRACTOR for ninety percent (90%) of the TWDB's share of each invoice pending the CONTRACTOR’s performance, completion of a Final Report, and written acceptance of said Final Report by the EXECUTIVE ADMINISTRATOR, at which time the TWDB shall pay the retained ten percent (10%) to the CONTRACTOR.

2. The CONTRACTOR shall submit payments and documentation for reimbursement billing according to the PAYMENT SUBMISSION SCHEDULE and in accordance with the approved task and expense budgets contained in Exhibit C to this CONTRACT. The CONTRACTOR 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 CONTRACTOR 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(S) and contracts or agreements between the CONTRACTOR and the subcontractor are consistent with the terms of this CONTRACT. The CONTRACTOR is fully responsible for paying all charges by subcontractors prior to reimbursement by the TWDB.

3. The CONTRACTOR 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 CONTRACTOR and its subcontractors shall be in a manner consistent with Generally Accepted Accounting Principles.

4. By executing this CONTRACT, the CONTRACTOR 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 CONTRACTOR shall comply with and cooperate in any such investigation or audit. The CONTRACTOR agrees to provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit. The CONTRACTOR 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.

5. The CONTRACTOR shall submit a progress report as described in Article II, Item 3 and the following documentation which documents the TOTAL STUDY COSTS for the reporting period even if the TOTAL STUDY COSTS is 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. Completed and Signed Payment Request Checklist which includes the following:
   (1) TWDB CONTRACT Number;
   (2) Billing period; beginning (date) to ending (date);
   (3) Total Expenses for this period;
   (4) Total In-kind services;
   (5) Less LOCAL SHARE OF THE TOTAL STUDY COSTS for the billing period;
   (6) Total TWDB's SHARE OF THE TOTAL STUDY COSTS for the billing period;
   (7) Amount of retainage to be withheld for the billing period;
   (8) Total costs to be reimbursed by the TWDB for the billing period; and
   (9) Certification, signed by the CONTRACTOR’s 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. For direct expenses incurred by the CONTRACTOR other than subcontracted work:
   (1) A spreadsheet showing the tasks that were performed; the percent and cost of each task completed; a total cost figure for each direct expense category including labor, fringe, overhead, travel, and other expenses such as communication and postage, technical and computer services, expendable supplies, printing and reproduction; and
   (2) Copies of detailed, itemized invoices/receipts for other expenses (credit card summary receipts or statements are not acceptable)

C. For direct expenses incurred by the CONTRACTOR for subcontracted work:
   (1) Copies of invoices from the subcontractors to the CONTRACTOR;

(2) A spreadsheet showing the tasks that were performed; the percent and cost of each task completed; a total cost figure for each direct expense category including labor, fringe, overhead, travel, and other expenses such as communication and postage, technical and computer services, expendable supplies, printing and reproduction; and the total dollar amount due to the consultant; and

(3) Copies of detailed, itemized invoices/receipts for other expenses (credit card summary receipts or statements are not acceptable)

D. For travel expenses for the CONTRACTOR and/or subcontractor(s) –

(1) 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 superseded. Receipts required for lodging;

(2) Copies of invoices or tickets for transportation costs or, if not available, names, dates, and points of travel of individuals; and

(3) All other reimbursable travel expenses -- invoices or purchase vouchers showing reason for expense with receipts to evidence the amount incurred.

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

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

8. The CONTRACTOR 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.

9. In accordance with Texas Administrative Code (TAC) Title 1, Part 5, Chapter 111, Subchapter B, Rule §111.14, the CONTRACTOR shall maintain business records documenting its compliance with the approved Historically Underutilized Business subcontracting plan in the format prescribed by the Texas Procurement and Support Services (Exhibit F). Exhibit F must include payment information on all HUB and non-HUB subcontractors. Submittal of these monthly reports is required as a condition of payment.

The TWDB will monitor the HUB subcontracting plan monthly to ensure the value of the subcontracts meets or exceeds the HUB subcontracting provisions specified in the contract. The CONTRACTOR who fails to implement the HUB subcontracting plan in good faith will be reported to Texas Procurement and Support Services. The TWDB may revoke the contract for breach of contract and make a claim against the CONTRACTOR.

ARTICLE V. INTELLECTUAL PROPERTY: OWNERSHIP, PUBLICATION, AND ACKNOWLEGEMENT

1. "Use" of a work product, whether it's CONTRACTOR Works, a Subcontractor Works or otherwise, shall mean and include, without limitation hereby, any lawful use, copying or dissemination of the work product, or any lawful development, use, copying or dissemination of derivative works of the work product, in any media or forms, whether now known or later existing.

2. "No Compensation Obligation" shall mean there is no obligation on the part of one co-owner or licensee of a work, whether it's CONTRACTOR Works, a Subcontractor Works or otherwise, to compensate other co-owners, licensees or licensors of the work for any use of the work by the using co-owner or licensee, including but not limited to compensation for or in the form of: royalties; co-owner or licensee accounting; sharing of revenues or profits among co-owners, licensees or licensors; or any other form of compensation to the other co-owners, licensees or licensors on account of any use of the work.

3. "Dissemination" shall include, without limitation hereby, any and all manner of: physical distribution; publication; broadcast; electronic transmission; internet streaming; posting on the Internet or World Wide Web; or any other form of communication, transmission, distribution, sending or providing, in any forms or formats, and in or using any media, whether now known or later existing.

4. The TWDB shall have an unlimited, unrestricted, perpetual, irrevocable, non-exclusive royalty-free right to access and receive in usable form and format, and to use all technical or other data or information developed by the CONTRACTOR and Subcontractor in, or otherwise resulting from, the performance of services under this CONTRACT.

5. For purposes of this Article, "CONTRACTOR Works" are work products developed by the CONTRACTOR and Subcontractor using funds provided under this CONTRACT or otherwise rendered in or related to the performance in whole or part of this CONTRACT, including but not limited to reports, drafts of reports, or other material, data, drawings, studies, analyses, notes, plans, computer programs and codes, or other work products, whether final or intermediate.

    a. It is agreed that all CONTRACTOR Works shall be the joint property of the TWDB and the CONTRACTOR.

    b. The parties hereby agree that, if recognized as such by applicable law, the CONTRACTOR Works are intended to and shall be works-made-for-hire with joint ownership between the TWDB and the CONTRACTOR as such works are created in whole or part.

c. If the CONTRACTOR Works do not qualify as works-made-for-hire under applicable law, the CONTRACTOR hereby conveys co-ownership of such works to the TWDB as they are created in whole or part. If present conveyance is ineffective under applicable law, the CONTRACTOR agree to convey a co-ownership interest of the CONTRACTOR Works to the TWDB after creation in whole or part of such works, and to provide written documentation of such conveyance upon request by the TWDB.

d. The TWDB and the CONTRACTOR acknowledge that the copyright in and to a copyrightable CONTRACTOR Work subsists upon creation of the CONTRACTOR Works and its fixing in any tangible medium. The CONTRACTOR or the TWDB may register the copyrights to such Works jointly in the names of the CONTRACTOR and the TWDB.

e. The TWDB and the CONTRACTOR each shall have full and unrestricted rights to use a CONTRACTOR Works with No Compensation Obligation.

6. For purposes of this Article, "Subcontractor Works" include all work product developed in whole or part by or on behalf of Subcontractors engaged by the CONTRACTOR to perform work for or on behalf of any CONTRACTOR under this CONTRACT (or by the Subcontractors' Subcontractors hereunder, and so on). The CONTRACTOR shall secure in writing from any Subcontractors so engaged:

a. unlimited, unrestricted, perpetual, irrevocable, royalty-free rights of the TWDB (and, if desired, of the CONTRACTOR) to access and receive, and to use, any and all technical or other data or information developed in or resulting from the performance of services under such engagement, with No Compensation Obligation; and either

b. assignment by the Subcontractor to the TWDB (and, if desired by them, jointly to the CONTRACTOR) of ownership (or joint ownership with the Subcontractor) of all Subcontractor Works, with No Compensation Obligation; or

c. grant by Subcontractor of a non-exclusive, unrestricted, unlimited, perpetual, irrevocable, world-wide, royalty-free license to the TWDB (and, if desired by them, the CONTRACTOR) to use any and all Subcontractor Works, including the right to sublicense use to third parties, with No Compensation Obligation.

7. No unauthorized patents. The CONTRACTOR Works and Subcontractor Works or other work product developed or created in the performance of this CONTRACT or otherwise using funds provided hereunder shall not be patented by the CONTRACTOR or their Subcontractor unless the EXECUTIVE ADMINISTRATOR consents in writing to submission of an application for patent on such works; and provided that, unless

otherwise agreed in writing, any application made for patent shall include and name the TWDB (and, as applicable and desired by them, the CONTRACTOR) as co-owners of the patented work:

a. no patent granted shall in any way limit, or be used by the CONTRACTOR or Subcontractor to limit or bar the TWDB's rights hereunder to access and receive in useable form and format, and right to use, any and all technical or other data or information developed in or resulting from performance pursuant to this CONTRACT or the use of funds provided hereunder; and

b. the TWDB (and, if applicable, the CONTRACTOR) shall have No Compensation Obligation to any other co-owners or licensees of any such patented work, unless otherwise expressly agreed in writing.

8. The CONTRACTOR shall include terms and conditions in all contracts or other engagement agreements with any Subcontractors as are necessary to secure these rights and protections for the TWDB; and shall require that their Subcontractors include similar such terms and conditions in any contracts or other engagements with their Subcontractors. For the purposes of this section, "Subcontractors" includes independent contractors (including consultants) and also employees working outside the course and scope of employment.

9. Any work products subject to a TWDB copyright or joint copyright and produced or developed by the CONTRACTOR or their Subcontractor pursuant to this CONTRACT or using any funding provided by the TWDB may be reproduced in any media, forms or formats by the TWDB or the CONTRACTOR at their own cost, and be disseminated in any medium, format or form by any party at its sole cost and in its sole discretion. The CONTRACTOR may utilize such work products as they may deem appropriate, including Dissemination of such work products or parts thereof under their own name, provided that any TWDB copyright is noted on the materials.

10. The CONTRACTOR agrees to acknowledge the TWDB in any news releases or other publications relating to the work performed under this CONTRACT.

ARTICLE VI. AMENDMENT, TERMINATION, AND STOP ORDERS

1. This CONTRACT may be altered or amended by mutual written consent or terminated by the EXECUTIVE ADMINISTRATOR at any time by written notice to the CONTRACTOR. Upon receipt of such termination notice, the CONTRACTOR 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 CONTRACTOR shall submit a statement showing in detail the work performed under this CONTRACT to the date of termination.

The TWDB shall then pay the CONTRACTOR 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 CONTRACTOR at any time. Upon receipt of such order, the CONTRACTOR 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 CONTRACTOR of the Stop Work Order, the CONTRACTOR shall regard this CONTRACT terminated in accordance with the foregoing provisions.

ARTICLE VII. SUBCONTRACTS

Each Subcontract entered into to perform required work under this CONTRACT shall contain the following provisions:

a. a detailed budget estimate with specific cost details for each task or specific item of work to be performed by the Subcontractor and for each category of reimbursable expenses;

b. a clause stating that the Subcontract is subject to audit by the Texas State Auditor's Office and requiring the Subcontractor to cooperate with any request for information from the Texas State Auditor, as further described in Article X, Section 1, Paragraph D hereof;

c. a clause stating that payments under the Subcontract are contingent upon the appropriation of funds by the Texas Legislature, as further described in Article X, Section 1, Paragraph A hereof;

d. a clause stating that ownership of data, materials and work papers, in any media, that is gathered, compiled, adapted for use, or generated by the Subcontractor or the CONTRACTOR shall become data, materials and work owned by the TWDB and that Subcontractor shall have no proprietary rights in such data, materials and work papers, except as further described in Article V hereof;

e. a clause stating that Subcontractor shall keep timely and accurate books and records of accounts according to generally acceptable accounting principles as further described in Article X, Section 2, Paragraph G;

f. a clause stating that Subcontractor is solely responsible for securing all required licenses and permits from local, state and federal governmental entities and that Subcontractor is solely responsible for obtaining sufficient insurance in accordance with the general standards and practices of the industry or governmental entity; and

g. a clause stating that Subcontractor is an independent contractor and that the TWDB shall have no liability resulting from any failure of Subcontractor that results in breach of CONTRACT, property damage, personal injury or death.

ARTICLE VIII. LICENSES, PERMIT, AND INSURANCE

1. For the purpose of this CONTRACT, the CONTRACTOR will be considered an independent contractor and therefore solely responsible for liability resulting from negligent acts or omissions. The CONTRACTOR shall obtain all necessary insurance, in the judgment of the CONTRACTOR, to protect themselves, the TWDB, and employees and officials of the TWDB from liability arising out of this CONTRACT.

2. The CONTRACTOR shall be solely and entirely responsible for procuring all appropriate licenses and permits, which may be required by any competent authority for the CONTRACTOR to perform the subject work.

3. Indemnification. The CONTRACTOR shall indemnify and hold the TWDB and the State of Texas harmless, to the extent the CONTRACTOR may do so in accordance with state law, from any and all losses, damages, liability, or claims therefore, on account of personal injury, death, or property damage of any nature whatsoever caused by the CONTRACTOR, arising out of the activities and work conducted pursuant to this CONTRACT. The CONTRACTOR is solely responsible for liability arising out of its negligent acts or omissions during the performance of this CONTRACT.

ARTICLE IX. SEVERANCE PROVISION

Should any one or more provisions of this CONTRACT be held to be null, void, voidable, or for any reason whatsoever, of no force and effect, such provision(s) shall be construed as severable from the remainder of this CONTRACT and shall not affect the validity of all other provisions of this CONTRACT which shall remain of full force and effect.

ARTICLE X. GENERAL TERMS AND CONDITIONS

1. GENERAL TERMS.

   a. No Debt Against the State. This CONTRACT does not create any debt by or on behalf of the State of Texas and the TWDB. The TWDB's obligations under this CONTRACT are contingent upon the availability of appropriated funds and the continued legal authority of the TWDB to enter into this CONTRACT.

   b. Independent Contractor. Both parties hereto, in the performance of this contract, shall act in an individual capacity and not as agents, employees, partners, joint ventures or associates of one another.

The employees or agents of one party shall not be deemed or construed to be the employees or agents of the other party for any purposes whatsoever.

c. Procurement Laws. The CONTRACTOR shall comply with applicable State of Texas procurement laws, rules and policies, including but not limited to competitive bidding and the Professional Services Procurement Act, Government Code, Chapter 2254, relating to contracting with persons whose services are within the scope of practice of: accountants, architects, landscape architects, land surveyors, medical doctors, optometrists, professional engineers, real estate appraisers, professional nurses, and certified public accountants.

d. Right to Audit. The CONTRACTOR and its Subcontractors shall maintain all financial accounting documents and records, including copies of all invoices and receipts for expenditures, relating to the work under this CONTRACT. The CONTRACTOR shall make such documents and records available for examination and audit by the EXECUTIVE ADMINISTRATOR or any other authorized entity of the State of Texas. The CONTRACTOR'S financial accounting documents and records shall be kept and maintained in accordance with generally accepted accounting principles. By executing this CONTRACT, the CONTRACTOR accepts the authority of the Texas State Auditor's Office to conduct audits and investigations in connection with all state funds received pursuant to this CONTRACT. The CONTRACTOR shall comply with directives from the Texas State Auditor and shall cooperate in any such investigation or audit. The CONTRACTOR agrees to provide the Texas State Auditor with access to any information the Texas State Auditor considers relevant to the investigation or audit. The CONTRACTOR 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 all state funds received pursuant to the Subcontract.

e. Force Majeure. Unless otherwise provided, neither the CONTRACTOR nor the TWDB nor any agency of the State of Texas, shall be liable to the other for any delay in, or failure of performance, of a requirement contained in this CONTRACT caused by force majeure. The existence of such causes of delay or failure shall extend the period of performance until after the causes of delay or failure have been removed provided the non-performing party exercises all reasonable due diligence to perform. Force majeure is defined as acts of God, war, strike, fires, explosions, or other causes that are beyond the reasonable control of either party and that by exercise of due foresight such party could not reasonably have been expected to avoid, and which, by the exercise of all reasonable due diligence, such party is unable to overcome. Each party must inform the other in writing with proof of receipt within two (2) business days of the existence of such force majeure or otherwise waive this right as a defense.

f. Interested Parties. All non-governmental CONTRACTORS are required to submit a Certificate of Interested Parties at the time the signed contract is submitted to the TWDB. The Certificate of Interested Parties (Form 1295) is a sworn statement by the

contracting business entity and must be submitted even if there is no interested party in the transaction. The Form 1295 and instructions for completing and submitting the form are available at: https://www.ethics.state.tx.us/tec/1295-Info.htm.

The TWDB is prohibited from executing a contract unless the contracting business entity submits a completed Form 1295. Any contract resulting from a TWDB procurement with a business entity will be void if the Certificate of Interested Parties is not submitted within 30 days of submitting an executed contract.

2. STANDARDS OF PERFORMANCE.

a. Personnel. The CONTRACTOR shall assign only qualified personnel to perform the services required under this CONTRACT. The CONTRACTOR shall be responsible for ensuring that any Subcontractor utilized shall also assign only qualified personnel. Qualified personnel are persons who are properly licensed to perform the work and who have sufficient knowledge, skills and ability to perform the tasks and services required herein according to the standards of performance and care for their trade or profession.

b. Professional Standards. The CONTRACTOR shall provide the services and deliverables in accordance with applicable professional standards. The CONTRACTOR represents and warrants that he is authorized to acquire Subcontractors with the requisite qualifications, experience, personnel and other resources to perform in the manner required by this CONTRACT.

c. Antitrust. The CONTRACTOR represents and warrants that neither the CONTRACTOR nor any firm, corporation, partnership, or institution represented by the CONTRACTOR, or anyone acting for such firm, corporation, partnership, or institution has (1) violated the antitrust laws of the State of Texas under the Texas Business & Commerce Code, Chapter 15, of the federal antitrust laws; or (2) communicated directly or indirectly the proposal resulting in this CONTRACT to any competitor or other person engaged in such line of business during the procurement process for this CONTRACT.

d. Conflict of Interest. The CONTRACTOR represents and warrants that the CONTRACTOR has no actual or potential conflicts of interest in providing the deliverables required by this CONTRACT to the State of Texas and the TWDB. The CONTRACTOR represents that the provision of services under this CONTRACT will not create an appearance of impropriety. The CONTRACTOR also represents and warrants that, during the term of this CONTRACT, the CONTRACTOR will immediately notify the TWDB, in writing, of any potential conflict of interest that could adversely affect the TWDB by creating the appearance of a conflict of interest.

CONTRACTOR represents and warrants that neither the CONTRACTOR nor any person or entity that will participate financially in this CONTRACT has received

compensation from the TWDB or any agency of the State of Texas for participation in the preparation of specifications for this CONTRACT. The CONTRACTOR represents and warrants that he has not given, offered to give, and does not intend to give at any time hereafter, any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor or service to any public servant in connection with this CONTRACT.

e. Proprietary and Confidential Information. The CONTRACTOR warrants and represents that any information that is proprietary or confidential, and is received by the CONTRACTOR from the TWDB or any governmental entity, shall not be disclosed to third parties without the written consent of the TWDB or applicable governmental entity, whose consent shall not be unreasonably withheld.

f. Public Information Act. The CONTRACTOR acknowledges and agrees that all documents, in any media, generated in the performance of work conducted under this CONTRACT are subject to public disclosure under the Public Information Act, Government Code, Chapter 552. The CONTRACTOR shall produce all documents upon request of the TWDB within two (2) business days when the documents are required to comply with a request for information under the Public Information Act.

g. Accurate and Timely Record Keeping. The CONTRACTOR warrants and represents that he will keep timely, accurate and honest books and records relating to the work performed and the payments received under this CONTRACT according to generally accepted accounting standards. Further, the CONTRACTOR agrees that he will create such books and records at or about the time the transaction reflected in the books and records occurs.

h. Dispute Resolution. The CONTRACTOR and the TWDB agree to make a good faith effort to resolve any dispute relating to the work required under this CONTRACT through negotiation and mediation as provided by Government Code, Chapter 2260 relating to resolution of certain contract claims against the state. The CONTRACTOR and the TWDB further agree that they shall attempt to use any method of alternative dispute resolution mutually agreed upon to resolve any dispute arising under this CONTRACT if this CONTRACT is not subject to Chapter 2260.

i. Contract Administration. The TWDB shall designate a project manager for this CONTRACT. The project manager will serve as the point of contact between the TWDB and the CONTRACTOR. The TWDB's project manager shall supervise the TWDB's review of the CONTRACTOR's technical work, deliverables, draft reports, the final report, payment requests, schedules, financial and budget administration, and similar matters. The project manager does not have any express or implied authority to vary the terms of the CONTRACT, amend the CONTRACT in any way or waive strict performance of the terms or conditions of the CONTRACT.

ARTICLE XI. CORRESPONDENCE

All correspondence between the parties shall be made to the following addresses:

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

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

For the **LBG-GUYTON ASSOCIATES:**

Contract Issues:
LBG-Guyton Associates
James A. Beach
1101 S Capital of Texas Highway, Suite B-220
Austin, Texas 78746
Email: jbeach@lbg-guyton.com

Payment Request Submission:
LBG-Guyton Associates
James A. Beach
1101 S Capital of Texas Highway, Suite B-220
Austin, Texas 78746
Email: jbeach@lbg-guyton.com

Physical Address:
1101 S Capital of Texas Highway, Suite B-220
Austin, Texas 78746

TEXAS WATER DEVELOPMENT BOARD

Kevin Patteson
Executive Administrator

Date: 4/11/16

LBG-GUYTON ASSOCIATES

James A. Beach
Senior Vice President

Date: 3/31/2016

EXHIBIT A

ORIGINAL GRANT APPLICATION

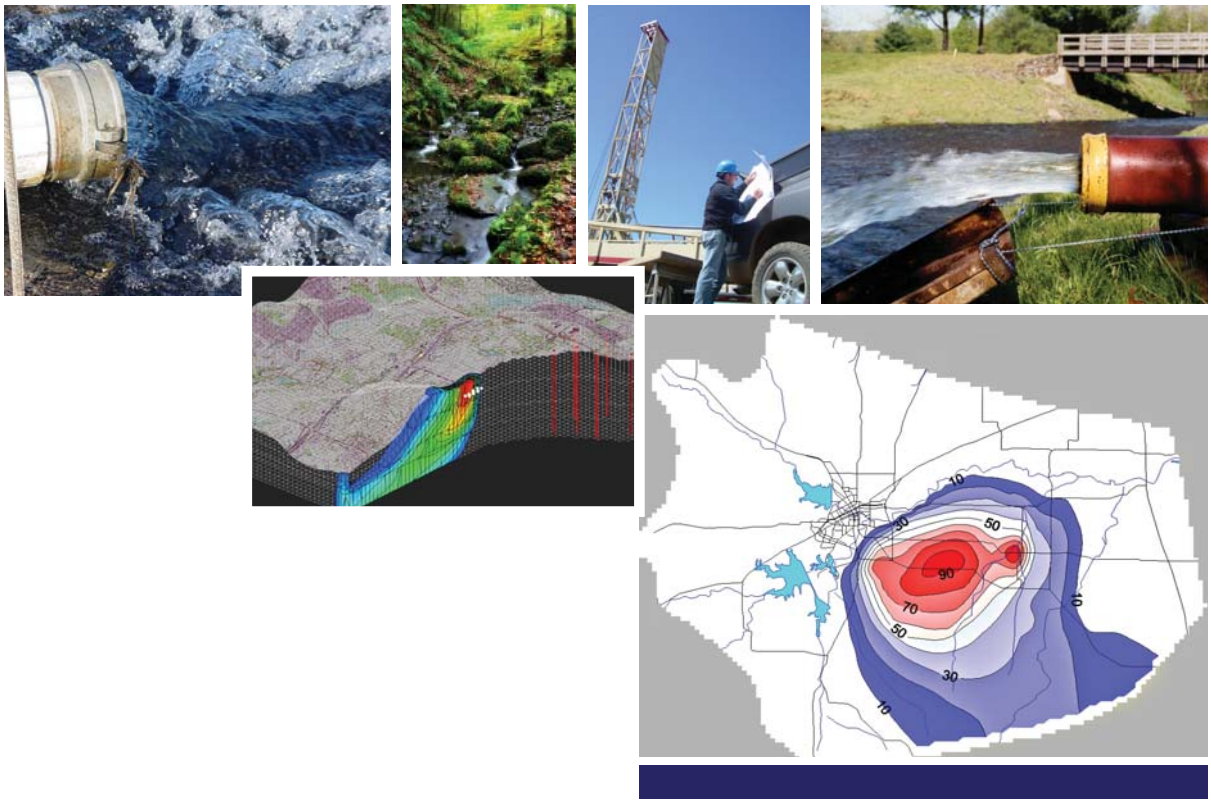
Statement of Qualifications For Services Associated to Study Brackish Aquifers in Texas

RFQ # 580-16-RFQ0008

PROJECT #6: NACATOCH AQUIFER

Prepared for

Texas Water Development Board



November 24, 2015

Prepared by

LBG-Guyton Associates

Professional Groundwater & Environmental Services

A DIVISION OF LEGGETTE, BRASHEARS & GRAHAM, Inc.

LBG-GUYTON ASSOCIATES

PROFESSIONAL GROUNDWATER AND ENVIRONMENTAL ENGINEERING

1101 S CAPITAL OF TEXAS HIGHWAY
SUITE B-220
AUSTIN, TX 78746
O: 512-327-9640
F: 512-327-5573
www.lbgweb.com

November 24, 2015

Ms. Tina Newstrom
Texas Water Development Board
Stephen F. Austin Building
1700 North Congress Avenue
Austin, Texas 78701

Re: Statement of Qualifications for Services Associated to Study Brackish Aquifers in Texas (Request for Qualifications No. 580-16-RFQ0008)

Project No. 6 – Nacatoch Aquifer

Dear Ms. Newstrom:

We appreciate the opportunity to submit our qualifications to provide services associated to study brackish aquifers in Texas, specifically Project No. 6 – Nacatoch Aquifer, to support the Texas Water Development Board's requirements under House Bill 30 passed during the 84th Texas Legislative Session. To meet and exceed your goals for this research project, LBG-Guyton Associates has teamed with the Bureau of Economic Geology and Collier Consulting. You will see that our team of professionals has extensive experience evaluating water quality, determining salinity from geophysical log signatures, geostatistically interpreting sparse data, developing GIS datasets for volumetric analysis, and modeling hydrogeologic conditions for evaluation of aquifer impacts.

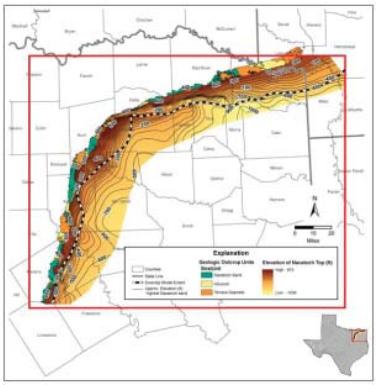
Thank you again for allowing LBG-Guyton Associates and our team the opportunity to submit the attached Statement of Qualifications for the Services Associated to Study Brackish Aquifers in Texas. We look forward to working closely with the Texas Water Development Board on this project and applying our expertise to help determine the 30- and 50-year volumes of brackish groundwater available from potential production areas in the Nacatoch Aquifer. If you have any questions, please do not hesitate to contact me at (512) 327-9640.

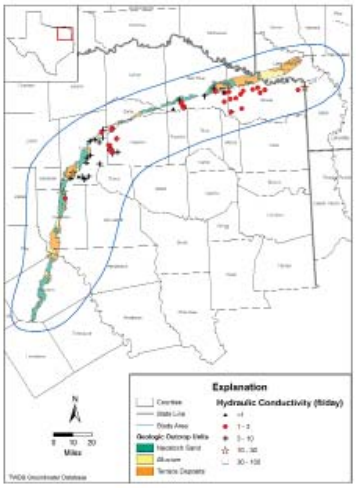
Sincerely,
LBG-GUYTON ASSOCIATES

James Beach

James Beach, P.G.
Senior Vice President

TABLE OF CONTENTS





SECTION 1:

Signed/Dated Execution of Response to the RFQ (Section 1) 1

SECTION 2: Company Profile Summary and History

LBG-Guyton Associates 3
Collier Consulting, Inc. 4
Bureau of Economic Geology 4

SECTION 3: Company References

Reference #1 5
Reference #2 6
Reference #3 7

SECTION 4: Project Team Members' Qualifications and Resumes

LBG-Guyton Associates 9
Collier Consulting, Inc. 26
Bureau of Economic Geology 43

SECTION 5: HUB Form

Collier Consulting, Inc 47

SECTION 6: Ownership of Business Entity 57

SECTION 7: Detailed Scope of Work 58

SECTION 8: Addenda 77

SECTION 9: Appendix

Appendix A: Project Descriptions ..... A
Appendix B: Project Schedule ..... B
Appendix C: Organization Chart C
Appendix D: RFQ Document ..... D

SECTION 1: SIGNED/DATED EXECUTION OF RESPONSE TO THE RFQ (Section 1)

Texas Water Development Board
REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008
FOR SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

SECTION 1 EXECUTION OF RESPONSE

FOR PROJECT NO. 6 Nacatoch Aquifer

Company Name: LBG-GUYTON ASSOCIATES

Address: 1101 S. Capital of Texas Highway
Suite B-220
Austin, Texas 78746

Phone Number: 512-327-9640

I, James A. Beach, am the above-referenced company's representative and I am authorized to submit this response and sign future contract documents. By signing, vendor certifies that if a Texas address is shown as the address, the vendor qualifies as a Texas Resident Bidder as defined in Texas Administrative Code, Title 34, Part 1, Chapter 20.

James Beach
Authorized Signature

11/24/2015
Date

SECTION 2: COMPANY PROFILE SUMMARY AND HISTORY

Project Team:

- **LBG-Guyton Associates**
- **Collier Consulting, Inc.**
- **Bureau of Economic Geology**

LBG-Guyton Associates

Professional Groundwater & Environmental Services

A DIVISION OF LEGGETTE, BRASHEARS & GRAHAM, Inc.

LBG-Guyton Associates was formed in 1951 as Texas' first consulting firm focusing on groundwater. LBG-Guyton has performed many brackish evaluation and mapping projects. Projects have included initial collection and analysis of available data, geophysical log interpretation, refinement of hydrogeologic structure, volume calculations, and design of well fields, planning and supervision of test drilling, GAM modification for brackish project purposes, flow/transport modeling, and actual brackish wellfield development.

William F. Guyton Associates was established in 1951 and quickly became recognized for its preeminence in water resources development in the South and Southwest. In 1992, Guyton merged with Leggette, Brashears & Graham, Inc. (LBG) in order to better serve clients in the Texas and Southwest Region.

Backed by over 50 years of groundwater resource experience, LBG-Guyton Associates is well suited in aiding municipalities and private companies solve their water supply needs. We have extensive practical hands-on experience and utilize state-of-the-art technology in locating and developing reliable groundwater sources, and in assisting our clients navigate the often complex requirements of permitting agencies. Our portfolio includes groundwater exploration, municipal, industrial wellfield planning, construction, testing, expansion, permitting, numerical modeling and well rehabilitation and maintenance.

We bring to every project the highest level of professional expertise and commitment. Our reputation for the highest quality work and consistent performance is achieved through a hands-on approach to project management. Our project management skills are client focused and solution directed. Every project we undertake is personally supervised by a Principal or Associate of the firm and benefits from an extensive quality assurance/quality control program.

LBG-Guyton Associates
(Corporation)
1101 S Capital of Texas Highway,
Suite B-220, Austin, Texas 78746
Phone: 512-327-9640

Contact person:
James A. Beach, P.G.
Senior Vice President
Phone: 512-327-9640 Ext. 428
jbeach@lbg-guyton.com

Participant	Primary Role	Phone Number	Email Address
James Beach	Project Manager	512-327-9640 Ext. 428	jbeach@lbg-guyton.com
John Ashworth	Senior Technical Advisor; Characterization and Interpretation	512-327-9640 Ext. 412	jashworth@lbg-guyton.com
Mike Keester	Modelling; Database Administration	512-327-9640 Ext. 422	mkeester@lbg-guyton.com
Brant Konetchy	Data Acquisition; Database Administration	512-327-9640 Ext. 417	bkonetchy@lbg-guyton.com
Kristie Laughlin	Characterization and Interpretation	512-327-9640 Ext. 430	klaughlin@lbg-guyton.com
Bill Stein	Characterization and Interpretation	210-590-1331	bstein@lbg-guyton.com

Collier Consulting, Inc. (Corporation)
590 E South Loop, Stephenville, Texas 76401
Phone: 254-968-8741

Contact person:

Gail Collier
President
590 E South Loop
Stephenville, Texas 76401
Phone: 254-968-8741
gail@collierconsulting.com

Collier Consulting, Inc. (CCINC) is a privately owned geoscience and engineering consulting firm with strong core competencies in hydrogeology, groundwater modeling, subsurface mapping (hydrostratigraphy), aquifer testing, surface/borehole geophysics, geographic information systems (GIS), software development, and water resources engineering. Additional competencies include environmental engineering, environmental permitting, and compliance monitoring. CCINC holds NCTRCA and SCTRCA WBE status as well as State of Texas HUB certification.

Participant	Primary Role	Phone Number	Email Address
Hughbert Collier	Senior Technical Advisor	254-968-8721	hughbert@collierconsulting.com
Lou Fleischhauer	Characterization and Interpretation	254-968-8741	lou@collierconsulting.com
Peter George	Data Acquisition; Database Administration	254-968-8741	peter_g@collierconsulting.com
Peter Schulmeyer	Modelling	254-968-8741	peter@collierconsulting.com
Matthew Wise	Characterization and Interpretation	254-968-8741	matthew@collierconsulting.com

Our headquarters is located in Stephenville, Texas with satellite offices in Fort Worth, Waco, Austin, and Big Lake. The company was incorporated in 1998 and has enjoyed sustained growth throughout its history. Our staff includes hydrogeologists, geologists, engineers, computer scientists, GIS professionals, hydrologists, and environmental scientists.

Established in 1909, the Bureau of Economic Geology in the Jackson School of Geosciences functions as the Texas Geological Survey, and is the oldest and second-largest organized research unit within the University of Texas at Austin.

As part of the Jackson School, the Bureau has access to matching funds to support external research that can extend the research support. The Bureau conducts research focusing on the intersection of energy, the environment, and the economy. Strong linkages between the Bureau and industry may result in the Bureau becoming an archive for geophysical logs and water quality data from operators in the future.

Participant	Primary Role	Phone Number	Email Address
Scott Hamlin	Data Acquision, Hydrogeological Evaluation	512-471-8241	scott.hamlin@beg.utexas.edu
Robert Reedy	Data Acquision, Hydrogeological Evaluation	512-471-8241	robert.reedy@beg.utexas.edu

SECTION 3: COMPANY REFERENCES

Texas Water Development Board
REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008
FOR SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

SECTION 3 COMPANY REFERENCES

FOR PROJECT NO. 6 Nacatoch Aquifer

REFERENCE #1

Name of Organization:	Parkhill, Smith & Cooper, Inc.		
Business Address:	1700 W. Wall St.		
	Suite 100		
Business City:	Midland		
Business State:	Texas	**Zip:**	79701
Contact Person Name:	Jay Edwards, P.E.		
Contact Person Title:	Principal		
Phone Number:	432-697-1447	**Fax:**	432-697-9758
Client Comments:	LBG-Guyton has provided hydrological expertise to PSC for the		
City of Midland and Midland County Freshwater District well fields that have been recently			
constructed for long-term municipal supply in Loving and Winkler Counties.			
LGB-Guyton did an excellent job of characterizing fresh and brackish groundwater with			
geophysical logs, quantifying volumes, assessing impact from production.			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3: COMPANY REFERENCES

Texas Water Development Board
REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008
FOR SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

SECTION 3 COMPANY REFERENCES

FOR PROJECT NO. 6 Nacatoch Aquifer

REFERENCE #2

Name of Organization:	El Paso Water Utilities		
Business Address:	1154 Hawkins Boulevard		
Business City:	El Paso		
Business State:	Texas	**Zip:**	79961-0511
Contact Person Name:	Scott Reinert		
Contact Person Title:	Water Resource Manager		
Phone Number:	915-594-5579	**Fax:**	915-594-5572
Client Comments:	El Paso Water Utilities (EPWU) has dealt with LBG-Guyton in the past ten years during which time they provided EPWU with excellent support in the areas of monitor well design; geophysical log interpretation; delineation of fresh, brackish, and saline groundwater; quantified the volume of fresh, brackish, and saline groundwater; and identified potential production areas. Their work has been a major factor in understanding the dynamics of the brackish-fresh water interface in the Hueco Bolson. This understanding was instrumental in the design, building, and operation of the Kay Bailey Hutchinson Desalination Plant in El Paso. The desalination plant is a very important component in our diviersified water supply portfolio. I can confidently recommend LBG-Guyton as a solid and reliable expert in their field.		

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

LBG GUYTON

SECTION 3: COMPANY REFERENCES

Texas Water Development Board
REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008
FOR SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

SECTION 3 COMPANY REFERENCES

FOR PROJECT NO. 6 Nacatoch Aquifer

REFERENCE #3

Name of Organization:	The University of Texas System - University Lands		
Business Address:	704 Dengar		
Business City:	Midland		
Business State:	Texas	**Zip:**	79702-0553
Contact Person Name:	James Buice, P.G.		
Contact Person Title:	Lands & Oil Field Representative		
Phone Number:	432-686-4778	**Fax:**	432-682-7456
Client Comments:	LBG-Guyton compiled a stratigraphic database using geophysical		
logs provided by UT Lands and BRACS in Andrews, Ector, Loving, Ward, and Winkler Counties.			
Discrete sand intervals within water-producing zones were also tabulated from the log data. The			
hydrogeologic report is currently in progress.			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 4: PROJECT TEAM MEMBERS' QUALIFICATIONS AND RESUMES

LBG-GUYTON ASSOCIATES

1. James Beach, P.G., *Senior Vice President*
2. John B. Ashworth, *Senior Consultant*
3. John Jansen, P.G., R.GP, PH.D., *Senior Associate*
4. William G. Stein, *Senior Associate*
5. Michael Keester, *Senior Hydrogeologist*
6. Kristie Laughlin, *Senior Hydrogeologist*
7. Brant Konetchy, *Hydrogeologis*t

COLLIER CONSULTING, INC.

1. Hughbert Collier, Ph.D. P.G., *Senior Vice President*
2. Louis Fleischhauer, P.G., *Senior Hydrogeologist*
3. Peter G. George, Ph.D. P.G., *Senior Hydrogeologist*
4. Peter Schulmeyer, P.G., *Senior Hydrogeologist*
5. Matthew Wise, P.G., *Geophysicist/Geologist*

BUREAU OF ECONOMIC GEOLOGY

1. Herbert Scott Hamlin, Ph.D. P.G., *Research Associate*
2. Robert Reedy, *P.G., Research Scientist Associate*

JAMES A. BEACH, P.G.
Senior Vice President

EDUCATION
B.S. in Hydrology, 1987
Tarleton State University, Stephenville, Texas

M.S. in Hydrology, 1989, New Mexico Institute of Mining & Technology, Socorro, New Mexico

REGISTRATIONS
- Certified Ground Water Professional, #118904, National Ground Water Association
- Professional Geoscientist #2965, State of Texas

TECHNICAL SOCIETIES
- National Ground Water Association
- Texas Water Conservation Association
- Texas Groundwater Association
- Texas Alliance of Groundwater Districts

James Beach is a Professional Geoscientist with over 25 years' experience in groundwater hydrology, water resources, numerical flow and solute transport modeling, and groundwater quality analysis and well field development. He specializes in application of numerical models to evaluate water resources as well as contaminant flow and transport in the subsurface. Mr. Beach has experience in field hydrology and hydrogeology and application of quantitative hydrology in the water resources arena. This includes evaluation of ground-water availability and quality in heterogeneous aquifer systems including the Gulf Coast.

Mr. Beach has experience in the application of saturated and unsaturated flow and transport models, GIS applications and mapping, visualization and animation, database development and management, statistical, geostatistical, and stochastic analysis, technology transfer, and regulatory/public inter¬action.

SUMMARY OF PROFESSIONAL EXPERIENCE
2011 to current: Sr. Vice President with LBG-Guyton Associates, Austin, Texas
2009 to 2010: Vice President with LBG-Guyton Associates, Austin, Texas
2005 to 2008: Senior Associate with LBG-Guyton Associates, Austin, Texas
2002 to 2005: Associate with LBG-Guyton Associates, Austin, Texas
1999 to 2001: Senior Hydrologist with LBG-Guyton Associates, Austin, Texas
1992 to 1999: Ground-water Hydrologist, INTERA, Austin, Texas
1989 to 1992: Ground-water Hydrologist with McCulley, Frick & Gillman, Inc., Austin, Texas
1987: Staff Hydrologist with Hall Southwest Water Consultants, Austin, Texas
1984: Assistant Well Driller with Magill Well Service, Eden, Texas

SPECIFIC EXPERIENCE
Development of the Nacatoch Aquifer GAM
Served as project manager to develop a MODFLOW model to simulate ground-water flow in the Nacatoch Aquifer. Developed an appropriate conceptual model based on structural information, aquifer response, water chemistry and other data. All model data was developed and evaluated within ArcGIS. Model development included assimilation of historical pumping and water level data, as well as aquifer characteristics. Completed steady-state and transient calibration and sensitivity analysis. Prepared final report on time.

Brackish Groundwater Characterization and Modeling
Conducted brackish groundwater studies for San Antonio Water System (SAWS) using existing geophysical logs to potential quantity and quality and develop locations for test wells in the Wilcox and Edwards Aquifers. Characterization included correlation of water quality results from existing wells with geophysical logs and estimating hydraulic properties. The study covered a multi-county area in GMA-13. TWDB Southern Queen City/ Sparta GAM was used to assess production and impacts from potential wellfields and the GAM was updated with hydraulic properties from pumping tests completed in the new brackish zone wells to develop wellfield layout.

Refinery Complex, Texas Gulf Coast
Led technical team to develop appropriate site conceptual model and a three-dimensional flow and transport model (2.1 million grid blocks) to statistically evaluate alleged ground-water contamination by petroleum hydrocarbons in a heterogeneous aquifer. State-of-the-art geostatistical and stochastic modeling tools were utilized to complete the analysis; visualization/animation techniques were used to effectively illustrate model results.

RELEVANT PROJECT EXPERIENCE

Southern Gulf Coast Aquifer Assessment and Modeling
Assess groundwater availability and water quality for large landowner (825,000 acres) in Kleberg, Jim Wells, Brooks and Kenedy Counties. Used the Southern Gulf Coast GAM to assess impacts from potential projects, assess GMA and groundwater district issues.

Brackish Groundwater Manual for Regional Water Planning Groups - Texas
Managed project for the Texas Water Development Board to assess the potential for desalinization of brackish ground water in Texas' major and minor aquifers. The study included evaluation of water-quality and geophysical data for over 30 aquifer systems throughout the state and development of hydrogeologic and water-quality maps that can be used to assess potential brackish water projects for planning purposes. The evaluation also included preliminary cost estimation formulas for source water production (wells and well fields) and engineering considerations for different aquifers.

Development of Igneous-Bolson Aquifer Ground-Water Availability Model
Served as project manager and primary modeler to develop a 3-layer MODFLOW model to simulate groundwater flow in the west Texas Bolson and Igneous aquifers. All model data was developed and evaluated within ArcGIS and was compatible/interchangeable with the modeling GUI. Model development and calibration included assimilation of historical pumping and water level data, as well as aquifer characteristics. Aquifer water levels and streamflow data were used to calibrate and verify the steady state and transient models. Predictive simulations, which incorporated 50-year demand projections and potential drought conditions, were used to assess aquifer impact and groundwater availability.

Modeling Gulf Coast Strategies, Lavaca Region, Texas
Completed groundwater studies regarding groundwater resources planning within the region. Collect and evaluate groundwater pumpage and aquifer response, and groundwater supply facilities data. Develop groundwater resources supply options for region. Participate in regional committee meetings and public meetings to provide study results and address questions.

Harris-Galveston Subsidence District, Gulf Coast Area, Texas
Performed a study to update and recalibrate a multiple county groundwater flow model for the Chicot and Evangeline aquifers. Collect and areally distribute municipal, industrial, and irrigation pumpage data over the model area. Evaluate aquifers potentiometric head data to review aquifer response to pumpage. Perform recalibration in part of the model area to improve model predicted aquifer response. Total groundwater pumpage in model area was about 400 MGD.

Catahoula Model Development, Montgomery County, Texas
Develop a groundwater model for the Catahoula aquifer in the vicinity of Montgomery County. Assess water quality, hydraulic properties, boundary conditions, and calibrate model.

Evaluation of Groundwater Availability for the Gulf Coast Aquifer, Texas
Used existing hydrogeologic evaluations, databases, and GAMs in east Texas and the Coastal Bend area to develop availability estimates and long-term impacts from current and proposed groundwater usage.

Evaluation of Groundwater Availability in the Carrizo-Wilcox Aquifer
Utilized existing MODFLOW groundwater flow model in northeast and central Texas to develop availability estimates and to determine the long-term impacts from projected groundwater demand. Evaluation helped iden¬tify potentially critical areas and aided in the development of a set of wells throughout the region to help assess future water-level changes.

PUBLICATIONS

Beach, J. A., C. W. Kreitler, and W. B. Klemt, 2002. Brackish Water Resources of the Gulf Coast Aquifers in Texas. Gulf Coast Association of Geological Societies Symposium, Austin Texas, October 2002.

Beach, J. A., and G. Ruskauff, 2000. Practical Aspects of Conceptualization and Modeling of Heterogeneous Deltaic Deposits. Presented at the Society of Sedimentary Geology/International Association of Sedimentologists (SEPM/IAS) Conference on Environmental Sedimentology: Hydrogeology of Sedimentary Aquifers, September 24-27, 2000; Santa Fe, New Mexico.

Fryar, D. G., J. A. Beach, V. A. Kelley, and M. K. Knowles, 1997. Long-Term Brine Migration Through an Engineered Shaft Seal System, Proceedings of the ASCE Fourth Congress on Computing in Civil Engineering, 1997

Beach, J. A., D. G. Fryar, H. S. Rifai, K. Appling and T. B. Stauffer, 1996. Simulation of Natural Attenuation of Organic Tracers at the MADE Site Using the Bioplume II Transport Model. In: Calibration and Reliability in Groundwater Modeling, Proceedings of the ModelCARE'96 Conference held at Golden, Colorado, September, IAHS Publication No. 237.

Beach, J. A., D. B. Stephens, and A. L. Gutjahr, 1989. Incorporation of Spatial Variability in Mill Tailings Hydraulic Properties into Numerical Models: Implications for Uncertainty in Seepage Prediction and Ground-Water Protection in Proceedings of the Ninth Annual AGU Front Range Branch Hydrology Days, April.

Beach, J. A., J. B. Ashworth, S.T. Finch, A. Chastain-Howley, K. Calhoun, K.M. Urbanczyk, J.M. Sharp, and J. Olson, 2004. Groundwater Availability Model for the Igneous and parts of the West Texas Bolsons (Wild Horse Flat, Michigan Flat, Ryan Flat, and Lobo Flat) Aquifers, Contractor Report to the Texas Water Development Board.

Beach, J. A., S.T. Burton, and B. Kolarik, 2004. Groundwater Availability Model for the Lipan Aquifer, Contractor Report to the Texas Water Development Board.

Beach, J. A. and B. Paris, 1999. Modelisation Hydrogologique de Secteur EST: Final Report. Contractor report to ANDRA, Paris, France.

Reeves, M. and J. A. Beach, 1996. Theoretical Development and Imple¬mentation of the Linear Carter-Tracy Boundary Condition in SWIFT-II. Submitted as an Appendix to Evaluation of Fluid Flow Through the Upper-Shaft, Short-Term Seal System of the Proposed Reference Seal System Design (PRSSD, 1993 Update).

Beach, J. A., 1994. Ground-Water Flow and Transport Modeling at the GNB Technologies, Inc. Facility, Columbus, Georgia.

Beach, J. A., 1989. Geostatistical and Stochastic Approaches to Incorporation of Heterogeneity in Mill Tailings Hydraulic Properties into Numerical Models: Implications for Seepage Prediction Uncertainty. Unpublished M.S. Thesis, New Mexico Institute of Mining and Technology.

JOHN B. ASHWORTH
Senior Consultant

EDUCATION
B.S. in Geology, 1973, Lamar University, Beaumont, Texas

REGISTRATIONS
- Professional Geoscientist #2238, State of Texas

TECHNICAL SOCIETIES
- Texas Ground Water Association (*Past Director, Ground Water Scientists Division*)
- Texas Water Conservation Association

John Ashworth has a wide range of experience with water-supply evaluations and water-resource management planning in his 23 years of working for the Texas Water Development Board, and now for LBG-Guyton Associates. He directs the firm's water management planning activities for two of the 16 water-planning regions in Texas designated by Senate Bill 1. The regional water management plans involve analyses of available water supplies to meet short- and long-term water needs for all water-use categories. The plans also provided for drought contingency water-supply strategies. Mr. Ashworth is also experienced in brackish groundwater desalination assessments, municipal water-supply development and groundwater conservation district activities.

His experience as a geologist with the Texas Water Development Board involved the supervision of the agency's ground-water availability studies. This duty included the identification, characterization and supply analysis of the major and minor aquifers in the state. Additional duties included the supervision of the Priority Ground Water Management Area (Critical Area) Program, Texas/Mexico Border Groundwater Program, technical assistance to groundwater conservation districts and other public entities, and involvement with the Aquifer Storage and Recovery Pilot Program. Technical duties with regard to the above programs consisted of water supply planning, subsurface mapping, test hole drilling, pumping tests, water-quality sampling, well construction analysis, and geophysical log analysis. His experience included project management of a number of multicounty groundwater availability studies requiring extended field reconnaissance, design of monitoring well networks, research of existing data, drilling and coring of test holes, subsurface geophysical studies and subsurface mapping.

He also authored much of the groundwater availability segment of previous State Water Plans, and was significantly involved in establishing the agency's Senate Bill 1 policies relating to the certification guidelines of groundwater con¬ser¬va¬tion district management plans.

Mr. Ashworth's experience with Gas Log Inc. included the evaluation of gas shows during oil field drilling operations and correlation with geophysical log interpretations. This activity resulted in his familiarity with large-scale drilling operations.

SUMMARY OF PROFESSIONAL EXPERIENCE

2007 to present: Senior Consultant with LBG-Guyton Associates, Austin, Texas
2006 to 2007: Senior Associate with LBG-Guyton Associates, Austin, Texas
2000 to 2007: Associate with LBG-Guyton Associates, Austin, Texas
1997 to 1999: Senior Consultant with LBG-Guyton Associates, Austin, Texas
1991: Instructor, Concordia Lutheran College, Austin, Texas
1974 to 1997: Geologist, Texas Water Development Board, Austin, Texas
1973 to 1974: Geologist, Gas Log Inc., Houston, Texas

SPECIFIC EXPERIENCE IN GROUND-WATER SUPPLY

Nacatoch Aquifer

Principal investigator and author of a regional groundwater availability study of the Nacatoch aquifer in 10 northeast Texas counties. The study included the collection, com¬pilation, and analysis of groundwater data, test hole drilling, subsurface mapping, and a published report. Also, assisted in a regional availability study of the Blossom aquifer in the same region.

Development of the Nacatoch Aquifer GAM
Served as project manager to develop a MODFLOW model to simulate ground-water flow in the Nacatoch Aquifer. Developed an appropriate conceptual model based on structural information, aquifer response, water chemistry and other data. All model data was developed and evaluated within ArcGIS. Model development included assimilation of historical pumping and water level data, as well as aquifer characteristics. Completed steady-state and transient calibration and sensitivity analysis. Prepared final report on time.

Central Texas
Principal investigator and author of a study and report evaluating the groundwater resources of part of south-central Texas (11 "Hill Country" counties), with emphasis on the lower Cretaceous Trinity formations. The general scope included the collection, compilation, and analysis of groundwater data, test hole drilling, subsurface mapping, and the presentation of the data, conclusions, and recommendations in a published report. Much of this region was later declared a "critical area" due to its limited groundwater availability and rapidly increasing water demand. Later work included monitoring water-level trends during normal and drought climatic conditions.

West Texas
Principal investigator and author of several regional groundwater availability studies including the following aquifers:

- Hueco-Mesilla Bolsons Aquifer - El Paso and Hudspeth Counties
- Bone Spring-Victorio Peak Aquifer - Dell City area of Hudspeth County
- Cenozoic Pecos Alluvium Aquifer - Reeves, Loving, Pecos, Ward, and Winkler Counties
- Salt Basin of the West Texas Bolsons Aquifer - Culberson, Jeff Davis, and Presidio Counties
- Edwards-Trinity (Plateau) Aquifer - Midland, Reagan, Upton, and Glasscock Counties
- Dockum Aquifer - numerous southern High Plains and northern Edwards Plateau Counties
- Igneous Aquifer - Brewster, Jeff Davis and Presidio Counties

Conducted the following local groundwater availability studies:

- Balmorhea/Toyahvale - Jeff Davis and Reeves Counties.
- Ryan Flat - Jeff Davis and Presidio Counties.
- Garden City - Glasscock County.
- Oil field - Central Sterling County.

Conducted an inventory of all public water supply well fields in 18 West Texas counties.

Texas High Plains
Participated in a regional groundwater study of the High Plains aquifer (principally the Ogallala Formation) in Texas as part of a nationwide (eight-state) study to improve the existing groundwater database and to develop a computer model capable of predicting future aquifer conditions. Primary area of responsibility was the drilling, coring, and testing of 41 test holes to ascer¬tain permeability and specific yield of the aquifer. Later involvement with the High Plains re¬gion included the monitoring of water level changes over time and continued improvement to the computer model.

Texas-Mexico Border
Project manager and co-author of a regional study of the Hueco Bolson and Rio Grande Alluvium Aquifers as they occur in Texas, Mexico, and New Mexico. The study included a bi-national agreement to exchange government approved groundwater data and resulted in a data report presented in both English and Spanish and a major aquifer evaluation report. Additional work included attending numerous meetings concerning water issues as they relate to the Free Trade Agreement and the International Boundary Environmental Plan.

Brackish Groundwater Desalination
Worked with a team of consultants to evaluate, design, and permit a brackish groundwater desalination facility for the City of El Paso and Fort Bliss Army Post. Work on this project included the identification, evaluation and

testing of an underground reservoir capable of storing the concentrated waste stream from the desalination facility. Also evaluated brackish ground water aquifers for potential desalination supply for the City of San Angelo.

Regional Groundwater Supply Analysis for the State Water Plan of Texas
Supervised and participated in the ongoing appraisal of the groundwater availability of the major and minor aquifers in the State. The scope of this assessment encompasses regional aquifer studies, aquifer computer models, and water-level and water-quality monitoring. Results are continuously reevaluated and applied to the most current State Water Plan. Principal author of the groundwater availability segment of previous State Water Plans.

Priority Ground-Water Management Area Program
Responsible for the Texas Water Development Board's contribution to the legislatively mandated Priority Groundwater Management Area Program (formerly referred to as the Critical Area Program). Assisted in the identification of areas to consider for designation. Conducted studies and authored reports on four of the 16 areas identified for consideration. Studies consisted of an evaluation of existing groundwater data to determine if the area was currently having water supply or quality degradation problems or if such problems were anticipated in the coming 20 years.

Regional Water Planning
Currently the project manager for the Senate Bill 1 and 2 Regions E and J regional water planning process. Region E is an area of Far West Texas that includes seven counties and stretches from El Paso to beyond the Big Bend area. Region J is an area that includes six counties stretching from Kerr to Val Verde County.

BIBLIOGRAPHY

Publications:

Ashworth, J. B., 1980, "Evaluating the Ground-Water Resources of the High Plains of Texas, Results of Test Hole Drilling," Texas Department of Water Resources Report LP-129, 55 p.

Ashworth, J. B., 1983, "Ground-Water Availability of the Lower Cretaceous Formations in the Hill Country of South-Central Texas," Texas Department of Water Resources Report 273, 173 p.

Ashworth, J. B., 1984, "Hydraulic Characteristics of the High Plains Aquifer as Determined from Core Analysis," in Proceedings of the Ogallala Aquifer Symposium II, G. A. Whetstone editor, p. 278-291.

Ashworth, J. B., 1986, "Evaluation of the Santa Rosa Aquifer in Glasscock County," Texas Water Development Board Report LP-203.

Ashworth, J. B., 1988, "Ground-Water Resources of the Nacatoch Aquifer," Texas Water Development Board Report 305, 151 p.

Ashworth, J. B. and P. L. Nordstrom, 1989, "Public Supply Ground-Water Use in Western Texas," Texas Water Development Board Report 311, 163 p.

Ashworth, J. B. and P. Christian, 1989, "Evaluation of Ground-Water Resources in Parts of Midland, Reagan, and Upton Counties, Texas," Texas Water Development Board Report 312, 52 p.

Ashworth, J. B., 1990, "Evaluation of Ground-Water Resources in Parts of Loving, Pecos, Reeves, Ward, and Winkler Counties, Texas," Texas Water Development Board Report 317, 51 p.

Ashworth, J. B., 1990, "Evaluation of Ground-Water Resources in El Paso County, Texas," Texas Water Development Board Report 324, 25 p.

Ashworth, J. B., P. L. Nordstrom, and R. Harston, 1990, "Ground-Water Quality in Garden City, Texas," Texas Water Development Board Report LP-210.

Ashworth, J. B., 1990, "Water Resources of the El Paso Area, Texas," in Kreitler C. W. and Sharp, J. M., Jr., eds., Hydrogeology of Trans-Pecos Texas, The University of Texas at Austin, Bureau of Economic Geology Guidebook 25.

Christian, P., J. B. Ashworth, and D. Coker, 1990, "Public Supply Ground-Water Use in the Southern High Plains of Texas", Texas Water Development Board Report 328, 221 p

Ashworth, J. B., 1990, "Predicting the Future of the Texas High Plains Aquifer," in Proceedings of the American Water Resources Association, Ground Water, Transport, and Hazardous Waste Symposium, Austin, Texas.

Ashworth, J. B., 1991, "Water-Level Changes in the High Plains Aquifer of Texas, 1980 - 1990", Texas Water Development Board Hydrologic Atlas No. 1.

Ashworth, J. B. and R. R. Flores, 1991, "Delineation Criteria for the Major and Minor Aquifer Maps of Texas," Texas Water Development Board Report LP-212, 27 p.

Ashworth, J. B., P. Christian, and T. C. Waterreus, 1991, "Evaluation of Ground-Water Resources in the Southern High Plains of Texas, " Texas Water Development Board Report 330, 39 p.

Ashworth, J. B., 1991, "The Drying Up of El Paso," in Proceedings of the American Water Resources Association, Twichell Hydrology Symposium, Austin, Texas.

Ashworth, J. B., 1992, "A Summary of the Ground-Water Resources in the Upper Rio Grande Region of Texas," Prepared for the Rio Grande Council of Governments, Water Resources Task Force, 28 p.

Coker, D., T. C. Waterreus, D. S. Peckham, and J. B. Ashworth, 1992, "Public Supply Ground-Water Use in the Northern High Plains of Texas," Texas Water Development Board Report 336, 136 p.

Ashworth, J. B., 1993, "Test Hole Investigation of a Contamination Site in Sterling County, Texas," Texas Water Development Board Open File Report Prepared for the Railroad Commission of Texas.

Peckham, D. S. and J. B. Ashworth, 1993, "The High Plains Aquifer System of Texas, 1980 to 1990, Overview and Projections," Texas Water Development Board Report 341, 34 p.

Ashworth, J. B., 1995, "Ground-Water Resources of the Bone Spring-Victorio Peak Aquifer in the Dell Valley Area, Texas," Texas Water Development Board Report 344, 42 p.

Ashworth, J. B. and J. Hopkins, 1995, "Aquifers of Texas," Texas Water Development Board Report 345, 69 p.

Ashworth, J. B., 1995, "New Emphasis on Trans¬boundary Water Resources," in Proceedings of the American Water Resources Association - National Convention, Houston, Texas.

Ashworth, J. B., 1995, "Texas Water Development Board Water Research Agenda," in Proceedings of the Water for Texas Conference, Austin, Texas.

Hibbs, B. J., B. K. Darling, and J. B. Ashworth, 1995, "Interbasin Movement of Ground Water and Vertical

Ground-Water Flow in Hudspeth County, Texas," in Proceedings of the Texas Water 95, a Component Conference of the First International Conference on Water Resources Engineering, American Society of Civil Engineers, San Antonio, Texas, p. 267-277.

Ashworth, J. B., 1997, "Trinity Aquifer System of the Texas Hill Country," in Environment and Land Restoration in the Central Texas Hill Country, Austin Geological Society Guidebook 17.

Ashworth, J. B. and D. Coker, 1997, "Ground-Water Movement in the Cienega Creek Basin, Southern Jeff Davis County, Texas, " Texas Water Development Board Open File Report, 7 p.

Texas Water Development Board and New Mexico Water Resources Research Institute, 1997, "Transboundary Aquifers of the El Paso/Ciudad Juarez/Las Cruces Region," TWDB and NMWRRI Report Prepared for the U.S. Environmental Protection Agency.

Ashworth, J. B., D. B. Coker, and W. Tschirhart, 1997, "Evaluation of Diminished Spring Flows in the Toyah Creek Valley, Texas," Texas Water Development Board Open File Report, 12 p.

TWDB, NMWRRI, IBWC, USEPA, CNA, JMAS, CILA, 1998, "Transboundary Aquifers and Binational Ground-Water Data Base, City of El Paso/Ciudad Juarez Area", International Boundary and Water Commission/Comision Internacional de Limites y Aguas.

Presentations:

Hydraulic Characteristics of the High Plains Aquifer as Determined from Core Analysis," Ogallala Aquifer Symposium II, Lubbock, Texas, 1984.

"Predicting the Future of the High Plains Aquifer, "American Water Resources Association Symposium, Austin, Texas, 1990.

"The Drying Up of El Paso," American Water Resources Association Symposium, Austin, Texas, 1991.

"Water Resource Conflicts in the Rio Grande Region of West Texas and Northern Mexico," Austin Geological Society, Austin, Texas, 1992.

"Ground-Water Management in Texas," Texas State Soil and Water Conservation Board Annual Conference, Austin, Texas, 1994.

"New Emphasis on Transboundary Water Resources," American Water Resources Association - Texas Section, El Paso, Texas, 1994.

"Current Conditions and Future Outlook for the Ogallala Aquifer," Texas Ground Water Association Annual Conference, Lubbock, Texas, 1995.

"New Emphasis on Transboundary Water Resources," American Water Resources Association National Convention, Houston, Texas, 1995.

"Texas Water Development Board Water Research Agenda, @ Water for Texas Conference, Austin, Texas, 1995.
"Transboundary Aquifers in the El Paso-Juarez-Las Cruces Region, @ American Society of Civil Engineers Quad Section Fall Meeting, El Paso, Texas, 1995.

JOHN JANSEN, P.G., R.GP, PH.D.
Senior Associate

EDUCATION

Ph.D. in Geological Sciences (Hydrogeology emphasis), 1995, University of Wisconsin, Milwaukee, Wisconsin

M.S. in Geological Sciences (Geophysics emphasis), 1983, University of Wisconsin, Milwaukee, Wisconsin

B.S. in Geology, 1981, University of Wisconsin, Milwaukee, Wisconsin

REGISTRATIONS

- Professional Geologist, State of Arizona, Delaware, Illinois, Indiana, Minnesota, Wisconsin and Wyoming
- Professional Geophysicist, State of California

PROFESSIONAL RECOGNITIONS AND AWARDS

- 2012 NGWA Keith E. Anderson Award for Service to the Groundwater Industry
- 2013 NGWA McEllhiney Distinguished Lecturer in Water Well Technology
- Lead Author of the Geophysical Well Logging Chapter in Ground Water and Wells, 3rd edition
- Three US Patents for Water Well Technologies

John Jansen has over thirty years of experience in groundwater resource investigations. He specializes in surface and borehole geophysics, high capacity well siting and design, groundwater modeling, managed aquifer recharge, surface and borehole geophysics, mine hydrogeology, and water permitting for energy projects. He has worked on surface and borehole geophysical studies to map brackish water aquifers and salt water intrusion studies in several states including California, Florida, Illinois and Wisconsin.

He previously worked nationally as an independent groundwater consultant, the chief geoscientist for an international well construction contractor, and as an office manager and principal for a large international natural resource management consultant. He is the author of numerous publications and presentations on other groundwater-related topics, including the borehole geophysics chapter in the third edition of Groundwater and Wells, and holds three patents on well rehabilitation, horizontal drilling, and in-situ radium treatment. He is the 2013 NGWA McEllhiney Distinguished Lecturer in Water Well Technology and the 2012 recipient of the NGWA Keith A. Anderson Award for service to the groundwater industry. He is a Professional Geologist in seven states and a Registered Geophysicist in California.

RELEVANT PROJECT EXPERIENCE

Groundwater Exploration, Olivenhain Municipal Water District

Dr. Jansen conducted a geophysical investigation conducted in and around the San Elijo Lagoon, located in north San Diego County. The objective if the survey was to map fresh water and brackish aquifers in the unconsolidated formations above basement rock to develop a potable water supply for the district. Three geophysical methods (high resolution resistivity, time domain electromagnetic induction, and gravity) were completed. The surveys were conducted for Stoney Miller Consultants, Inc. (Stoney Miller) in support of their on going water supply investigations being conducted on for the Olivenhain Municipal Water District (OMWD).

Orange County Water District, Orange County, California

Dr. Jansen conducted an electrical resistivity and TEM survey for OCWD on the Seal Beach Naval Base. The purpose of the survey was to map zones of saline water in the coastal groundwater basin migrating through the Sunset Gap. The project. The survey mapped brackish and saline water in a layered aquifer system to depths of approximately 1,200 feet. The results of the survey will be used to evaluate the extent of sea water intrusion and evaluate mitigation options.

Water Replenishment District of Southern California

Dr. Jansen directed a TEM and resistivity survey for WRD in Los Angeles County. The purpose of the survey was to map zones of saline water in the coastal groundwater basin. The project was complicated by the highly developed urban area which required modified field procedures to collect useful data. The survey identified zones of brackish and saline water in a layered aquifer system to depths of approximately 1,000 feet. Limited test drilling and water sampling completed to data has confirmed the interpretation of the survey results.

WILLIAM G. STEIN
Senior Associate

EDUCATION
B.S. in Geology, 1987
University of Texas
San Antonio, Texas

M.S. in Geology (Hydrology), 1993
University of Texas
San Antonio, Texas

REGISTRATIONS
- Professional Geoscientist #1402, State of Texas
- Certified Professional Geologist, American Institute of Professional Geologists, #10441

Bill Stein has over 27 years of professional experience in the field of hydrogeology. He has conducted a variety of groundwater studies on the Edwards, Trinity, Carrizo-Wilcox, Gulf Coast and many other aquifers throughout the State of Texas. His expertise includes evaluation of groundwater availability and quality in many different types of aquifers. He has made evaluations and developed strategies to match demand with the water supply.

Mr. Stein has supervised construction, performed sampling and pumping tests of wells completed into many different types of aquifers. He has assisted with design and planning of drilling programs, supervised well construction and testing of public-supply wells for private and public entities. He has supervised geophysical logging and utilized those logs to best construct productive wells. Mr. Stein has made evaluations utilizing existing geophysical logs from various sources to identify optimal well sites.

Mr. Stein has conducted numerous water availability studies. He has performed numerous pumping tests utilizing computerized data logging equipment and analyzed test data using a variety of industry methods. Mr. Stein has conducted geochemical and water-quality analyses and made interpretations of these data. He has performed groundwater modeling using both analytical and numerical techniques to determine future aquifer conditions. Mr. Stein has performed many quantitative and qualitative analyses of gravel, sand, karstic limestone or fracture volcanic rock groundwater systems.

SUMMARY OF PROFESSIONAL EXPERIENCE
2013 to present: Senior Associate, LBG-Guyton Associates
2003 to 2012: Associate, LBG-Guyton Associates
1994 to 2003: Senior Hydrologist, LBG-Guyton Associates
1993 to 1994: Hydrogeologist, LBG-Guyton Associates
1991 to 1993: Groundwater Hydrologist, LBG-Guyton Associates
1989 to 1991: Hydrologist, U.S. Geologic Survey WRD
1986 to 1989: Hydrologic Tech, U.S. Geological Survey WRD
1984: Geologic Technician, Raba-Kistner Engineering

SPECIFIC PROJECT EXPERIENCE
San Antonio Water Systems (SAWS) Brackish Well Field Development
Conduct brackish groundwater studies for San Antonio Water System (SAWS) utilizing oil-field geophysical logs to determine optimal location for test wells in the Wilcox and Edwards Aquifers. Assist with developing well specifications and supervise drilling, logging, and construction of brackish test wells. Conduct pumping test and sampling. Write reports that summarize and evaluate results. Evaluate Culebra well field for SAWS and make recommendations on additional wells in the Edwards aquifer. Supervise test and monitor wells constructed in the Carrizo and overlying aquifers for SAWS well fields in Gonzales County. Evaluation of Trinity aquifer well field in northern Bexar County, which included down-hole video, pumping tests, sampling, groundwater modeling and reports on groundwater availability from multiple well sites.

King Ranch Hydrogeologist - Kleberg, Jim Wells, Brooks and Kenedy County, Texas
Conducted groundwater consulting for the King Ranch with 825,000 acres in four counties. Supervise drilling construction, geophysical logging and performing pumping test and sampling of wells in Gulf Coast Aquifer. Assist with the GMA and groundwater district issues.

RELEVANT PROJECT EXPERIENCE

El Paso Water Utilities Kay Bailey Hutchinson Desalination Plant - El Paso, Texas
Supervise and report on drilling program for monitor wells into the Hueco Bolson aquifer for brackish water production site for desalinization for the El Paso Water Utilities. Perform groundwater evaluation for private entity and supervise well drilling for well completed in the fractured limestone aquifer east of town.

Hays County, Texas
Groundwater availability study and report that included test well construction, logging, testing and analytical groundwater modeling for 1,600-acre development utilizing the Trinity aquifer. Second project com¬pleted specifications and other contract documents for test hole drilling and testing and for constructing and equipping a public-water-supply well completed in the middle Trinity aquifer.

Bell County, Texas
Groundwater availability study and report that included test well construction, logging, testing and analytical and numerical groundwater modeling for 1,400-acre development utilizing the Trinity aquifer. Additional study of water quality issues with wells open to the upper Glen Rose limestone.

Kendall County, Texas
Consulting on groundwater availability from the Trinity aquifer for two clients with planned commercial developments, one over 6,000 acres and the other over 1,300 acres in size. Work included many phases of well drilling and testing and groundwater modeling with reports submitted to Kendall County Engineer and Cow Creek GCD.

Kerr and Bandera Counties, Texas
Conducted hydrologic studies and co-authored report on the lower Trinity aquifer for the Texas Water Development Board.

Del Rio, Texas
Studies included pumping tests, sampling for inorganic and microparticulate constituents, test hole drilling and estimating groundwater availability. Also, assisted with engineered design and specification of a new public water-supply well, supervision of drilling, construction and testing of Edwards aquifer well.

Fair Oaks Ranch, Texas
Report on pumping test and analytical groundwater model of the Middle Trinity aquifer for the Fair Oaks Ranch well field.

Edwards Aquifer - San Antonio Region, Texas
Conducted continuing studies on the Edwards aquifer for a variety of issues related to lawsuits involving the San Antonio Water System, including irrigation and water-level impacts, correlation of Comal springflow with different monitor wells, evaluation of fresh-water/saline-water monitor well data, population and well distribu¬tion of Edwards aquifer users, various hydrogeologic studies, and springflow augmentation or replacement.

Edwards and Trinity Aquifers - San Antonio Region, Texas
Groundwater studies for the Edwards Underground Water District that included field data collection, interpretation and reports evaluating Edwards and Trinity aquifers. Author on studies of groundwater resource of northern Bexar County, hydrologic communication between the Glen Rose and Edwards aquifer, and the groundwater divides evaluation on the northeastern and western ends of the Edwards aquifer.

PUBLICATIONS AND PRESENTATIONS

Stein, W.G., 2004, "Continuing Education Course: Aquifer Testing," Texas Groundwater 2004 at State Capitol sponsored by Texas State University, course coordinator and instructor.

Stein, W.G. and G. B. Ozuna, 1995, "Geologic Framework and Hydrogeologic Characteristics of the Edwards Aquifer Recharge Zone, Bexar County, Texas," U. S. Geological Survey Water-Resources Investigations Report 95-4030, 8 p., 1 plate.

Stein, W. G., 1995, "Hays County Ground-Water Divide," in A Look at the Hydro¬stratigraphic Members of the Edwards Aquifer in Travis and Hays Counties, Texas - Guide Book, Austin Geological Society, p. 23-34.

Stein, W.G., 1994, "Hydro¬geologic Characteristics of the Edwards Aquifer, Bexar County, Texas," Annual Meeting, American Institute of Hydrology.

Stein, W. G., 1993, "Population and Well Distribution for the Edwards Aquifer," in Proceedings, Man's Effect on Hydrologic Systems, Fall Meeting, AWRA Texas Section, p. 17 22.

Stein, W.G., 1993, "Hydrogeologic Map and Characteristics of the Recharge Zone of the Edwards Aquifer, Bexar County, Texas," MS Thesis, University of Texas at San Antonio, 83 p.

Stein, W. G., 1991, "Hydro¬geologic Characteristics of the Edwards Aquifer Recharge Zone in Northern Bexar County, Texas" in Abstracts with Programs, Annual Meeting, Geological Society of America, v. 23, no. 5.

Ozuna, G. B. and W. G. Stein, "Quality of the Shallow Groundwater in Southwest Bexar County, Texas," U. S. Geo¬logical Survey Water Resources Investigations Report, 72 p.

Ozuna, G. B., G. M. Nalley and W. G. Stein, 1988, "Compilation of Hydro¬logic Data for the Ed¬wards Aquifer, San Antonio Area, Texas, 1986, with 1934-86 Summa¬ry," Edwards Underground Water District Bulletin 46, 147 p.

MICHAEL KEESTER
Senior Hydrogeologist

EDUCATION
M.S., Hydrogeology, Oklahoma State University, Stillwater, Oklahoma, 2002
Thesis: "Arsenic in the Central Oklahoma Aquifer"

B.A., Philosophy/Religion, Oklahoma Baptist University, Shawnee, Oklahoma, 1996

REGISTRATION
Professional Geoscientist #10331, State of Texas

TECHNICAL SOCIETIES
- National Ground Water Association
- International Association of Hydrogeologists
- International Association for Mathematical Geology

Mr. Keester is a Professional Geoscientist (Texas #10331) that began his career as a hydrogeologist in 2003. During his career, he has conducted and supervised hydrogeologic investigations throughout Texas and Oklahoma. His specialization is the determination of groundwater availability with respect to quantity and quality through quantitative assessment of groundwater flow and transport by way of numerical modeling, evaluation of aquifer hydraulics, and appraisal of hydrochemical characteristics.

Michael has conducted appraisals of water quality in several aquifers with varying lithologic characteristics in Texas and Oklahoma. His evaluations of groundwater quality began with research and utilization of available sample data from the U.S. Geological Survey, Texas Water Development Board, Texas Commission on Environmental Quality, and other public entities. To supplement sample data, Mr. Keester developed custom tools within Microsoft Excel for the calculation of groundwater salinity using downhole measurements recorded on geophysical logs obtained from the Railroad Commission of Texas along with other public and private entities.

SUMMARY OF PROFESSIONAL EXPERIENCE
April 2014 to Present: Senior Hydrogeologist with LBG-Guyton Associates, Austin, Texas
July 2003 to April 2014: Consulting Hydrogeologist with Thornhill Group, Inc., Round Rock, Texas

SPECIFIC PROJECT EXPERIENCE
Clearwater Underground Water Conservation District – Trinity Aquifer – Bell County, Texas
Provided professional hydrogeologic consulting services to the District since 2014. Work includes scientific representation before Groundwater Management Area 8 during the joint planning process for establishing desired future conditions of the Trinity Aquifer. Have performed numerous Northern Trinity / Woodbine Groundwater Availability Model runs to evaluate potential projects and possible aquifer management practices. Responsibilities also include regular presentations before the District Board and Stakeholders.

Catahoula Formation – Gulf Coast Aquifer – Montgomery County, Texas
Performed extensive evaluations of likely water quality characteristics in the deep brackish aquifer using publically available geophysical logs. Developed custom tools within Microsoft Excel for performing rapid calculations of the apparent groundwater salinity based on measurements recorded on the geophysical log header and tracks. Tools created included functions for identifying errors and for limiting calculation results to applicable methods. Result from calculations were compared and with available water quality data from the Texas Water Development Board Groundwater Database and presented to clients for determining drilling depth and completion targets.

Central Oklahoma Water Resources Authority – Brackish Groundwater Supplies – Canadian County, Oklahoma
Conducted an extensive evaluation of potential brackish groundwater resources for treatment and use by local municipalities. Prepared model evaluations to determine the likelihood of long-term production and the potential effects on fresh groundwater resources used by others. Work involved interpretation of geophysical logs to assess the structure of the formations and potential salinity of the groundwater. Data were compiled in Microsoft Access project database for use and expansion during future studies. Geographic Information System (GIS) files and maps prepared in ArcMap by ESRI were documented with metadata, compiled into a Map Package (MPK) format, and provided to the clients as part of the final report.

PUBLICATIONS AND PRESENTATIONS

"Desired Future Conditions" – The Process, The Rules, The Conclusions, Why Science Matters? Presented at the Bell County Water Symposium, Belton, Texas, 2015

Status of the Middle Trinity Aquifer in Central Texas. Presented at the Bell County Water Symposium, Belton, Texas, 2014

Water Level Changes in Texas Aquifers. Presented at the TCEQ Public Drinking Water Conference, Austin, Texas, 2014

Unlock the Opportunity! A Re-Evaluation of the Lower Trinity Aquifer in Central Texas. Presented at the NGWA Groundwater Summit, Denver, Colorado, 2014.

Physical and Regulatory Constraints on Groundwater Availability. Presented at the NGWA Summit, San Antonio, Texas, 2013.

Rational and Empirical Ground-Water Modeling. Essay and Presented at the CLE International Texas Water Law Conference, Austin, Texas, 2012.

KRISTIE LAUGHLIN
Senior Hydrogeologist

EDUCATION
B.S. in Geological Sciences (Hydrogeology/ Environmental Geology Option), 2000
University of Texas at Austin

REGISTRATIONS
- Professional Geoscientist #10100, State of Texas
- Professional Geoscientist #372, State of Louisiana

Kristie Laughlin has over 15 years of experience providing technical support for a variety of geologic and ground-water investigations. Ms. Laughlin primarily provides the geologic interpretation and framework required for groundwater models and applications. She has provided substantial technical support for numerous water supply evaluations for the private sector, large regional water planning studies as well as numerous smaller projects for groundwater conservation districts.

She has technical experience in lignite mine permitting, both in industry and regulatory, specifically in Carrizo-Wilcox overburden characterization, surface water characterization and analysis of probable hydrologic consequences of mining on surface water quantity and quality. Additionally, she has been involved in large-scale site assessments and ground-water monitoring programs for industrial clients such as petroleum refineries, pipelines and manufacturing facilities.

Ms. Laughlin has over 30 years of experience in geologic mapping. Her drafting background is primarily in ground-water/environmental applications and petroleum exploration using both ArcGIS and AutoCAD.

SUMMARY OF PROFESSIONAL EXPERIENCE
2012 to present: Senior Hydrogeologist with LBG-Guyton Associates, Austin, Texas
2007 to 2012: Hydrogeologist with LBG-Guyton Associates, Austin, Texas
2003 to 2007: Engineering Specialist with Railroad Commission of Texas, Surface Mining and Reclamation Division, Austin, Texas
2002 to 2003: Staff Hydrogeologist with Pastor, Behling & Wheeler, LLC, Round Rock, Texas
1999 to 2002: Hydrogeologist, LBG-Guyton Associates, Austin, Texas
1998 to 1999: Hydrologic Technician/Research Assistant, with US Geological Survey, Austin, Texas
1997 to 1999: Geologic Technician/CAD Operator with MFG, Inc., Austin, Texas
1990 to 1997: Geologic Technician/CAD Operator/Draftsman with Hall Southwest, Corp., Austin, Texas

SPECIFIC EXPERIENCE

North Trinity GAM, Conceptual Model
Compiled and or estimated historical pumping data for the conceptual model for years 1900 through 2010 by county by use. Reviewed historic state groundwater reports for Texas, Arkansas and Oklahoma, compiled historic springflow data and locations, compiled flowing well data (primarily from Hill), extracted historic USDA farm census data to calculate historic livestock and irrigated acreage prior to existing compiled data, geospatially located hundreds of geophysical logs from W.F. Guyton's log library for potential inclusion in stratigraphic database.

Evaluation of Hydrochemical and Isotopic Data in Groundwater Management Areas 11, 12 and 13
Compiled well data, geophysical logs, selected preliminary geochemical transect wells, determined stratigraphic formation tops and constructed strike and dip transects through three separate areas of the study. The transects were the foundation for the geochemical modeling evaluation to determine change in geochemical signatures as water migrated along the transect.

PROJECT EXPERIENCE

UT Lands - Andrews, Ector, Loving, Ward and Winkler Counties
Compiled formation tops from over 750 geophysical logs from UT Lands data and other multiple sources (TWDB BRACS database, TWDB groundwater database, TDLR water well reports, historic state groundwater publications, TCEQ water well reports, and W.F. Guyton log library) to create a stratigraphic database for aquifers underlying UT Lands, verified compiled stratigraphic data against existing published GAM-associated surfaces, created stratigraphic cross sections transecting UT Lands, provided all databases and image file of data utilized to create database, cross-sections and report.

Confidential Client – Reeves County
Assessed the thickness and extent of Capitan Reef Complex aquifer. Reviewed existing stratigraphic and hydrogeological information on wells in the vicinity of the Site, included an exhaustive search of available geophysical logs, drilling records, scout tickets; pump test records, current groundwater conceptual models and all available data. Determined the Capitan Reef to be thicker than previously indicated in published reports.

City of Midland – Loving and Winkler Counties
Participated in the technical assessment of groundwater conditions to deliver up to 20 MGD of newly developed groundwater to the City of Midland. Analyzed the collected field data, confirmed structural trough located beneath the property. Driller's logs, geologist's logs, and geophysical logs were evaluated to select well locations. Constructed cross sections, determined base of Pecos Valley Alluvium encountered at the Ranch.

Confidential Client – Glasscock County
Performed a county-wide assessment of potential frac water resources available in Glasscock County, Texas. Relevant data required for this project included electric logs and aquifer specific data pertaining to well records, water levels, water quality, historical water use and projected demands. Structure and isopach maps for each potential source were created. Based on the structural data, potential water sources located between land surface and the San Andres Formation were investigated. Made recommendations to the operator of the best two or three groundwater options based upon the collective data for each of these potential groundwater sources. Water quality data was also considered where available. A maximum TDS of approximately 40,000 mg/L was used for general guidance in selecting potential resources.

Omimex – Reeves County
Investigated the availability of groundwater resources for a portion of Reeves County, Texas. The investigations were based on the review, compilation, and interpretation of hydrogeological information from available resources. Relevant data required for this project included geologic studies, well yields, water levels, and water quality information. The data from the testing and evaluation allowed for a comprehensive understanding of the hydrogeology of the Rustler aquifer in this area. Made recommendations to the operator of the best development options based upon the collective data for the potential groundwater source.

Expanded Brackish Desalination Well Field – Wilson County
Created structural strike and dip cross sections connecting the SAWS ASR facility and the Wilson County well field. Extended existing structure maps and isopachs of the Wilcox hydrostratigraphic units in Wilson County.

City of San Angelo – Tom Green County
Investigated feasibility of injection wells for disposing concentrated brine generated from the treatment of slightly brackish groundwater supply. Analyzed and mapped available injection well data to present the injection formation, the depth intervals permitted for injection, and the permitted surface injection pressures.

BRANT KONETCHY
Hydrogeologist

EDUCATION
M.S. Geology,
University of Kansas,
Lawrence, Kansas, 2014

B.S. Geosciences,
Trinity University,
San Antonio, Texas, 2012

Brant is a recent graduate from the University of Kansas where he obtained his masters in Geology with emphasis and focus on hydrogeology. His research was on quantifying the relationship between groundwater flux and heat induced temperature response in a laboratory sandbox setting. His current work focuses on geographic information systems, mapping and interpolation hydrogeologic data in a spatial context. Brant also works with manipulation and automation of large datasets, in order to efficiently obtain data of interest. Brant is proficient in ArcGIS, statistical program R (R studio), and Microsoft Office suite. He holds a B.S. in geoscience at Trinity University.

SUMMARY OF PROFESSIONAL EXPERIENCE
2014 to present: Hydrogeologist I with LBG-Guyton Associates, Austin, Texas
2010: Field Technician with Thornhill Group, Inc., Round Rock, Texas
2009: Intern, Thornhill Group, Inc., Round Rock, Texas

PROJECT EXPERIENCE
Source Water Assessment and Protection Program
Managed and processed data for 12 utilities within the SWAP program, producing maps and datasets with updated locations of wells and potential sources of contamination. Performed field work and set up and managed tremble GPS unit for data collection.

Prairielands Groundwater Conservation District
Analyzed metered well data within PGCD to produce a technical memo addressing potential concerns with NTWGAM simulated pumping data discrepancies. Manipulation of pumping datasets and geographical information systems to determine aquifer well designations, pumping volumes per aquifer based on hydrogeological properties, and determination of spatial locations of model cell grids relative to actual well locations. Developed a Theis drawdown model within R to evaluate well spacing concerns. The model allows for the replication and production of multiple scenarios to evaluate various drawdown possibilities, as well as automated production of graphs. The data used within the Theis model was acquired and processed from the North Trinity Groundwater Availability Model.

University of Texas Lands
Analyzed geophysical well logs within University of Texas lands to determine depth of formations to improve and develop depth surfaces to those formations. Develop script in R to manipulate TWDB groundwater database files to easily determine the most recent groundwater level readings for the purposes of producing groundwater contour levels within ArcGIS.

Regional Water Planning
Worked within regions A, D,E,F,I,J producing final maps and figures for the various regions. Work involved manipulation of state well databases, spatial analysis using ArcGIS to produce contours and raster datasets, and plotting of regional climate data. Geographical data needed for regional water planning strategies were developed in ModelBuilder within ArcGIS, that was automated to allow for quick and uniform process to create individual geodatabeses for each groundwater strategy for Regions A,E,F, and J.

Middle Trinity Groundwater Conservation District
Developed python scripts for ArcGIS to automatically produce a series of maps showing off various datasets within the MTGCD area. Developed a 3D model of the district using data from the North Trinity Groundwater Availability Model.

Brazos Valley Groundwater Conservation District
He produced a 3D model of the district using data collected from well logs as well as surface data obtained from the Yegua-Jackson Groundwater Availability Model.

Southern GMA 8
Developed python scripts that produced a series of maps over the entire extent of the southern GMA 8 area, as well as the individual counties.

Hughbert Collier, Ph.D., P.G.

Senior Vice President, Collier Consulting, Inc.
hughbert@collierconsulting.com
(254) 968-8721

Profile:

Dr. Collier's professional experience includes over thirty years of consulting, research, technical support for litigation, and teaching throughout the United States. Dr. Collier has conducted petrophysical and hydrogeological investigations of a number of aquifers throughout the United States. He has also provided technical support, including field investigations, hydrogeological reports, petrophysical analyses of fresh and saline water aquifers, and reviews of technical reports, for a number of clients.

Hughbert has been the principal investigator for a number of research projects in which he was the geologist, hydrogeologist, and/or petrophysicist. One of his specialties is the hydrogeological characterization of aquifers by integrating various types of data (e.g. borehole geophysics, water analyses, pumping tests, cuttings, cores, and surface geophysics). This expertise has been applied to a number of groundwater studies, environmental litigation cases, and brackish water studies.

Hughbert has authored a dozen papers, including a textbook, **Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas**. He has taught short courses for the National Ground Water Association and Environmental Education Enterprises. He has taught undergraduate and graduate geology and hydrogeology courses at Tarleton State University, Stephenville, Texas.

Dr. Collier manages the technical team at Collier Consulting, Inc. Hughbert is a Licensed Professional Geologist in Texas, Arkansas, and Florida.

Capabilities:

- Quantifying Brackish Water Resources
- Borehole Geophysical Techniques
- Groundwater Investigations
- Subsurface Stratigraphy
- Petrophysics
- Expert Witness Testimony

Professional Experience:

Senior Vice President, Collier Consulting, Inc., 1997-Present
Associate Professor, Geology Department, Tarleton State University, 1994-1998.
Associate Professor, Geology Department, Abilene Christian University,1982-1993.

Education

Ph.D Geosciences, 1993.
University of Texas at Dallas, Dallas, TX.

Master of Divinity, 1981.
Abilene Christian University, Abilene, TX.

M.A.T. in Geology, 1977
Mississippi State University, Starkville, MS.

B.S. Geology, 1975.
1975 & 77 Mississippi State University, Starkville, MS.

A.A. Science
Freed Hardeman College, Henderson, TN, 1973

Professional Affiliations:

Association of Ground Water Scientists and Engineers
Fort Worth Geological Society
Society of Professional Well Log Analysts
Texas Ground Water Association

Related Experience:

- Numerous hydrogeologic studies throughout the State, focusing on aquifer characterization and water quality
- Aquifer characterization, including brackish water characterization, in North Texas
- Conducted a research project for the Texas Water Development Board, which resulted in the publication of **Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas**, 1993, Texas Water Development Board Report 343 **(two volumes)**
- Delineated brackish and saline groundwater within San Patricio County, Texas
- Mapped, quantified, and developed brackish groundwater resources across the Permian Basin for several oil and gas companies
- Mapped, quantified, and developed the brackish groundwater resources for portions of Cameron County, Texas
- Characterized the fresh/saline-water interface in the Edwards Aquifer in New Braunfels and San Marcos, Texas
- Researched techniques for calculating hydraulic conductivity from borehole geophysical logs
- Quantified water quality in the Ogallala aquifer, Roberts County, Texas
- Taught borehole geophysical short courses throughout the United States

Recent Publications/ Presentations:

"Techniques for Determining Groundwater Quality from Borehole Geophysical Logs", a presentation given at various local, state, and national meetings.

Mirror, Mirror, On the Wall, Who's the Fairest Aquifer of Them All? – Locating and Assessing Aquifers Suitable for Storing Excess Water, AGWT, 2014. Collier and Collier.

Water, Water Everywhere…Finding What's Not Fit to Drink, AGWT, 2013. Collier and Collier.

Groundwater Resources: What to Expect When You're Expecting Shale Gas Development in Your Area, AGWT, 2012. Collier and Collier.

Issues in Groundwater Hydrology: "Let's Open Our Minds", IWSCOT, 2011. Collier and Collier.

Groundwater Conservation Districts and the Future of Groundwater Production in Texas, IWSCOT, 2010. Collier and Collier.

Desired Future Conditions and the Availability of Groundwater Supplies, TRWA, 2008. Collier and Collier.

"Squeezing More of Life's Blood from Rocks" – Options for Increased Groundwater Production, IWSCOT, 2007. Collier and Collier.

NMR and Acoustic Signatures in Vuggy Carbonates of South Florida @ in 2001 SPWLA Transactions. Parra, Hackert, Collier, and Bennett.

"Characterization of dispersion, attenuation, and anisotropy at the Buena Vista Hills field, California", Geophysics, 2001, 66, p. 90-96. Hackert, Parra, Brown, and Collier.

Characterization of Fractured Zones in the Twin Creek Reservoir, Lodgepole Field, Utah-Wyoming Overthrust Belt, Petrophysics, 2000, 41, p. 351-362. Parra and Collier.

Feasibility of Detecting Seismic Waves Between Wells at the Fractured Twin Creek Reservoir, Utah-Wyoming Overthrust Belt in Reservoir Characterization-Recent Advances, AAPG Memoir 71, 1999, p. 251-261. Parra, Collier, and Angstman.

Integrating Sample, Seismic, Petrophysical, and Engineering Data to Revitalize an Old Field, poster session at the 1998 Southwest Section AAPG Convention. Collier, Shaw, and McCracken.

Estimation of Components of Elastic Scattering and Intrinsic Attenuation via Well Control at the Buena Vista Hills Field, SEG International Exposition & 68th Annual Meeting, 1998. Parra, Hackert, Brown, and Collier.

Mechanism of Sulfide Formation in Rural Water Wells Contaminated with Hydrocarbons, 1998, Ground Water Protection Council Annual Forum.

Sublette, Waclawczyk, and Collier.

"Utilization of Interwell Seismic Logging for Formation Continuity at the Gypsy Test Site, Oklahoma", The Log Analyst, 1998, 39, p. 16-25. Parra, Zook, and Collier.

Seismic Signatures of the Fractured Twin Creek Reservoir, Utah-Wyoming Overthrust Belt, SEG International Exposition & 67th Annual Meeting, 1997. Parra, Collier, and Richards.

Steps for Creating a Digital Database@, 1997 West Texas Geological Society Fall Symposium. Collier, McCracken, and Shaw.

Quantification of the Depth and Volume of Mud Filtrate Invasion in Boreholes Drilled with the Mud Rotary Drilling Method. Proceedings of the Eleventh National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods 1997.

Seismic Signatures of the Lodgepole Fractured Reservoir in Utah-Wyoming Overthrust Belt, Fourth International Reservoir Characterization Conference Proceedings, 1997, p. 1-19.

Petrophysical Properties and Geology of Selected Intervals in the Frio Formation, Stratton Field for Modeling Interwell Seismic Logging Responses, in SPWLA 1997 Transactions, paper FFF.

Petrophysical Properties and Geology of Selected Intervals in the Frio Formation, Stratton Field, South Texas, for Modeling Interwell Seismic Logging Responses. Poster session at the 1996 G.C.A.G.S. Annual Convention. Collier and Parra.

Interwell Seismic Logging for Formation Continuity at the Gypsy Test Site, Oklahoma, The Journal of Applied Geophysics, 1996, 35, p. 45-52. Parra, Zook, and Collier.

"Transmissivity of the Albuquerque Aquifer: Estimates by Advanced Logging Techniques", at the 39th New Mexico Water Conference, Albuquerque, New Mexico, November 3 - 4, 1994. Shomaker and Collier.

"Guided Wave Propagation Techniques for Reservoir Characterization in the Gypsy Test Site, Oklahoma" Poster session at the October, 1994 Society of Exploration Geophysicists Annual Meeting. Parra, Zook, and Collier.

Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas, 1993, Texas Water Development Board Report 343 (two volumes).

"Utilization of the Borehole Televiewer in Fracture Analysis" in Proceedings of the FOCUS Conference on Eastern Regional Ground Water Issues 1992, p. 765-779, coauthored with Michael Ridder.

Investigation of the Fresh/Saline Water Interface in the Edwards Aquifer in

New Braunfels and San Marcos, Texas, Report 92-02 (two volumes), Edwards Underground Water District, coauthored with Diane Poteet.

"Proper Application of Borehole Geophysical Techniques to the Analysis of a Carbonate Aquifer: A Case History" in Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems 1992, p. 55-70.

"MRIL* An Environmentally Safe Measure of Porosity and Permeability" in Proceedings of the Fourth International Symposium on Borehole Geophysics for Minerals, Geotechnical, and Groundwater Applications 1991, Collier and Coates.

"Recognizing High Porosity-Low Permeability Sandstone Reservoirs with Routine Logs: A Case History" in SPWLA 1989 Transactions, paper W. p. 1-25.

"Assessment of the Dielectric Tool As a Porosity Log" in Proceedings of the Third National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring, and Geophysical Methods 1989, p. 151-165.

"A Guide to Selecting the Proper Borehole Resistivity Logging Suite" in Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems 1989, p. 310-24.

"Petrographic Analysis of Thin Sections of Cuttings and Sidewall Cores: An Effective Method for Obtaining Geological Data" in Southwest AAPG 1989 Convention Transactions, p. 35-42.

"Reservoir Characterization of the Camar Sand, Henderson Field, Concho County, Texas: a Stratigraphic Trap in a Lobate Delta System:" poster session at the 1989 National AAPG convention.

"The Effect of Isolated Biomoldic Porosity on the Log Analysis of a Pennsylvanian Carbonate Reservoir in North Texas" in SPWLA 1988 Transactions, paper X, p. 1-16.

"Recommendations for Obtaining Valid Data from Borehole Geophysical Logs" Proceedings of the Second National Outdoor Action Conference on Aquifer Restoration, Ground Water Monitoring and Geophysical Methods 1988, volume II, p. 897-923, Collier and Alger.

"Reservoir Characteristics and Depositional Environments of an Upper Strawn Series Pennsylvanian Capps Limestone and Fry Sandstone Core in the Lake Abilene Field, Taylor County, Texas" in Southwest AAPG 1987 Convention Transactions, p. 29-45.

"The Ellenburger of Central and West-Central Texas: A Literature Review" in Exploration in a Mature Area, Abilene Geological Society, 1985, p. 190-207.

Short Courses Instructed

Borehole Geophysical Techniques for Groundwater Applications A three-day short course for the Southwest Florida Water Management District, June 20-22, 2000.

Borehole Geophysical Techniques for Groundwater and Environmental Applications A two-day short course for Daniel B. Stephens and Associates, Albuquerque, New Mexico, June 8-9, 2000.

"New Techniques for Calculating Hydraulic Conductivity from Borehole Geophysical Logs" at the National Ground Water Association 10th National Outdoor Action Conference and Exposition, May 15, 1996, Las Vegas, Nevada.

"Borehole Geophysical Techniques for Environmental and Groundwater Investigations, Part I and Part II" Two two-day short courses for the Louisiana Department of Environmental Quality, November 6-7 and December 18-19, 1995.

"Advanced Applications of Borehole Geophysics to Hydrogeological Investigations" A one-day course sponsored by the National Ground Water Association in Natick, Massachusetts, October 3, 1995. I designed the course and taught most of it.

"Geophysical Well Log Acquisition and Interpretation" A three-day short course presented to the St. Johns River Water Management District, Palatka, FL, June 28-30, 1995.

"Applications of Borehole Geophysics to Hydrogeological Investigations" A two-day short course that I designed, coordinated, and partially taught at the National Ground Water Association 9th National Outdoor Action Conference and Exposition, May 2, 1995, Las Vegas, Nevada.

"Borehole Geophysical Logging of Cased Holes" at the National Ground Water Association 9th National Outdoor Action Conference and Exposition, May 2, 1995, Las Vegas, Nevada.

"Calculating Hydraulic Conductivity from Borehole Geophysical Logs" at the National Ground Water Association 8th National Outdoor Action Conference and Exposition, May 24, 1994, Minneapolis, Minnesota.

"Utilization of Borehole Geophysical Techniques in Ground-Water and Hazardous Waste Investigations" Knoxville, Tennessee; St. Petersburg, Florida (Florida Water Well Convention); Brooksville, Florida (SWFWMD); Houston, Texas; Austin Texas (Texas Ground Water Convention); Sacramento and Baldwin Park, California; Seattle, Washington; Boston, Massachusetts; Two or three-day courses 1989 to 1993.

"An Introduction to the Hydrogeology of Carbonate Aquifers" National Ground Water Association, San Francisco, California, three-day course 1991; Tampa, Florida, four-day course 1992; San Antonio, Texas, four-day

course 1993.

"Field Hydrogeology: Investigative Techniques Required to Characterize a Multi-Aquifer System" Environmental Education Enterprises , Austin, Texas, four-day course 1993 and 1994.

"Borehole Geophysical Techniques for Ground Water and Environmental Investigations" two-day school for the 1993 NGWA Outdoor Action Conference.

"Tips for Verifying the Accuracy of Water Analyses" two-hour workshop for the 1993 NGWA Outdoor Action Conference.

"An Introduction to Borehole Geophysical Methods" and "The Hydrogeology of Carbonate Aquifers" three hours of instruction for the 1991 and 1992 NGWA Outdoor Action Conferences.

"An Introduction to Borehole Geophysical Methods", "The Hydrogeology of Carbonate Aquifers", and "Using a PC to Analyze Well Logs", five hours of instruction for the 1990 NWWA Outdoor Action Conference.

"Do's and Don'ts for Effective Borehole Logging," one-hour workshop for the 1989 NWWA National Convention.

"Applications of Borehole Geophysical Techniques to Ground Water and Hazardous Waste Investigations," four-hour course for the 1989 NWWA Outdoor Action Conference, Orlando, Florida.

"Utilization of Borehole Geophysical Tools in the Investigation of Hazardous Waste Sites," a five-hour course for the 1989 Lower Mississippi Valley Section of AEG Convention.

"Interpretation of Electric Well Logs," a one-hour review for the Texas Water Well Association.

"Techniques for Evaluating Sandstone and Carbonate Reservoir in North Texas," a seven-hour course for the North Texas Geological Society, 1989.

"Sandstones of the Eastern Shelf," a four-hour course for the 1989 SW AAPG meeting, San Angelo, Texas.

"Geological Data Available from Conventional Cores," a six-hour course for the Oklahoma City Geological Society, 1987.

"Evaluation of Petroleum Reservoirs," a seven-hour course at Midwestern State University, Wichita Falls, Texas, 1986 and 1987.

Matthew R. Wise, P.G.
Geophysicist/Geologist
Collier Consulting, Inc.

Profile: Matthew has 17 years of professional experience encompassing various types of geoscientific work. He is skilled in integrating geophysical data analysis with hydrogeological studies. His responsibilities include geophysical data collection, processing, and interpretation, groundwater quality assessments, as well as subsurface geology studies.

Capabilities:

- Subsurface characterization
- Hydrogeology
- Geophysical log analysis
- Surface geophysics (Resistivity, EM, GPR, Seismic)
- Borehole geophysics
- Geographic Information Systems
- Environmental compliance
- Project management

Software Experience: ArcGIS 10.1, ArcGIS Spatial Analyst, Microsoft Access, Neuralog

Professional Experience:
Geophysicist/Geologist – Collier Consulting, Inc. 2014-present
Geoscientist – Texas Water Development Board 2009-2014
Geologist – Rosengarten, Smith, & Associates, Inc. 2005-2009
Geologist – Parsons Corporation 1999-2004
Geophysicist – BHP Petroleum Inc. 1997-1999

Education/ Training:
Master of Science in Geophysics, 1999, Wright State University, Dayton, OH.
Bachelor of Science in Geology with Geophysics Emphasis, 1995, University of Kentucky, Lexington, KY.
OGCI Fundamentals of Drilling Technology
OGCI Basic Well Log Interpretation
ESRI Building Geodatabases
John Estepp's Determining Groundwater Quality Using Geophysical Logs

Professional Affiliations:
Environmental and Engineering Geophysical Society
Texas Board of Professional Geoscientists (PG License 6867)

Related Experience:

- Analyzed geophysical well logs for stratigraphy, lithology, and groundwater salinity.
- Completed a study on the brackish groundwater resources of the Queen City and Sparta aquifers in Atascosa and McMullen counties disseminated as a Texas Water Development Board publication.
- Contributed to a study on brackish groundwater resources of the Pecos Valley Aquifer disseminated as a Texas Water Development Board publication.
- Contributed to a study on brackish groundwater resources of the Lower Rio Grande Valley region disseminated as a Texas Water Development Board publication.
- Calculated groundwater volumes in aquifer storage to aid water planning efforts.
- Participated in a hydrogeologic study of the Trinity Aquifer, focusing on water production and groundwater chemistry.
- Produced technical plans documenting geophysical data analysis techniques and procedures.
- Planned and implemented acquisition of geophysical well logs from multiple state agencies.
- Designed and executed ground penetrating radar and frequency domain electromagnetic induction surveys to delineate former solid waste disposal areas at hazardous waste sites.
- Collected, inverted, and analyzed 2D direct current resistivity and induced polarization data to identify groundwater flow pathways in fractured limestone for remedial design studies.
- Provided cost estimates, determined staffing needs, and prepared project plans for multiple environmental remediation clients that were completed within established budget parameters.

Recent Publications:

Meyer, J.E., Croskrey, A.D., Wise, M.R., and Kalaswad, S., 2014, Brackish groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas: TWDB Report 383, 169 p.

Wise, M.R., 2014, Queen City and Sparta aquifers, Atascosa and McMullen counties, Texas: Structure and brackish groundwater: TWDB Technical Note 14-01, 67 p.

Meyer, J.E., Wise, M.R., and Kalaswad, S., 2012, Pecos Valley Aquifer, West Texas: Structure and brackish groundwater: TWDB Report 382, 86 p.

Louis Fleischhauer, P.G.

Senior Hydrogeologist, Collier Consulting, Inc.
lou@collierconsulting.com
(254) 640-3911 (mobile)

Profile: Louis has over 30 years work experience in groundwater investigations for both resource development and environmental compliance. Much of this experience is field-based, with a focus on well-site geology, well installation, and well testing, sampling and instrumentation. He has conducted numerous groundwater availability studies for permitting and for development of development of water supply.

Capabilities:

- Subsurface stratigraphic and hydrogeological characterization
- Hydrogeology
- Geophysical log analysis
- Groundwater availability studies
- Pumping test design and analysis
- Well design and testing
- Project management

Software Experience: Aqtesolv, Microsoft Access, ArcGIS 10.1

Professional Experience:
Hydrogeologist – Collier Consulting, Inc. 2013-present
Hydrogeologist – Kleinfelder, 2000-2013
Hydrogeologist – Brazos Environmental and Engineering Services, 1992-2000
Geoscientist – Callahan Environmental Consultants, 1991-1992
Geoscientist – UNC Geotech/UNC Remediation, 1986-1991
Geoscientist – Bendix Field Engineering, 1979-1986

Education/ Training:
Master of Science in Geology, 1977, New Mexico Institute of Mining and Technology, Socorro, NM.
Bachelor of Science in Geology, 1974, Baylor University, Waco, TX
Johnson Screens, Groundwater and Wells Design
Baroid Mud School, Water Well Applications

Professional Affiliations:
National Ground Water Association
Austin Geological SocietyTexas
Board of Professional Geoscientists (PG License 4496)

Relevant Experience:

- Regional subsurface stratigraphic correlation and hydrogeologic analysis of basal Trinity Group across 14 counties in Central Texas
- Assessment of localized increase of sodium chloride in a Trinity Aquifer municipal well
- Groundwater availability certification for Trinity water supply wells in Bell County
- Well-site geology for Trinity well installation, Bell County
- Availability and quality study of Trinity Aquifer for industrial use in Dallas County
- Hydrogeologic study for permitting the Armstrong WSC #2 well pursuant to rules of the Clearwater Underground Water Conservation District, Bell County.
- Groundwater availability study of Edwards-Trinity and Dockum aquifers, near Maryneal, Nolan County, Texas

Peter G. George, Ph.D., P.G.

Senior Hydrogeologist, Collier Consulting, Inc.
peter_g@collierconsulting.com
(512) 699-0697 (cell)

Profile: Dr. George has been working as a geoscientist for 22 years. During that time he has worked in academic research, the mining industry, the oil and gas industry, state agencies, and currently at Collier Consulting. At the Universities of Texas and Wyoming he worked on field and lab based studies involving structural geology and geochronology. He worked as a field geologist on mining projects in the western United States and managed testing of Halliburton's petrophysical software. At the Texas Water Developed Board he produced reports on the hydrogeology of the State's aquifers and at the Railroad Commission of Texas he worked on protecting groundwater resources during oil and gas production. At Collier Consulting he has worked on a variety of projects related to groundwater production in Texas.

Capabilities:

- Stratigraphic and Structural analysis
- Subsurface characterization
- Techniques in Remote Sensing
- Hydrogeology
- Geochemistry
- Geographic Information Systems
- Borehole geophysics
- Project management

Software Experience: ArcGIS 10.2 (Spatial Analyst, 3D Spatial Analyst, Arc Hydro, ArcScene), Microsoft Access, AquaChem, Surfer, and GeoGraphix

Professional Experience:
Senior Hydrogeologist – Collier Consulting, Inc. 2012-present
Hydrogeologist – Railroad Commission of Texas 2011-2012
Hydrogeologist – Texas Water Development Board 2004-2011
Geologic Software Analyst: Halliburton - Landmark Graphics 1997-2001
Visiting Researcher: University of Texas at Austin, 1994-1996
Post-doctoral Research Associate: University of Wyoming, 1992-1993
Field Geologist: E. K. Lehman and Associates, 1981-1982

Education
Louisiana State University, Ph.D. in Geology, 1993 (Dissertation concerned structural geology and geochronology of Cretaceous rocks in southern California)
Texas A&M University, M.S. in Geology, 1985 (Thesis concerned carbonate stratigraphy of Mississippian rocks in New Mexico)
Duke University, B.S. in Geology (minor in Economics), 1980

Professional Affiliations:

Geological Society of America
American Association of Petroleum Geologists
Texas Board of Professional Geologists (PG License 10344)

Related Experience:

- Revised the original Aquifers of Texas report published in 1995. For this study, Dr. George adjusted the boundaries of the Blaine, Bone Spring–Victorio Peak, Edwards (Balcones Fault Zone), Igneous, Lipan, Ogallala, Pecos Valley, Seymour, and Trinity aquifers (Texas Water Development Board - TWDB).
- Characterized Hudspeth County's groundwater in terms of availability and water quality, and assessed the boundary of the Bone Spring–Victorio Peak Aquifer (TWDB).
- Completed a study on the geology of the Carrizo-Wilcox Aquifer to a Texas Water Development Board publication on the aquifers of the Upper Coastal Plains of Texas (TWDB).
- Contributed to a study on shared aquifers bordering the State of Texas. The study included stratigraphic interpretations, constructing maps, and analyzing groundwater chemistry (TWDB).
- Involved in developing conceptual geologic models and DFCs for the State's groundwater availability models (TWDB).
- Determined depths to fresh and brackish groundwater, mostly in West Texas, based on geophysical logs provided to the Railroad Commission of Texas (Groundwater advisory Unit of the RRC).
- In-house hydrogeologic study of the Rustler Aquifer looking at its stratigraphy east of the TWDB's defined boundaries (Collier Consulting).
- Hydrogeologic studies of the Trinity Aquifer, focusing on water production and groundwater chemistry (Collier Consulting)

Recent Publications:

Petrossian, R., George, P.G., Backhouse, S., Davidson, S.C., Bradley, R.G., and Boghici, R., *in prep.,* Transborder Aquifers: Texas Water Development Board, Draft Report.

George, P., Mace, R.E., and Petrossian, R., 2011, Aquifers of Texas: Texas Water Development Board Report 380, 172 p. (http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R380_AquifersofTexas.pdf)

George, P. G., 2009, Geology of the Carrizo-Wilcox Aquifer, in Hutchison, W. R., Davidson, S. C., Brown, B. J., and Mace, R. E., eds., Aquifers of the Upper Coastal Plains of Texas: Texas Water Development Board Report 374, p. 17-34. (http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R374_AquifersofUpperCoastalPlains.pdf)

George, P., Mace, R.E., and Mullican, W.F., III, 2005, The hydrogeology of Hudspeth County, Texas: Texas Water Development Board Report 364, 95 p. (http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R364/R364.pdf)

Peter M. Schulmeyer, P.G.

Senior Hydrogeologist, Collier Consulting, Inc.
peter@collierconsulting.com
(254) 968-8741

Profile: Peter Schulmeyer has over 20 years of experience as a hydrogeologist. He has developed 3-d multi-layer groundwater flow models to study the shallow and confined aquifer systems and optimize well placement along the Gulf Coast and other area in Texas. The models simulated land surface subsidence, saltwater intrusion, and water levels. He has conducted subsurface mapping, geophysical log interpretation, and constructed cross-sections for formations in the Gulf Coast Aquifer System and the Permian, Pennsylvanian, Triassic, and Cretaceous Systems across many Counties in Texas. Conducted water quality assessment for wells completed in various aquifers. Performed aquifer tests to determine hydraulic properties in various aquifers.

Capabilities:

- Groundwater modeling
- Hydrogeology - Subsurface characterization
- Geographic Information Systems (GIS)
- Borehole and Surface geophysics
-

Software Experience: MODFLOW, MODPATH, MT3D and PEST through Groundwater Vistas, GMS, or Argus Numerical Environments, GeoGraphix Explorer, UNSAT-H, ESRI ArcGIS (ARCINFO/ARCVIEW/Spatial Analyst/SDE), Earth Visualization (EVS-PRO)/Mining Visualization System (MVS), SURFER, AQTESOLVE, Aquachem, FORTRAN and C computer programming.

Professional Experience:
Senior Hydrogeologist - Collier Consulting Inc., Stephenville, Texas, 1/24/2011 - Present
Engineering Technician – Prime Star Solar Inc., Arvada, Colorado, 11/29/2010-1/20/2011
Hydrogeologist - Entrix, Houston, Texas, 5/2010 - 6/2010
Hydrogeologist - Geomega Corp, Boulder, Colorado, 9/2009 - 12/2009
Hydrogeologist - Trihydro Corp., Laramie, Wyoming, 6/2005 - 8/2009
Geohydrologist - URS Corp, West Valley, New York, 1/2003 – 3/2005
Hydrogeologist - USGS, Iowa City, Iowa, 5/1990 – 6/2001
Physical Science Techician - USGS, Lakewood, Colorado, 6/1986 – 5/1990

Education/ Training:
Masters of Science in Hydrogeology, May 2002, University of Iowa,
Bachelors in Geophysics, December 1983, University of Colorado,
2013, Using MODFLOW-USG in Groundwater Vistas
2013, Model Calibration with Groundwater Vistas and PEST
40 hr. Hazardous waste operations and emergency response
2006, Environmental Visualization System
1996, Statistical Methods for Environmental Data Analysis

1995, Advanced Modeling of Ground-Water Flow
1994, Modeling of Ground-Water Flow Using Finite-Difference Methods
1993, Surface Geophysical Techniques in Water Resources Investigations
1991, Ground-Water/Surface-Water Relationships

Professional Affiliations:

National Ground Water Association
International Association of Hydrogeologists
American Geophysical Union

Professional Licenses:

Professional Geoscientist, Texas, PG-11085
Professional Geologist, Wyoming, PG-3624

Related Experience:

- A numerical groundwater flow model was developed to investigate the effect of Aquifer Storage and Recovery wells on area water level, land surface subsidence, and saltwater intrusion in the Gulf Coast Aquifer. MODFLOW-NWT (2005) was used to simulate water level changes and land surface subsidence in the Gulf Coast Aquifer under various pumping scenarios. SEAWAT was used to simulate saltwater intrusion that may result from pumping in the proposed well field. Over 151 geophysical well logs were analyzed using GeoGraphixs Explorer well log analysis software to determine the hydrostratigraphy of the area.
- Developed numerical groundwater flow model to investigate the effect of a well field on area water level, land surface subsidence, and saltwater intrusion in the Chicot Aquifer. MODFLOW (2005) was used to simulate water level changes and land surface subsidence in the Chicot aquifer under various pumping scenarios. SEAWAT was used to simulate saltwater intrusion that may result from pumping in the proposed well field. Over 350 geophysical well logs were analyzed using GeoGraphixs Explorer well log analysis software to determine the hydrostratigraphy of the area.
- Developed numerical groundwater flow model to investigate the effect of a well field on area water level in the Paleozoic aquifers in Cooke County, Texas. MODFLOW (2005) was used to simulate water level changes, optimize well field design, and determine any interaction between the the Paleozoic and the Antlers Aquifers that may result from pumping in the proposed well field. Over 1000 geophysical well logs were analyzed using GeoGraphixs Explorer well log analysis software to determine the hydrostratigraphy of the area. Aquifer test were conducted on several production wells and analyzed using AQTESOLV to determine aquifer properties.
- Developed numerical groundwater flow model to investigate the effect of a well field on area water level, subsidence, and saltwater intrusion in the Chicot Aquifer. MODFLOW (2005) was used to simulate water level changes and subsidence in the Chicot aquifer under various pumping scenarios. SEAWAT was used to simulate saltwater intrusion that may result from the proposed well field. Over 330 geophysical well logs were analyzed using GeoGraphixs Explorer well log analysis software to determine the hydrostratigraphy of the area.
- Hydrostratigraphy of the Gulf Coast aquifer system was mapped using GeoGraphixs Explore well log analysis software on over 503 well logs and 4 cross sections were constructed. The resistivity curves were used to

estimate the conductivity of the groundwater in various sand units and map the aerial extent of fresher water units.

- Developed numerical groundwater flow model to investigate the effect artesian pressure on wells in the Mirando Sand. Over 600 geophysical logs were analyzed using GeoGraphix log analysis software to determine the tops and bottoms of the various formations of interest to the study. AquaChem geochemical software was used to analyze and correlate water quality samples for water type from the different hydrologic units.
- Developed numerical groundwater flow and contaminant transport models to locate municipal water wells, predict plume migration, contaminant load, time of travel, simulate subsidence, and saltwater intrusion

Publications:

Schulmeyer, Peter M., 2002, Groundwater flow modeling and analysis of zone of transport around Cedar Rapids municipal well fields, Iowa, Masters thesis, University of Iowa, Iowa City, Iowa, 124 p.

Schulmeyer, P. M. and Schnoebelen, D. J., 1998, Hydrogeology and water quality in the Cedar Rapids area, Iowa, 1992-96: U.S. Geological survey, Water-Resources Investigations Report 97-4261, 77 p.

Schulmeyer, P. M., 1995, Effect of the Cedar River on the quality of the ground-water supply for Cedar Rapids, Iowa: U.S. Geological Survey, Water-Resources Investigations Report 94-4211, 68 p.

Schulmeyer, P. M., Barnes, K. K., and Squillace, P. J., 1995, Hydrologic data from the lower Cedar River basin, Iowa, 1989-91: U.S. Geological Survey, Open-File Report 94-711,116 p.

Boyd, R. A., Kuzniar, R. L., and Schulmeyer, P. M., 1999, Selected Hydrologic Data from the Cedar Rapids Area, Linn County, Iowa, April 1996 through March 1999: U.S. Geological Survey, Open-File Report 99-461, 241 p.

Schnoebelen, D. J. and Schulmeyer, P. M., 1996, Selected Hydrologic Data from the Cedar Rapids Area, Benton and Linn Counties, Iowa, October 1992 Through March 1996: U.S. Geological Survey, Open-File Report 96-471, 171 p.

Squillace, P. J., Caldwell, J. P., Schulmeyer, P. M., and Harvey, C. A., 1996, Movement of agricultural chemicals between surface water and ground water, lower Cedar River Basin, Iowa: U.S. Geological Water Supply Paper 2448, 59 p.

Remus, J. I. and Schulmeyer, P. M., 1996, Locating abandoned river control structures using continuous seismic reflection techniques: Sixth Federal Interagency Sedimentation Conference, March 10-14, 1996, Las Vegas, Nevada

Presentations:

Schulmeyer, P. M., 1999, Effect of the Cedar River on the ground-water Supply of the City of Cedar Rapids, Iowa: Abstracts, International Riverbank Filtration Conference, November 4-6, 1999, Louisville, Kentucky, p. 33.

Schulmeyer, P. M., 1996, Modeling the ground-water flow system near Cedar Rapids, Iowa: Programs and Abstracts, 41st Midwest Ground Water Conference, September 29 - October 1, 1996, Lexington, Kentucky, p. 80.

Schulmeyer, P. M., 1993, Application of continuous seismic-reflection and seismic-refraction methods to mapping an alluvial aquifer in Iowa: Programs and Abstracts, 38th Annual Midwest Ground Water Conference, October 6-8, 1993, Champaign, Illinois, p. 33.

Schulmeyer, P. M., 1991, Relation of selected water-quality constituents to river stage in the Cedar River, Iowa. Abstracts of the technical meeting Monterey, California March 11-15,1991, U.S. Geological Survey Open-File Report 91-88, 18 p.

Schulmeyer, P. M. and Furlong, E. T., 1989, Methodological improvements in sediment organochlorine insecticide analyses: in U.S. Geological Survey Second National Symposium on Water Quality: Abstracts of the Technical Sessions, Orlando, Florida, November 12-17, 1989, U.S. Geological Open-File Report 89-409, 85 p.

Herbert Scott Hamlin

Research Associate

Years of Experience: 29

Number of Years with Firm: 24

Education:

- B.A., Anthropology, 1975, The University of Texas at Austin.
- M.A., 1984, The University of Texas at Austin.
- Ph.D., Geology, 1999, The University of Texas at Austin.

Professional History:

2007 – Present: Research Associate, Bureau of Economic Geology, Bureau of Economic Geology, The University of Texas at Austin.

2004 – 2007: Hydrologist, Texas Water Development Board, Austin, Texas.

2001 – 2003: Research Associate, Transgenomic, Inc., San Diego, California.

1983 – 2001: Research Associate, Bureau of Economic Geology, Bureau of Economic Geology, The University of Texas at Austin.

Professional Registration:

- Professional Geoscientist, Texas, 2006, No. 10169

Scott Hamlin is a Research Associate at the Bureau of Economic Geology with more than 25 years of professional experience in hydrogeology and petroleum geology. Both aquifers and petroleum reservoirs are composed of superimposed rock layers having contrasting properties, such as mineral composition, porosity, and fluid content. Dr. Hamlin uses geophysical well logs to distinguish and map these layers and to determine layer properties. He also integrates well log interpretation and layer characterization (stratigraphy) with hydrologic data, such as fluid pressures and chemical compositions, to develop comprehensive models of water-rock systems. At the Bureau of Economic Geology, Dr. Hamlin provides research and advice related to energy and environmental issues in the State of Texas. In this capacity, he has published reports that serve as references for resource management, presented seminars and workshops for public dissemination of technical information, and provided training for K-12 and college students. His report on the Carrizo-Wilcox aquifer in South Texas, for example, has become a standard reference for subsequent research including GAM development. His research on the hydrogeology of the Gulf Coast aquifer near salt domes has helped to shape policy regarding utilization of salt domes for brine disposal. His publications on petroleum resources of the Texas Gulf Coast and West Texas are also standard references. Dr. Hamlin spent almost four years at the Texas Water Development Board in the GAM program, where he worked on most of the aquifers in Texas and contributed significantly to the Trinity Hill Country, Edwards-Trinity Plateau, and Gulf Coast GAMs.

Relevant Project Experience

- Assessment of Brackish Water Use for Hydraulic Fracturing: Case Study Eagle Ford Shale Play. Shell-UT Unconventional Research Program. 2013-2014. *Lead Geologist.* Used electric logs (mean Ro method) to estimate volumes of fresh and brackish groundwater in the Carrizo-Wilcox aquifer in South Texas as potential source of water for hydraulic fracturing in the Eagle Ford Play. Interpreted groundwater salinity in context of stratigraphic and depositional framework.
- Groundwater Availability Model for the High Plains Aquifer System for TWDB. 2012-2014. *Principal Investigator.* Led hydrogeology tasks for the conceptual model. Used over 2000 geophysical logs to correlate layers and interpret lithology in 6 different aquifers. Constructed maps showing locations and thicknesses of all model layers. Constructed digital log cross sections for visualization of layer lithology and bed thicknesses in profile.
- Update of the Northern Trinity and Woodbine Groundwater Availability Model for GMA 8, Selected GCDs. 2011-2013. *Principal Investigator.* Led hydrostratigraphy tasks. Used over 1300 electric logs to correlate layers and interpret lithology and water quality. Constructed maps and cross sections showing hydrostratigraphy both regionally and locally in each GCD.
- State of Texas Advanced Oil and Gas Resource Recovery Program. 2008-2015. *Manager and Lead Geologist.* Regional stratigraphy and depositional systems analysis using geophysical logs, cores, and outcrops in support of oil and gas exploration and development in Texas. Managed four industry partnerships in the Wolfberry Play of West Texas. Prepared written reports and presented technology transfer workshops.

Relevant Publications, Presentations, and Reports:

Hamlin, H. S., and de la Rocha, Luciana, 2014, Using electric logs to estimate salinity and map resources of fresh and brackish groundwater (abs.): Geological Society of America Annual Meeting.

Hammes, Ursula, Hamlin, H. S., and Ewing, T. E., 2013, Geologic analysis of the Upper Jurassic Haynesville Shale in east Texas and west Louisiana: Reply: AAPG Bulletin, v. 97, no. 3, p. 529.

Hamlin, H. S., and Baumgardner, R. W., Jr., 2012, Wolfberry (Wolfcampian-Leonardian) deep-water depositional systems in the Midland Basin: stratigraphy, lithofacies, reservoirs, and source rocks: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 277, 62 p. + 4 pls. in pocket.

Hammes, U., Hamlin, H. S., and Ewing, T. E., 2011, Geologic analysis of the Upper Jurassic Haynesville Shale in east Texas and west Louisiana: AAPG Bulletin v. 95, no. 10, p. 1643–1666.

Hamlin, H. S., 2009, Ozona sandstone, Val Verde Basin, Texas: synorogenic stratigraphy and depositional history in a Permian foredeep basin: AAPG Bulletin, v. 93, no. 5, p. 573–594.

Hamlin, H. S., 2006, Salt domes in the Gulf Coast aquifer, *in* Mace R. E., Davidson, S. C., Angle, E. S., and Mullican, W. F., III, eds., Aquifers of the Gulf Coast of Texas: Texas Water Development Board Report 365, p. 217–230.

Hamlin, H. S., 1996, Frontier Formation stratigraphy on the Moxa Arch, Green River Basin, Wyoming: The Mountain Geologist, v. 33, no. 2, p. 35–44.

Dutton, S. P., Hamlin, H. S., Folk, R. L., and Clift, S. J., 1996, Early siderite cementation as a control on reservoir quality in submarine fan sandstones, Sonora Canyon gas play, Val Verde Basin, Texas, *in* Siliciclastic diagenesis and fluid flow: concepts and applications: SEPM (Society for Sedimentary Geology), Special Publication No. 55, p. 115–127.

Hamlin, H. S., Dutton, S. P., Seggie, Robert, and Tyler, Noel, 1996, Depositional controls on reservoir properties in a braid-delta sandstone, Tirrawarra oil field, South Australia: AAPG Bulletin, v. 80, no. 2, p. 139–156.

Hamlin, H. S., Clift, S. J., Dutton, S. P., Hentz, T. F., and Laubach, S. E., 1995, Canyon sandstones—a geologically complex natural gas play in slope and basin facies, Val Verde Basin, southwest Texas: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 232, 74 p.

Dutton, S. P., Hamlin, H. S., and Laubach, S. E., 1995, Geologic controls on reservoir properties of low-permeability sandstone, Frontier Formation, Moxa Arch, southwestern Wyoming: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 234, 89 p.

Hamlin, H. S., Dutton, S. P., Seggie, Robert, Tyler, Noel, and Yeh, J. S., 1995, Flow-unit characterization and recovery optimization of a braid-delta sandstone reservoir, Tirrawarra oil field, South Australia: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 231, 44 p.

Dutton, S. P., Clift, S. J., Hamilton, D. S., Hamlin, H. S., Hentz, T. F., Howard, W. E., Akhter, M. S., and Laubach, S. E., 1993, Major low-permeability-sandstone gas reservoirs in the continental United States: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 211, 221 p.

Marin, B. A., Clift, S. J., Hamlin, H. S., and Laubach, S. E., 1993, Natural fractures in Sonora Canyon sandstones, Sonora and Sawyer fields, Sutton County, Texas: Society of Petroleum Engineers, Paper No. SPE 25895, p. 523–531.

Hamlin, H. S., 1989, Hydrocarbon production and exploration potential of the distal Frio Formation, Texas Gulf Coast and offshore: The University of Texas at Austin, Bureau of Economic Geology Geological Circular 89-2, 47 p.

Hamlin, H. S., Smith, D. A., and Akhter, M. S., 1988, Hydrogeology of Barbers Hill salt dome, Texas Coastal Plain: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 176, 41 p.

Hamlin, H. S., 1988, Depositional and ground-water flow systems of the Carrizo–Upper Wilcox, South Texas: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 175, 61 p.

Hamlin, H. S., Smith, D. A., and Akhter, M. S., 1988, Hydrogeology of Barbers Hill salt dome, Texas Coastal Plain: The University of Texas at Austin, Bureau of Economic Geology Report of Investigations No. 176, 41 p.

Hamlin, H. S., 1984 (Thesis). Depositional and groundwater flow systems of the Carrizo–Upper Wilcox in South Texas: Austin, Texas, The University of Texas at Austin, 143 p.

Robert Reedy

Research Scientist Associate

Years of Experience: 23

Number of Years with Firm: 18

Education:

- B.S., 1982, New Mexico Institute of Mining and Technology.
- M.S., 1996, New Mexico Institute of Mining and Technology.

Professional Registrations/Affiliations:

- Professional Geoscientist (Texas) No. 4038

Professional History:

1997 – Present: Research Associate, Bureau of Economic Geology, the University of Texas at Austin.

1996 - 1997: Research Hydrologist, New Mexico Institute of Mining and Technology, Socorro, New Mexico.

1994 – 1997: Consultant, Socorro, New Mexico.

1984 – 1994: Senior Computer Graphics Specialist, Bohannan-Huston, Inc., Albuquerque, New Mexico.

1982 – 1983: Staff Geologist, Profile, Inc. Carlsbad, New Mexico.

1979 – 1980: Geological Assistant, Atlas Minerals, Naturita, Colarodo.

Hydrologic research focusing on unsaturated zone processes, land-atmosphere interactions, and water quality and quantity issues is Robert's expertise. His experience includes designing, installing, and maintaining monitoring and data acquisition systems; coordinating and conducting field activities, including soil coring and geophysical surveys and laboratory characterization of environmental sample physical and chemical properties; and, designing and maintaining digital databases and analyzing data. Project experience has included the design, specification, purchase, and construction of physical experimental apparatus to characterize solute mixing behavior in saturated fracture junctions over a range of flow regimes. He has published on his research to evaluate the impact of common agricultural fertilizers and pesticides on shallow ground-water quality, as well as infiltrometer experiments, water quality and soil sampling, electromagnetic induction surveys, and ground-water computer modeling.

Relevant Project Experience

- Supervisor of production of a wide range of topographic and engineering design maps and digital data-base products.
- Experience with CAD and GIS software packages, including DigiMap, Intergraph, AutoCAD and ARCInfo on various computer platforms including VAX, PC, and UNIX. Extensive use of digital terrain modeling techniques to generate surface contours and to perform volumetric analyses for hydrogeologic settings.

Relevant Publications, Presentations, and Reports:

Crosbie, R. S., Scanlon, B. R., Mpelasoka, F. S., Reedy, R. C., Gates, John, and Zhang, L., 2013, Potential climate change effects on groundwater recharge in the High Plains Aquifer, USA: Water Resources Research, v. 49, p. 1–16, doi:10.1002/wrcr.20292.

Huang, Y., Scanlon, B. R., Nicot, J. -P., Reedy, R. C., Dutton, A. R., Kelley, V. A., and Deeds, Neil, 2012, Sources of groundwater pumpage in a layered aquifer system in the Upper Gulf Coastal Plain, USA: Hydrology Journal, v. 20, p. 783–796.

Scanlon, B. R., Reedy, R. C., Strassberg, Gil, Huang, Y., and Senay, G., 2011, Estimation of groundwater recharge to the Gulf Coast aquifer in Texas, USA: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Water Development Board, 33 p.

Reedy, R. C., Scanlon, B. R., Walden, Steven, and Strassberg, Gil, 2011, Naturally occurring groundwater contamination in Texas: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Water Development Board, variously paginated.

Sheffer, N. A., Scanlon, B. R., and Reedy, R. C., 2010, Evaluation of elevated arsenic levels in the Gulf Coast aquifer: The University of Texas at Austin, Bureau of Economic Geology, report prepared for Texas Commission on Environmental Quality, under contract no. 582-8-75374-117, 20 p.

Scanlon, B. R., Stonestrom, D. A., Reedy, R. C., Leaney, F. W., Gates, John, and Cresswell, R. G., 2009, Inventories and mobilization of unsaturated zone sulfate, fluoride, and chloride related to land use change in semiarid regions, southwestern United States and Australia: Water Resources Research, v. 45, W00a18.

Scanlon, B. R., Nicot, J. -P., Reedy, R. C., Kurtzman, D., Mukherjee, A., and Nordstrom, D. K., 2009, Elevated naturally occurring arsenic in a semiarid oxidizing system: Southern High Plains aquifer, Texas, USA: Applied Geochemistry, v. 24, no. 11 p. 2061–2071.

Reedy, R. C., Nicot, J. -P., Scanlon, B. R., Deeds, N. E., Kelley, V. A., and Mace, R. E., 2009, Chapter 11. Groundwater recharge in the Carrizo-Wilcox aquifer, *in* Aquifers of the upper coastal plains of Texas: Texas Water Development Board Report 374, p. 185–203.

Scanlon, B. R., Reedy, R. C., and Bronson, K. F., 2008, Impacts of land use change on nitrogen cycling archived in semiarid unsaturated zone nitrate profiles, southern High Plains, Texas: Environmental Science & Technology v. 42, no. 20, p. 7566–7572.

Scanlon, B. R., Reedy, R. C., Sheffer, N. A., and Gates, John, 2009, Evaluation of sources and mobilization of contaminants in Texas with reference to public water systems: The University of Texas at Austin, Bureau of Economic Geology, final contract report prepared for the Texas Commission on Environmental Quality, 36 p.

Reedy, R. C., Sheffer, N. A., Gates, J. B., and Scanlon, B. R., 2009, Sampling to assess stratification of groundwater chemistry for compliance strata in the Gulf Coast aquifer system: The University of Texas at Austin, Bureau of Economic Geology, report prepared for Texas Commission on Environmental Quality, 20 p.

Gates, John, Nicot, J. -P., Scanlon, B. R., and Reedy, R. C., 2008, Evaluation of elevated arsenic levels in the Gulf Coast aquifer: The University of Texas at Austin, Bureau of Economic Geology, report prepared for Texas Commission on Environmental Quality, under Contract No. 263404-22, 21 p. + tables and figs.

Reedy, R. C., Davidson, S., Crowell, A., Gates, John, Akasheh, O. Z., and Scanlon, B. R., 2008, Groundwater recharge in the Central High Plains: Roberts and Hemphill Counties: The University of Texas at Austin, Bureau of Economic Geology, contract report prepared for the Panhandle Water Planning Group, 68 p.

Reedy, R. C., Scanlon, B. R., Nicot, J. -P., and Tachovsky, J. A., 2007, Unsaturated zone arsenic distribution and implications for groundwater contamination: Environmental Science & Technology, v. 41, no. 20, p. 6914–6919.

Reedy, R. C., Scanlon, B. R., and Tachovsky, J. A., 2007, Analysis of nitrate contamination in groundwater in Texas: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Commission on Environmental Quality.

Reedy, R. C., Kurtzman, D. J., Tachovsky, J. A., and Scanlon, B. R., 2006, Development and field evaluation of an aquifer stratification testing program system: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Commission on Environmental Quality, 26 p.

Tachovsky, J. A., Reedy, R. C., Kurtzman, D. J., and Scanlon, B. R., 2006, Reconnaissance study of groundwater recharge in the central High Plains of Texas: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Panhandle Groundwater Conservation District, 28 p.

Scanlon, B. R., Tachovsky, J. A., Reedy, Robert, Nicot, J. -P., Keese, Kelley, Merwade, Venkatesh, Howard, M. T., Mullins, G. J., Wells, G. L., and Ortiz, D. M., 2005, Groundwater-surface water interactions in Texas: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for TCEQ GWSW, 240 p.

Keese, K. E., Scanlon, B. R., and Reedy, R. C., 2004, Controls on groundwater recharge using unsaturated flow modeling, *in* Mace, R. E., Angle, E. S., and Mullican, W. F., III, eds., Aquifers of West Texas: San Angelo, Texas, Texas Water Development Board, Report 360, p. 269–291.

Reedy, R. C., Scanlon, B. R., and Dutton, A. R., 2003, Collection and analysis of environmental tracers for estimation of recharge rates in the GAM model of the central Carrizo-Wilcox aquifer, *in* Dutton, A. R., Harden, B., Nicot, J. P., and O'Rourke, D., eds., Groundwater availability model for the central part of the Carrizo-Wilcox aquifer in Texas: The University of Texas at Austin, Bureau of Economic Geology, final technical report prepared for Texas Water Development Board, under contract no. 2001-483-378, CD-ROM.

Reedy, R. C., and Scanlon, B. R., 2003, Soil water content monitoring using electromagnetic induction: Journal of Geotechnical and Geoenvironmental Engineering, November, p. 1028–1039.

Scanlon, B. R., Reedy, R. C., and Keese, K. E., 2003, Estimation of groundwater recharge in Texas related to aquifer vulnerability to contamination: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Texas Commission on Environmental Quality, 125 p.

Reedy, R. C., Scanlon, B. R., Bruce, B. W., McMahon, P. B., Dennehy, K. F., and Ellett, K. M., 2003, Groundwater recharge in the Southern High Plains, *in* Blandford, N. T., Blazer, D. J., Calhoun, K. C., Dutton, A. R., Naing, T., Reedy, R. C., and Scanlon, B. R., eds., Groundwater availability of the southern Ogallala Aquifer in Texas and New Mexico: numerical simulations through 2050: Daniel B. Stephens and Associates, final report prepared for Texas Water Development Board, variously paginated.

Scanlon, B. R., Christman, Marty, Reedy, R. C., Porro, Indrek, Simunek, Jirka, and Flerchinger, G. N., 2002, Intercode comparisons for simulating water balance of surficial sediments in semiarid regions: Water Resources Research, v. 38, no. 12, 16 p.

Dutton, A. R., Mace, R. E., and Reedy, R. C., 2001, Quantification of spatially varying hydrogeologic properties for a predictive model of groundwater flow in the Ogallala aquifer, northern Texas Panhandle, *in* New Mexico Geological Society Guidebook, 52nd Field Conference, Geology of the Llano Estacado, p. 297–308.

Dutton, A. R., Reedy, R. C., and Mace, R. E., 2001, Saturated thickness in the Ogallala aquifer in the Panhandle Water Planning Area–simulation of 2000 through 2050 withdrawal projections: The University of Texas at Austin, Bureau of Economic Geology, final report prepared for Panhandle Water Planning Group, Panhandle Regional Planning Commission, under contract no. UTA01-462, 61 p.

Dutton, A. R., Reedy, R. C., and Mace, R. E., 2000, Predicted saturated thickness in the Ogallala aquifer in the Panhandle Water Planning Area—numerical simulations of 2000 through 2050 withdrawal projections: The University of Texas at Austin, Bureau of Economic Geology, topical report prepared for Panhandle Water Planning Group, Panhandle Regional Planning Commission, under contract no. UTA99-0230, 72 p.

Dutton, A. R., Reedy, R. C., and Mace, R. E., 2000, Model of groundwater flow in the Ogallala aquifer in the northern Texas Panhandle: The University of Texas at Austin, Bureau of Economic Geology, data report prepared for the Panhandle Water Planning Group, Panhandle Regional Planning Commission, under contract no. UTA99-0230, CD-ROM.

SECTION 5: HUB FORM

Rev. 09/15

HUB Subcontracting Plan (HSP)

QUICK CHECKLIST

While this HSP Quick Checklist is being provided to merely assist you in readily identifying the sections of the HSP form that you will need to complete, it is very important that you adhere to the instructions in the HSP form and instructions provided by the contracting agency.

➤ **If you will be awarding all of the subcontracting work you have to offer under the contract to only Texas certified HUB vendors, complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors.
- ☐ Section 2 c. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you do not have a *continuous contract** in place for more than five (5) years *meets or exceeds* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors or only to Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you do not have a *continuous contract** in place for more than five (5) years *does not meet or exceed* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - No
- ☐ Section 4 - Affirmation
- ☐ GFE Method B (Attachment B) - Complete an Attachment B for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will not be subcontracting any portion of the contract and will be fulfilling the entire contract with your own resources (i.e., employees, supplies, materials and/or equipment, including transportation and delivery), complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - No, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources.
- ☐ Section 3 - Self Performing Justification
- ☐ Section 4 - Affirmation

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Rev. 09/15

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.13 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.14(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION-1 RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: LBG-Guyton Associates State of Texas VID #: 10609469704

Point of Contact: Heidi Moga Phone #: 512-327-9640

E-mail Address: hmoga@lbg-guyton.com Fax #: 512-327-5573

b. Is your company a State of Texas certified HUB? ☐ **- Yes** ☑ **- No**

c. Requisition #: 580-16-RFQ0008 Bid Open Date: 11/24/2015 (mm/dd/yyyy)

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

SECTION-2: RESPONDENT's SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods, services, transportation and delivery will be subcontracted**. Note: In accordance with 34 TAC §20.11, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☑ - *Yes*, I will be subcontracting portions of the contract. (If *Yes*, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - *No*, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods, services, transportation and delivery. (If *No*, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	Percentage of the contract expected to be subcontracted to non-HUBs.
1	Data Acquisition	3 %	%	3 %
2	Hydrogeologic Evaluation	4 %	%	4 %
3	GIS Dataset Development	3 %	%	3 %
4	Production Area Evaluation	2 %	%	2 %
5	Draft Project Report	2 %	%	2 %
6	Final Project Report	1 %	%	1 %
7		%	%	%
8		%	%	%
9		%	%	%
10		%	%	%
11		%	%	%
12		%	%	%
13		%	%	%
14		%	%	%
15		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	15 %	%	15 %

(Note: If you have more than fifteen subcontracting opportunities, a continuation sheet is available online at http://window.state.tx.us/procurement/prog/hub/hub-subcontracting-plan/).

c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, Item b.

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☑ - *No* (If *No*, continue to Item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements**."

☑ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

SECTION-2 RESPONDENT's SUBCONTRACTING INTENTIONS (CONTINUATION SHEET)

This page can be used as a continuation sheet to the HSP Form's page 2, Section 2, Item b. Continue listing the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	**Percentage of the contract expected to be subcontracted to non-HUBs.**
16		%	%	%
17		%	%	%
18		%	%	%
19		%	%	%
20		%	%	%
21		%	%	%
22		%	%	%
23		%	%	%
24		%	%	%
25		%	%	%
26		%	%	%
27		%	%	%
28		%	%	%
29		%	%	%
30		%	%	%
31		%	%	%
32		%	%	%
33		%	%	%
34		%	%	%
35		%	%	%
36		%	%	%
37		%	%	%
38		%	%	%
39		%	%	%
40		%	%	%
41		%	%	%
42		%	%	%
43		%	%	%
Aggregate percentages of the contract expected to be subcontracted:		**%**	**%**	**%**

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

SECTION-3 SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.)

If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment, to include transportation and delivery.

SECTION-4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at http://www.window.state.tx.us/procurement/prog/hub/hub-forms/progressassessmentrpt.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

James Beach	James Beach	Senior Vice President	11/24/2015
Signature	Printed Name	Title	Date (mm/dd/yyyy)

Reminder:

- If you responded "Yes" to SECTION 2, Items c or d, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded "No" SECTION 2, Items c and d, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.

HSP Good Faith Effort - Method A (Attachment A)

Rev. 09/15

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

IMPORTANT: If you responded "*Yes*" to **SECTION 2, Items c** or **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at http://window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
Collier Consulting, Inc.	☑ - Yes ☐ - No	1752761984900	$ 30,000	15 %
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

HSP Good Faith Effort - Method B (Attachment B)

Rev. 09/15

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

IMPORTANT*:** If you responded "No***" to **SECTION 2, Items c** and **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at http://window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan-gfe-achm-b.pdf.

SECTION B-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION B 2: MENTOR PROTÉGÉ PROGRAM

If respondent is participating as a Mentor in a State of Texas Mentor Protégé Program, submitting its Protégé (Protégé must be a State of Texas certified HUB) as a subcontractor to perform the subcontracting opportunity listed in **SECTION B-1**, constitutes a good faith effort to subcontract with a Texas certified HUB towards that specific portion of work.

Check the appropriate box (Yes or No) that indicates whether you will be subcontracting the portion of work you listed in SECTION B-1 to your Protégé.

☐ - Yes (If *Yes*, continue to SECTION B-4.)

☐ - No / Not Applicable (If *No* or *Not Applicable*, continue to SECTION B-3 and SECTION B-4.)

SECTION B 3: NOTIFICATION OF SUBCONTRACTING OPPORTUNITY

When completing this section you MUST comply with items a, b, c and d, thereby demonstrating your Good Faith Effort of having notified Texas certified HUBs and trade organizations or development centers about the subcontracting opportunity you listed in SECTION B-1. Your notice should include the scope of work, information regarding the location to review plans and specifications, bonding and insurance requirements, required qualifications, and identify a contact person. When sending notice of your subcontracting opportunity, you are encouraged to use the attached HUB Subcontracting Opportunity Notice form, which is also available online at http://www.window.state.tx.us/procurement/prog/hub/hub-subcontracting-plan.

Retain supporting documentation (i.e., certified letter, fax, e-mail) demonstrating evidence of your good faith effort to notify the Texas certified HUBs and trade organizations or development centers. Also, be mindful that a working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.

a. Provide written notification of the subcontracting opportunity you listed in SECTION B-1, to three (3) or more Texas certified HUBs. Unless the contracting agency specified a different time period, you must allow the HUBs at least seven (7) working days to respond to the notice prior to you submitting your bid response to the contracting agency. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

b. List the **three (3) Texas certified HUBs** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the company's Texas Vendor Identification (VID) Number, the date you sent notice to that company, and indicate whether it was responsive or non-responsive to your subcontracting opportunity notice.

Company Name	Texas VID (Do not enter Social Security Numbers.)	Date Notice Sent (mm/dd/yyyy)	Did the HUB Respond?
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No

c. Provide written notification of the subcontracting opportunity you listed in SECTION B-1 to two (2) or more trade organizations or development centers in Texas to assist in identifying potential HUBs by disseminating the subcontracting opportunity to their members/participants. Unless the contracting agency specified a different time period, you must provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response to the contracting agency. A list of trade organizations and development centers that have expressed an interest in receiving notices of subcontracting opportunities is available on the Statewide HUB Program's webpage at http://www.window.state.tx.us/procurement/prog/hub/mwb-links-1/.

d. List **two (2) trade organizations or development centers** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the date when you sent notice to it and indicate if it accepted or rejected your notice.

Trade Organizations or Development Centers	Date Notice Sent (mm/dd/yyyy)	Was the Notice Accepted?
		☐ - Yes ☐ - No
		☐ - Yes ☐ - No

HSP Good Faith Effort - Method B (Attachment B) Cont.

Rev. 09/15

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

SECTION B-4: SUBCONTRACTOR SELECTION

Enter the item number and description of the subcontracting opportunity you listed in **SECTION 2, Item b,** of the completed HSP form for which you are completing the attachment.

a. Enter the item number and description of the subcontracting opportunity for which you are completing this Attachment B continuation page.

Item Number:_____ Description:_____

b. List the subcontractor(s) you selected to perform the subcontracting opportunity you listed in **SECTION B-1**. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Emplioyer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

c. If any of the subcontractors you have selected to perform the subcontracting opportunity you listed in **SECTION B-1** is **not** a Texas certified HUB, provide written justification for your selection process (attach additional page if necessary):

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to **all** the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity it (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

Rev. 09/15

HUB Subcontracting Opportunity Notification Form

In accordance with Texas Gov't Code, Chapter 2161, each state agency that considers entering into a contract with an expected value of $100,000 or more shall, before the agency solicits bids, proposals, offers, or other applicable expressions of interest, determine whether subcontracting opportunities are probable under the contract. The state agency I have identified below in Section B has determined that subcontracting opportunities are probable under the requisition to which my company will be responding.

34 Texas Administrative Code, §20.14 requires all respondents (prime contractors) bidding on the contract to provide notice of each of their subcontracting opportunities to at least three (3) Texas certified HUBs (who work within the respective industry applicable to the subcontracting opportunity), and allow the HUBs at least seven (7) working days to respond to the notice prior to the respondent submitting its bid response to the contracting agency. In addition, at least seven (7) working days prior to submitting its bid response to the contracting agency, the respondent must provide notice of each of its subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code, §20.11(19)(C).

We respectfully request that vendors interested in bidding on the subcontracting opportunity scope of work identified in Section C, Item 2, reply no later than the date and time identified in Section C, Item 1. Submit your response to the point-of-contact referenced in Section A.

SECTION: A PRIME CONTRACTOR'S INFORMATION

Company Name: LBG-Guyton Associates

State of Texas VID #: 10609469704

Point-of-Contact: Heidi Moga

Phone #: 512-327-9640

E-mail Address: hmoga@lbg-guyton.com

Fax #: 512-327-5573

SECTION: B CONTRACTING STATE AGENCY AND REQUISITION INFORMATION

Agency Name:

Point-of-Contact:

Phone #:

Requisition #: 580-16-RFQ0008

Bid Open Date: 11/24/2015 (mm/dd/yyyy)

SECTION: C SUBCONTRACTING OPPORTUNITY RESPONSE DUE DATE, DESCRIPTION, REQUIREMENTS AND RELATED INFORMATION

1. Potential Subcontractor's Bid Response Due Date:

If you would like for our company to consider your company's bid for the subcontracting opportunity identified below in Item 2,

we must receive your bid response no later than _____ (Central Time) on _____ (Date (mm/dd/yyyy)).

In accordance with 34 TAC §20.14, each notice of subcontracting opportunity shall be provided to at least three (3) Texas certified HUBs, and allow the HUBs at least seven (7) working days to respond to the notice prior to submitting our bid response to the contracting agency. In addition, at least seven (7) working days prior to us submitting our bid response to the contracting agency, we must provide notice of each of our subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code, §20.11(19)(C).

(A working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.)

2. Subcontracting Opportunity Scope of Work:

3. Required Qualifications: ☐ - Not Applicable

4. Bonding/Insurance Requirements: ☐ - Not Applicable

5. Location to review plans/specifications: ☐ - Not Applicable

HSP Good Faith Effort - Method A (Attachment A)

Rev. 09/15

Enter your company's name here: LBG-Guyton Associates Requisition #: 580-16-RFQ0008

IMPORTANT: If you responded "*Yes*" to **SECTION 2, Items c** or **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at http://window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
BEG	☐ - Yes ☑ - No		$ 30,000	15 %
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

SECTION 6: OWNERSHIP OF BUSINESS ENTITY

Texas Water Development Board
REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008
FOR SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

SECTION 6 – OWNERSHIP OF BUSINESS ENTITY
(if applicable)
FOR PROJECT NO. 6: Nacatoch Aquifer

Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity Submitting the RFQ

THIS FORM IS NOT APPLICABLE

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

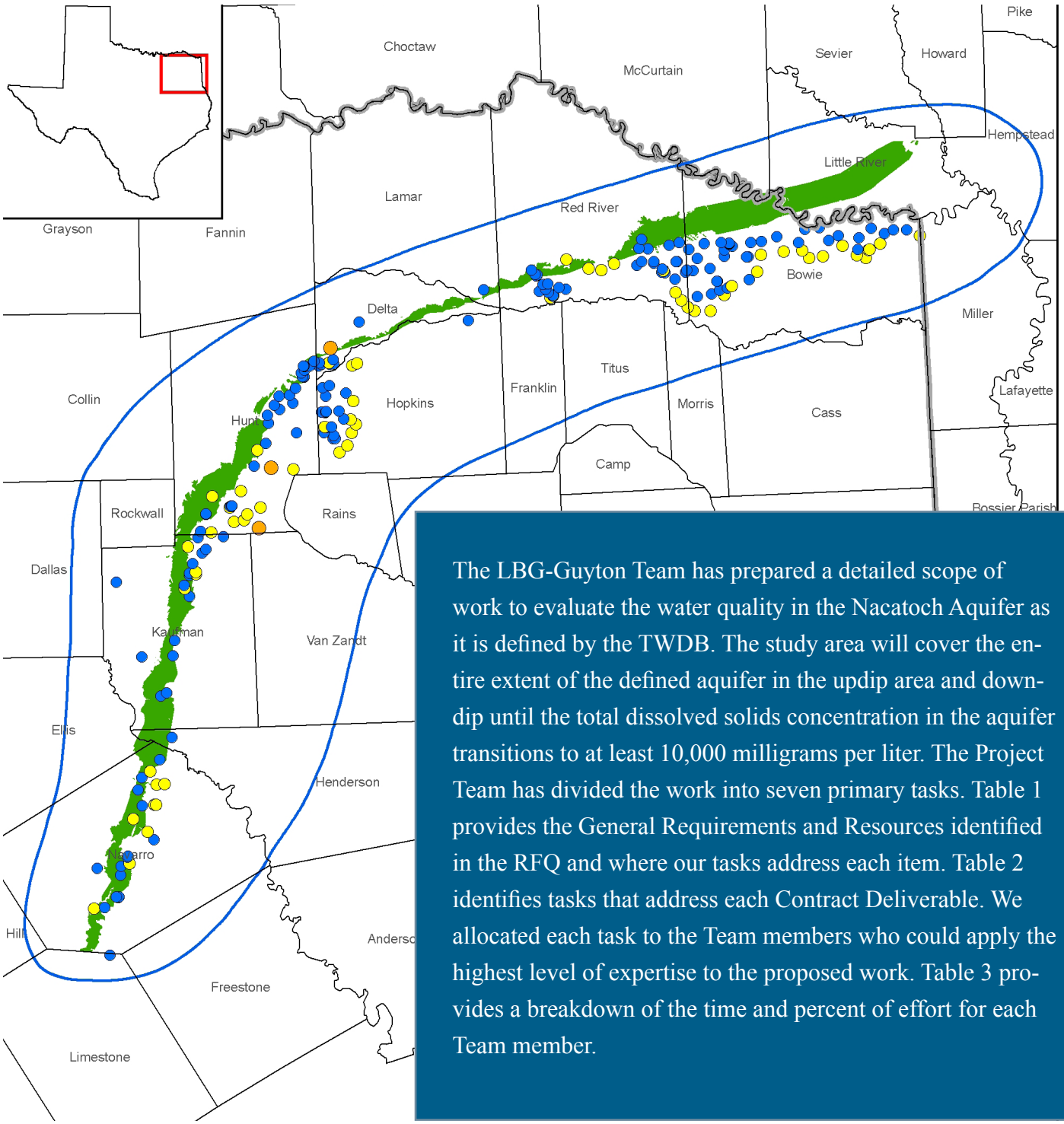
_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

SECTION 7: DETAILED SCOPE OF WORK



The LBG-Guyton Team has prepared a detailed scope of work to evaluate the water quality in the Nacatoch Aquifer as it is defined by the TWDB. The study area will cover the entire extent of the defined aquifer in the updip area and downdip until the total dissolved solids concentration in the aquifer transitions to at least 10,000 milligrams per liter. The Project Team has divided the work into seven primary tasks. Table 1 provides the General Requirements and Resources identified in the RFQ and where our tasks address each item. Table 2 identifies tasks that address each Contract Deliverable. We allocated each task to the Team members who could apply the highest level of expertise to the proposed work. Table 3 provides a breakdown of the time and percent of effort for each Team member.

SECTION 7: DETAILED SCOPE OF WORK

Table 1. Tasks Addressing the Project General Requirements and Resources

RFQ Item (Section 2.2)	Requirement or Resource	Task
A	Three-dimensional delineation of fresh, brackish, and saline groundwater	Task 2, Task 3, & Task 4
B	Groundwater salinity classification per the U.S.G.S.	Task 4.3
C	Quantify volume of fresh, brackish, and saline groundwater	Task 4.3
D	Delineation of potential production areas	Task 4.4
E	Meet with TWDB to discuss recommendations of potential production areas and develop a prioritized list of areas	Task 1.1.3
F	Stakeholder meeting regarding implementing House Bill 30	Task 1.2.1
G	Determine the volume of brackish groundwater that the potential production areas are capable of producing	Task 5
H	Utilization and familiarity with the BRACS Database	Task 2
I	TWDB expects to meet with the Project Team four times during the Project and conduct two stakeholder meetings	Task 1
J	TWDB Contractor Meetings	Task 1.1
J.1	Project initiation	Task 1.1.1
J.2	Discussion and approval of Project methodology	Task 1.1.2
J.3	Discussion and prioritization of potential production areas	Task 1.1.3
J.4	Project completion	Task 1.1.4
K	Additional technical meetings and/or TWDB staff visits	Task 1.1
L	Detailed monthly progress reports	Task 1.3
M	A draft report documenting the technique(s) and approaches for geophysical well log interpretation	Task 2.5 Task 1.1.2
N	A meeting to discuss the potential production areas	Task 1.1.3 Task 1.2.2
O	A formal presentation on the results of the Project to TWDB	Task 1.1.4
P & P.1	Two formal stakeholder meetings	Task 1.2
Q	Attend and present at the second stakeholder meeting	Task 1.2
R	Meetings and/or conference calls will be held on regular business days during regular business hours	Task 1.1Task 1.2

SECTION 7: DETAILED SCOPE OF WORK

Table 2. Tasks Addressing the Project Deliverables

RFQ Item (Section 3.1)	Contract Deliverables	Task
A	Updated and new data for the BRACS Database	Task 2
B	Copies of water well reports, water quality reports, and geophysical well logs used in the study	Task 2.3 & Task 2.4
C	Three-dimensional GIS datasets that delineate groundwater salinity zones	Task 4.2 & Task 4.3
D	Three-dimensional GIS datasets that delineate potential production areas and the estimated volumes of brackish groundwater production in 30- and 50-year timeframes	Task 4.4 & Task 5
E	A technical report summarizing the study	Task 6 & Task 7
F	All geophysical well logs and all interpretation data values documented in a Microsoft Access BRACS database format	Task 2 & Task 3
G	New and updated maps of the water resources	Task 2
H	Technical report, Microsoft Access tables, GIS files with metadata, and groundwater modeling files related to project.	Task 4
I	Calculated volumes of groundwater within the aquifer and each TWDB-prioritized potential production area	Task 4 & Task 5
J	Training for TWDB staff, as needed (for example: volume calculations, salinity zone delineation)	Task 8
K	Draft and final reports delivered in Microsoft Word and PDF formats	Task 6 & Task 7
L	Compliance of GIS and data deliverables with BRACS program contract data requirements and conventions	Task 4.1

Table 3. Effort Breakdown by Task for Each Team Member

Task Number and Name	LBG-Guyton	BEG	Collier – HUB
1 – Project Management	100%	0%	0%
2 – Data Acquisition	50%	25%	25%
3 – Hydrogeologic Evaluation	50%	25%	25%
4 – GIS Dataset Development	50%	5%	45%
5 – Production Area Evaluation	100%	0%	0%
6 – Draft Project Report	70%	10%	20%
7 – Final Project Report	70%	10%	20%
Project Total	**70%**	**15%**	**15%**

SECTION 7: DETAILED SCOPE OF WORK

Task 1. Project Management, Meetings, and Communication

The project will require coordination between the Project Team, TWDB staff, and interested stakeholders. To monitor work efficiently amongst the Project Team, the project manager will use GanttProject, an open source project planning and tracking software, as the tool for tracking and managing tasks and deadlines. Use of the project management software will allow us to update TWDB staff and stakeholders quickly with a quantifiable assessment of the project completion status. As part of our coordination with the Project Team, TWDB staff, and stakeholders, we will provide updates on the project status in the form of a Gantt chart with each monthly status report.

The project will be complete prior to August 31, 2017 and we anticipate completion by July 1, 2017. Table 4 illustrates our proposed project schedule broken down by the seven primary tasks.

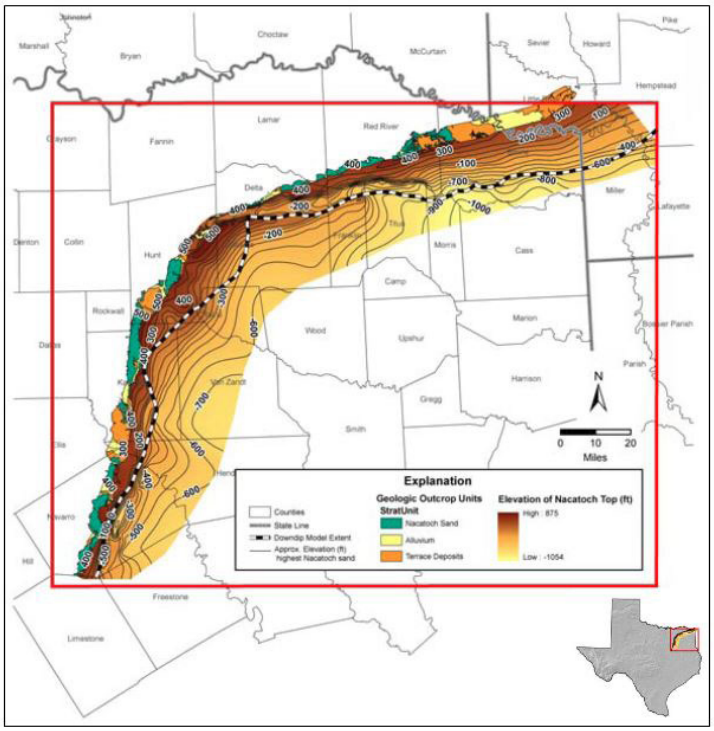


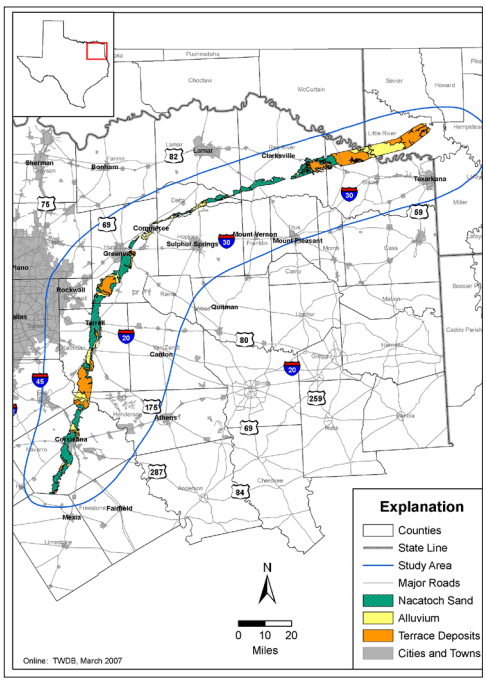
Table 4. Proposed Project Schedule by Task

Task Number and Name	2016												2017							
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
1 – Project Management																				
2 – Data Acquisition																				
3 – Hydrogeologic Evaluation																				
4 – GIS Dataset Development																				
5 – Production Area Evaluation																				
6 – Draft Project Report																				
7 – Final Project Report																				

SECTION 7: DETAILED SCOPE OF WORK

Task 1.1. Meetings with TWDB Staff

We anticipate four meetings with TWDB staff during the course of the project. However, we understand that we or the TWDB may need to schedule additional technical meetings either in person, through a webinar, or teleconference to discuss Project progress and issues. We also are aware that TWDB staff may periodically visit the Project Team's offices to assess progress on the Project. All meetings and/or conference calls will be held on regular business days (Monday through Friday) during regular business hours (8:00 a.m. to 5:00 p.m. CT) upon agreed dates and times. The following tasks describe the anticipated meetings.



Task 1.1.1. Project Kickoff Meeting

We will meet with the TWDB within two weeks following award of the contract for a project kickoff meeting. We anticipate that this meeting will focus on schedule refinements, TWDB interaction, and data acquisition and evaluation.

Task 1.1.2. Discussion and Approval of Project Methodology Meeting

After reaching 75 percent completion of Task 2, we will meet with TWDB staff to discuss the status of the compiled data. Prior to this meeting, the Team will submit to the TWDB staff a draft report documenting the techniques and approaches selected for geophysical well log interpretation of aquifer total dissolved solids concentration (see Task 2.5). This meeting will allow the Project Team and the TWDB to collaborate on the identification of potential data gaps that we can address prior to completion of the project. In addition, we will discuss revised or additional evaluation that the compiled data may dictate. During this meeting the Project Team will discuss the proposed methods of evaluating the proposed brackish production zones to determine the 30- and 50-year volumes of brackish groundwater production and the effect that production may have on other areas or aquifers.

Task 1.1.3. Discussion of Potential Production Areas Meeting

Prior to the stakeholder meeting where the project results and information are presented and the TWDB solicits input on the potential brackish production areas (see Task 1.2.2), the Project Team will meet with the TWDB staff to discuss the potential production areas and prioritization for production calculations. During this meeting, we anticipate focusing on the apparent water quality at specific locations within the study area, the spatial and temporal trends in water quality with regard to salinity, the areas that meet criteria for potential production areas, and the application of methods for evaluating the potential brackish groundwater production areas.

Task 1.1.4. Final Draft Report Completion

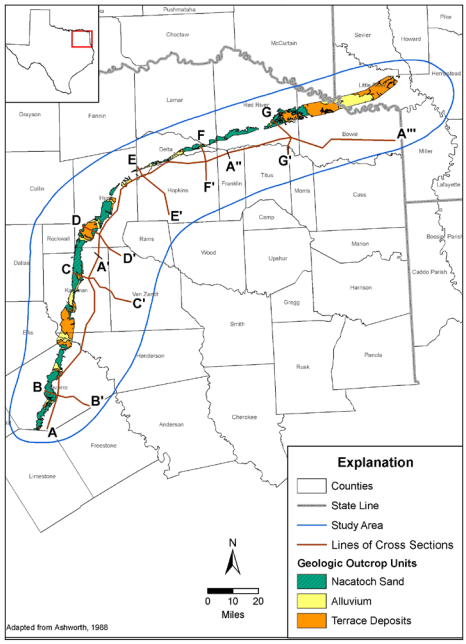
This meeting will involve presentation of the final report and project results. During this meeting the Project Team will demonstrate the three-dimensional GIS datasets developed during the project that illustrate the salinity zones. The Team will also discuss the results of the evaluations conducted for the defined potential brackish groundwater production areas.

Task 1.2. Stakeholder Meetings

Stakeholders will be able to provide data and important insights that the data may not readily reflect. We anticipate two stakeholder meetings as described below. For the stakehold-

SECTION 7: DETAILED SCOPE OF WORK

er meetings, we understand that the TWDB staff will organize the meetings and invite stakeholders. The Project Team will attend and present information and results at the second stakeholder meeting.



Task 1.2.1. Discussion of House Bill 30 (Meeting Conducted on October 26, 2015)

The first stakeholder meeting discussed in the RFQ occurred on October 26, 2015. During this first meeting, the TWDB staff discussed House Bill 30 and sought input on key phrases in the bill. Specifically, the TWDB staff sought stakeholder input regarding the meaning of "significant impact" and "significant source." In addition, TWDB staffed posed the question of how they should define "hydrogeologic barriers sufficient to prevent significant impacts?" Comments on these phrases were accepted through October 30, 2015 and will help guide the evaluations to be conducted during the latter part of the study.

Task 1.2.2. Solicitation of Input on Potential Brackish Production Areas

Following completion of Task 4, the TWDB will schedule a stakeholder meeting to present the results of the salinity delineations and solicit input on the potential brackish groundwater production areas. During this meeting the Project Team will present a summary of the data collected, the methodology for evaluating the salinity of the groundwater in the aquifer, and the three-dimensional datasets develop that quantify the estimated groundwater salinity throughout the aquifer.

Task 1.3. Monthly Progress Reports to TWDB

The Team's project manager will summarize progress by providing the TWDB with monthly letter reports for the duration of the project. The project manager will document any problems or unexpected data shortfalls in each report, and if necessary, will call to discuss problems with the TWDB project manager. The progress reports will include a Gantt chart showing the original or adjusted schedule with and detail how the Project is progressing. The Team's project manager will provide detailed descriptions of the progress made by task and correlate the progress descriptions with the submitted invoice.

Task 2. Hydrogeologic Data Acquisition and Compilation

The TWDB is a repository of an immense amount of information and insight into the hydrogeology of the Nacatoch Aquifer. In addition to data available from the TWDB (BRACS Database, Groundwater Database, and Submitted Driller's Report Database), we will also scour data sources such as the Texas Railroad Commission, the Texas Commission on Environmental Quality, Bureau of Economic Geology, General Land Office of Texas, U.S. Geological Survey, Environmental Protection Agency, Log Libraries, and local stakeholders (such as, conservation districts, municipalities, public water suppliers, etc.). During this task we will compile all data obtained into the Brackish Resources Aquifer Characterization System (BRACS) Microsoft Access database format (Meyer, 2014) and Groundwater Database format, as applicable.

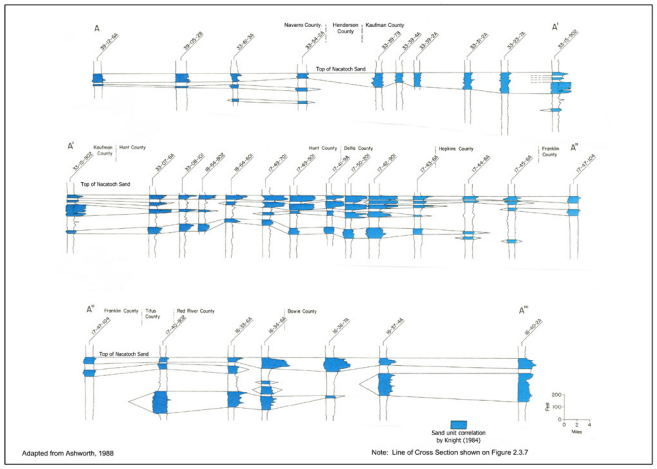
The Project Team has extensive experience in the Nacatoch Aquifer, providing a distinct advantage for data assimilation. LBG-Guyton Associates developed a regional groundwater availability model (GAM) for the Nacatoch Aquifer (LBG-Guyton Associates, 2009). This two year effort involved the collection of data, integration of data into GIS and groundwater model

SECTION 7: DETAILED SCOPE OF WORK

files, and the construction and calibration of a MODFLOW model of the aquifer system. All collected and developed spatial data for this project adhered to strict GIS source data geodatabase protocol and FGDC metadata standards required by the TWDB for GAM development. Staff of LBG-Guyton also authored "Ground-Water Resources of the Nacatoch Aquifer," TWDB Report 305 (Ashworth, 1988). The report includes the determination of the occurrence, availability, quality, and quantity of groundwater from the Nacatoch Aquifer. The Bureau of Economic Geology, a member of the Project Team, also authored "Depositional Systems in the Nacatoch Formation (Upper Cretaceous) Northeast Texas and Southwest Arkansas" (McGowen, 1983). This study was designed to determine the depositional framework of the basin during deposition of the Nacatoch Formation. The Project Team has developed a clear and robust understanding of locally available data, developed strong relationships with local stakeholders, and has developed tools and methods for efficient evaluation of the aquifer conditions within the Nacatoch Aquifer.

A thorough quality-assured database is critical to any project, as database errors can result in incorrect analyses and reports. The Project Team will prepare and implement a quality control plan that will include specific checklists for use during work progression and will address the following:

- **Verification** – Part of our standard quality control procedure is to verify data entered into a database against the original source data, if available. Data imported from an internal agency database or an outside database will be compared against the post-imported database to check records for accuracy and ensure that duplication of data has not occurred.
- **Level of confidence** – Mapping and visualization requires significant data, but in some parts of the study area the available data are limited. Therefore, it is critical to include a quantitative measure of confidence for all new data to inform subsequent evaluations with regard to quality and uncertainty of the data point. We will develop procedures to screen the validity of data and rank them according to specified levels of confidence in data accuracy. We can then use these confidence rankings during interpolation and mapping to help estimate potential errors associated with low-confidence data. We will coordinate with the TWDB in this effort.
- **Self-validation** – We will build a series of automated checks into the system for self-validation. Examples may include instrument reporting ranges, historic data for a sampling location (where available), expected ranges of values, correlations between measurements (for example, chlorides and total dissolved solids), missing data fields, consistency of units, or the identification of duplicate records. This is an efficient method proven for validating data and identifying outliers.



Task 2.1. Brackish Resources Aquifer Characterization System Database

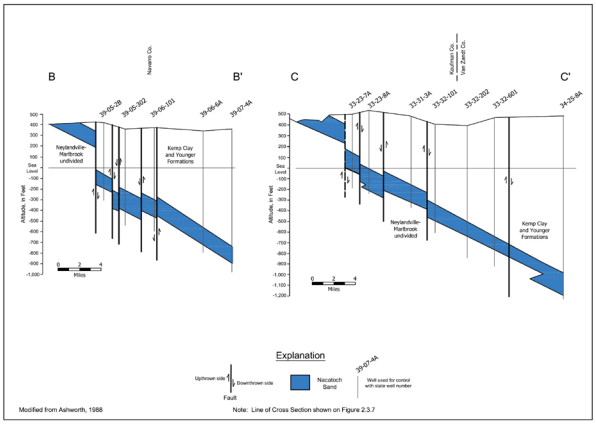
The BRACS database will be our starting point for data acquisition and compilation. Our work will focus on enhancing and building upon the work conducted by others to

SECTION 7: DETAILED SCOPE OF WORK

develop and maintain the current database (Ortuño, et al., 2012; Meyer, 2014). We will not modify the current BRACS database, but will work with the TWDB BRACS group to ensure seamless synchronization with the most recent BRACS database format.

Task 2.2. Groundwater Availability Model and Model Datasets

The groundwater availability model (GAM) developed for the Nacatoch Aquifer (LBG-Guyton Associates, 2009) provides a robust repository of data relative to the hydrogeologic framework for the aquifer. In addition to the model itself, work associated with the development of the GAM included compilation of data used to define the geologic structure, lithology, and movement of groundwater. We will compile the GAM data with the existing BRACS data and crosscheck the data to ensure we do not include duplicates in the final datasets. LBG-Guyton, Bureau of Economic Geology, and Collier have performed significant hydrogeologic evaluations, brackish studies, well completion, and aquifer testing in aquifers throughout Texas and realize some of the limitations of the existing structure interpretations, hydraulic properties, and water quality information. The Project Team will use the publically available data to enhance this study.



Two key components to the volumetric calculation of groundwater are the static water level and specific yield of the aquifer. We will incorporate the specific yield data compiled for and included in the GAM into the project database for re-interpolation, if needed, during our evaluations. The Project Team will also use GAM simulated water levels from the end of the model calibration period for each model to perform calculations.

Task 2.3. Water Quality Sample Data

The TWDB Groundwater Database is a regularly updated database containing groundwater quality data. For public water systems, we will review the TCEQ Safe Drinking Water Information System to obtain source water quality data. We will supplement these datasets with water quality data available from the U.S. Geological Survey National Water Information System. The team will work with local Districts, water authorities, and well owners to collect any additional data for inclusion in the dataset.

We will also collect data from the U.S. Geological Survey Produced Water Database, which will provide information on the composition of water in deeper portions of the geologic units. We will also be able to use the total dissolved solids (TDS) data to aid in calibrating salinity calculations from geophysical logs.

For these datasets, we will use well identification numbers, well location, well completion, and sample results to identify duplicate samples. We will remove duplicates from the dataset, but the well identifier from the non-BRACS database will be added to the BRACS foreign key table to relate it back to the BRACS well ID. During the acquisition process we will work diligently to ensure the reliability of the sample data. Format of the data will be compatible with the Groundwater Database table design. Water quality reports not currently in the BRACS database will be cataloged and related to the BRACS well ID.

Task 2.4. Geophysical Logs and Well Reports

There are several opportunities for obtaining non-proprietary geophysical logs and well reports. For many public supply wells, we will work to obtain geophysical logs

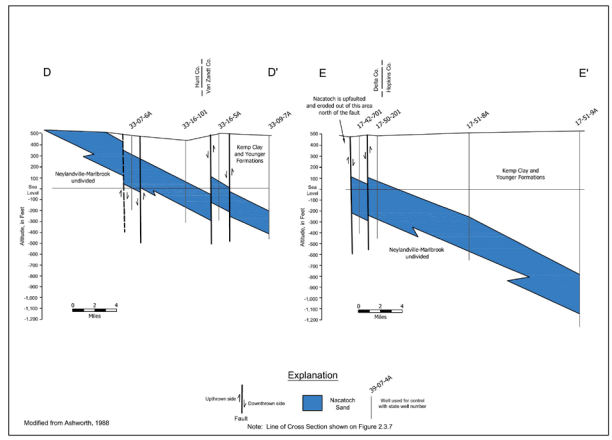
SECTION 7: DETAILED SCOPE OF WORK

from TCEQ. In addition, we will work with local Districts and well owners to obtain additional well logs or reports. We will also gather logs for oil and gas wells from the Railroad Commission and Bureau of Economic Geology (Groundwater Advisory Unit and Integrated Core and Log Database) that are additional to those previously delivered to the TWDB as part the work by Ortuño, et al. (2012).

For reports and logs obtained that are in addition to those already in the BRACS database, we will catalog the well logs and relate the log to the BRACS well ID in the database. As with the samples, we will use information from the log header to compare each log and ensure we do not create duplicates in the database. For logs not currently in digital format, we will scan the log to a Tagged Image Format (TIFF) to allow rapid access via hyperlink in the BRACS database. If available, we will also include the geophysical log data in Log ASCII Standard (LAS) format. We will assure all geophysical well logs and interpretation data values are documented in BRACS database table format with links to well numbers, log numbers, depths, and names of geological formations.

Task 2.5. Draft Evaluation Technique and Approach Report

While acquiring and compiling data for evaluating the brackish groundwater resource, the Project Team will prepare a draft report documenting the techniques and approaches proposed for geophysical well log interpretation of aquifer total dissolved solids concentration. The report will include information on the types of geophysical well logs available in the project area, how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements, how the log correction factors are determined, and how the interpretation techniques will be applied across the entire salinity range within the aquifer. We will submit this draft report to the TWDB staff for review at least



four weeks prior to the Discussion and Approval of Project Methodology Meeting (Task 1.1.2). Task 3.3 provides a brief discussion of anticipated evaluation methods to be included in our evaluation.

Task 3. Hydrogeologic Evaluation

During and subsequent to compilation of available data, the Project Team will apply their intimate knowledge of the Nacatoch Aquifer (see Qualifications and Experience) as they assimilate newly acquired data into their current understanding. The Team's experience with previous groundwater desalination projects (LBG-Guyton Associates, 2003; LBG-Guyton Associates, 2008; LBG-Guyton Associates, 2009) will provide a significant advantage towards efficient evaluation of the collected data. Project Team members will focus on their area of expertise while the project manager will facilitate coordination amongst the experts.

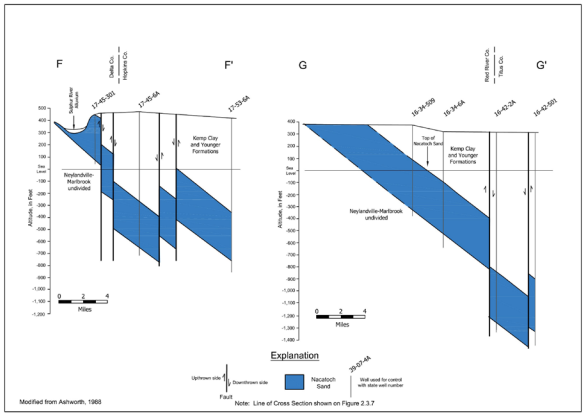
In many areas, we expect a high degree of uncertainty associated with the data. To incorporate the data uncertainty into our evaluations we anticipate applying Bayesian kriging (Pilz, et al., 2005) or fuzzy kriging (Masoomia, et al., 2011), as the data dictate, to interpolate the water quality data at well sites to the defined grid in the study area. Our evaluations will begin with determining the vertical distribution of water quality at well sites throughout the study area. The following describes the evaluations we will conduct

SECTION 7: DETAILED SCOPE OF WORK

during Task 3 to develop the water quality information for the geologic units penetrated by well.

Task 3.1. Geologic Framework

The current Nacatoch Aquifer GAM (Beach, 2009) provides an excellent basis for the geologic and hydrologic framework of the aquifer and confining units. Nonetheless, as regional models the GAMs necessarily provide only a rough approximation of the geologic structure and lithology. While it is beyond the scope of this project to develop additional conceptual models for the area, we will identify and record structural and lithologic characteristics, as evidenced by geophysical log data, that are not currently recorded in existing datasets. As applicable, we will extend the aquifer surface in the downdip direction beyond the extent of the existing GAM to allow calculating volumes of higher salinity groundwater than the current surface would permit.



To evaluate the lithologic characteristics, we will apply the four-class system discussed by Young, et al. (2010, p. 81) to representative geophysical logs. In addition, we will use select geophysical logs containing a gamma ray curve to calculate the shale percentage based on the log signature. Using these two methods will allow the Project Team to evaluate the lithology at select locations and form a preliminary assessment of potential conceptual models especially with regard to how the lithology affects apparent groundwater quality. With the derived information, we will also be able to calculate net sand thicknesses within defined intervals for use in subsequent volumetric calculations of stored groundwater.

Task 3.2. Water Quality Sample Data

To conduct our evaluation of the collected water quality sample data we will use protocols discussed in LBG-Guyton Associates Evaluation of Hydrochemical and Isotopic Data in Groundwater Management Areas 11, 12 and 13 (Kreitler, et al., 2013). As discussed in that report, with regard to water quality data the Team used the following criteria as the standard for eliminating potentially erroneous information:

- A well must have total depth estimate or documented completion intervals;
- A site must have a location accuracy of one minute or better; and,
- A water quality analysis must have a charge balance within five percent.

LBG-Guyton Associates applied the same criteria in evaluating data quality in work performed in Groundwater Management Areas 3 and 7 (Kreitler, et al., 2013). For this project, we will follow these established protocols to assess the reliability of all data acquired to supplement our existing dataset. Importantly, we will not remove any of the compiled data from the database; rather, we will assign a reliability flag to the sample in order to eliminate potential duplication of data compilation and assessment work in the future.

Once we have evaluated the reliability of the data, we will have a final XYZCt water quality sample dataset. That is, we will have a value (C) for various constituents and TDS at a spatial location (XYZ – latitude, longitude, elevation) at a specified time (t) for each reliable water quality sample. While the focus of this project is the TDS of the groundwater resouces, we will use this final dataset to prepare Piper diagrams and Stiff diagram maps that will illustrate spatial changes in overall water quality and TDS. Brackish treatment approaches and cost will vary significantly depending on

SECTION 7: DETAILED SCOPE OF WORK

the type of anions and cations in the water. Providing these summaries will help stakeholders develop preliminary treatment methods and cost estimates. If data are sufficient, we will prepare these illustrations for time intervals that will provide insight into the temporal changes in water quality throughout the study area. In addition, we will use the most recent and reliable data available to identify the representative TDS values for use in future modeling and analyses, including volumetric calculations.

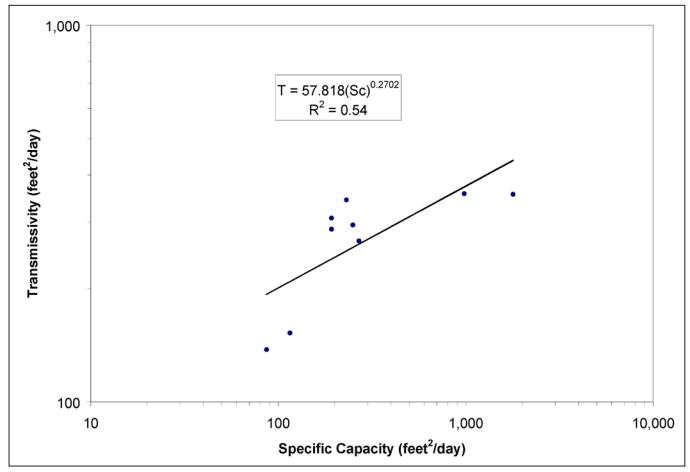
Task 3.3. Geophysical Logs

Geophysical logs will provide the majority of the data for the aquifers. Unlike a water quality sample, which is only representative of the interval from which the sample was collected, a geophysical log provides essentially continuous measurements of the solid, liquid, and gas properties in and near a borehole across all of the formations penetrated. In a study such as this one, we will use these signatures to develop estimates of the salinity concentration of water in sand and clayey sand layers.

The Project Team will apply our unique expertise to the evaluation of geophysical logs for estimating formation water salinity. Mr. Wise will apply his direct experience as coauthor of BRACS reports (Wise, 2014; Meyer, et al., 2014) to serve as technical lead for the evaluations. In addition, Dr. Hughbert Collier (1993), author of TWDB Report 343, will lend his extensive experience regarding the quantification of groundwater salinity from geophysical logs to the project.

There are several methods for developing estimates of salinity from geophysical logs (Turcan, Jr., 1966; Guyod, 1972; Ken E. Davis Associates, 1988; Collier, 1993; Estepp, 2010). As listed in the BRACS database, these methods include (Estepp, 2010):

- The SP (Spontaneous Potential) Method
- The Alger Harrison Method



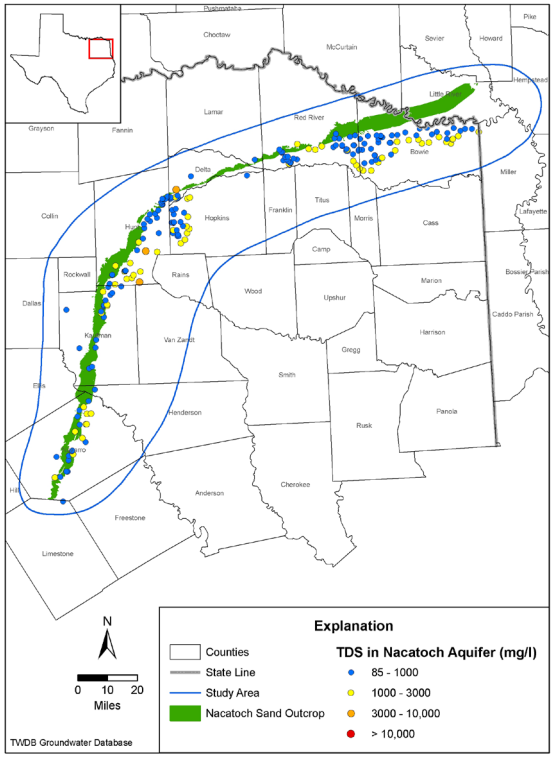
- The Estepp Method
- The Mean Ro Method
- The Rwa Method

The BRACS database notes that these methods, as applied within the BRACS database, are most applicable to waters with TDS concentrations less than 10,000 milligrams per liter (mg/L). In waters with TDS concentrations greater than 10,000 mg/L TDS, sodium (Na) and chloride (Cl) ions typically dominate the solution and will control its resistivity. In fact, while other ions (for example calcium, magnesium, bicarbonate, and sulfate) affect the resistivity of the formation water, their influence is most significant in fresh water, but their concentrations can be converted to represent a NaCl solution.

During our analysis of geophysical logs, we will conduct all calculations to determine the concentration in parts per million (ppm) of an equivalent NaCl solution. By focusing on the determination of an equivalent NaCl solution salinity, we will be able to make a direct calculation of the salinity from the formation water resistivity as calculated from log signatures. That is, we can use derived formulas, such as those used to create reference charts (Schlumberger, 2009, p. 8), for calculating formation water salinity in ppm using methods discussed below.

SECTION 7: DETAILED SCOPE OF WORK

For each geophysical log, we will use as many methods as are applicable. The curves available for each log will dictate the methods used. As discussed by Ortuño, et al. (2012), the majority of the geophysical signatures provided as a deliverable for their project contained an SP curve followed in quantity by conductivity then resistivity curves. When porosity curves are available, we will incorporate those measurements into the formation factor calculations (see below). We anticipate being able to develop resistivity of water estimates throughout the sand zones identified during Task 3.1 using these three curves. We will then convert the water resistivity to salinity of a NaCl solution.



All calculations will begin with the information provided on the log header. If it is available, from the header for each well we will obtain its identification, location, elevation, measuring point, total depth, mud resistivity and temperature, mud filtrate resistivity and temperature, mud density, and bottom hole temperature. For the resistivity of the mud filtrate, we will crosscheck the value entered on the log header by recalculating the filtrate resistivity based on the mud density and resistivity (Schlumberger, 2009, p. 4). These data will be critical for subsequent calculations.

One drawback of the SP method is its sensitivity to clay or shale in and near the sand zone. To overcome some of the sensitivity we will apply a bed thickness correction factor to the SP reading. While charts are available for determining the correction factor (Schlumberger, 2009, pp. 52-55), for expediency and increased precision we will apply a formula using the mud resistivity, flushed zone resistivity, and bed thickness to determine the correction factor. We will multiply the correction factor and the SP deflection to determine the static SP, which we will then use to calculate the resistivity of the water at the formation temperature (Asquith & Gibson, 1982, p. 29).

We will use the deep conductivity and resistivity curves in 100 percent water saturated sand zones to calculate the resistivity of the formation water directly. In the zones that are 100 percent saturated with water, the true formation resistivity is equal to the deep resistivity and the resistivity of the formation water is equal to the deep resistivity divided by a formation factor (Asquith & Gibson, 1982, p. 99). However, the formation factor can vary greatly and is dependent on the porosity, tortuosity, and cementation of the formation. While standard values for tortuosity and cementation are presented in the literature (Asquith & Gibson, 1982, p. 44), we anticipate calibrating these components versus measured TDS values to obtain specific coefficients for the studied aquifers.

Where data permit, we will prepare plots of the salinity calculations versus the TDS values from water quality samples. These plots will allow for developing equations relating salinity of the equivalent NaCl solution to TDS that are applicable to specific aquifers, sand zones, or geographic areas, as appropriate. In addition, the plots will allow us to crosscheck and calibrate the constants in the salinity calculations. These equations will allow us to translate the salinity derived from the geophysical log to an estimate of the TDS

(LBG-Guyton Associates, 2006).

An advantage of calculating the salinity from geophysical logs is the opportunity to calculate salinity at multiple points within the sand zones. The many calculations will allow the Project Team to apply a statistical analysis (for example mean, median, or mode) to the multiple values for later use in volumetric calculations. Following verification of the results, we will compile the calculated values in the BRACS database format. In addition, we will prepare box-and-whisker plots to illustrate the statistical salinity characteristics at various locations in the aquifers.

Task 4. Geographic Information System (GIS) Dataset Development

The dataset developed during Task 2 and evaluations conducted during Task 3 will provide information located primarily at point locations in the study area. That is, the information developed will represent the aquifer at specific well locations rather than conditions across wide areas of the aquifer. Calculation of the three-dimensional delineation of groundwater salinity will require some form of interpolation. Interpolation is required because TDS values will be available at specific points, but we will need to develop estimates of the water quality at all locations in the aquifer. Performing an interpolation will enable the assignment of probable TDS concentrations over large geographic regions from the comparatively small number of data points.

Task 4.1. Convert BRACS Database to ESRI Geodatabase Format

The Project Team will compile and integrate pertinent geologic and hydrogeologic data from the datasets into a GIS geodatabase to facilitate technical analysis and organize, store, and document the information used to delineate fresh, brackish (slightly saline and moderately saline), and very saline groundwater in the Nacatoch Aquifer. We will use the standard data model framework developed by the TWDB for geologic structure and groundwater modeling projects to accomplish this task. The ArcGIS geodatabase supports a model of spatially-related feature classes, as well as more complex related GIS datasets that can be added in the future, if desired (for example, surface soils and precipitation distribution), relationships (for example, estimated recoverable groundwater, water level declines versus local water well production), and relevant geoprocessing tools.

Within the geodatabase, a geology feature dataset will contain all of the point, line, and polygon feature classes and a water quality dataset will contain sample results, calculated salinity of an equivalent NaCl solution, and calculated TDS values as point data. The Project Team will manage raster data within the geodatabase as a raster catalog. Any scanned hardcopy water quality maps will be georeferenced and managed within the geodatabase raster catalog. The stratigraphic GIS data sets will include well location, well depth, log type, and aquifer top and bottom elevations and depth from land surface. The Team will develop metadata for each data layer that documents data descriptions, spatial characteristics, attribute information, data structure, data reliability, relevant dates, sources, field descriptions, units (as applicable), and contact information. We will develop the metadata within the editor in ESRI ArcCatalog and will comply with Federal Geographic Data Committee standards, in particular ISO 19139:2007. In addition, we will use BRACS program-naming conventions and map projection parameters for all datasets.

Task 4.2. Interpolate Data to Enable Water Volume Calculations

The Project Team has extensive experience in the application of a variety of approaches to interpolating concentrations of various chemicals and solutes in groundwater. For this application, we anticipate focusing on the inverse distance weighted (IDW) and Kriging interpolation methods. The Team will assume that vertical variations in TDS within a given aquifer

are either 1) minor and can be neglected or 2) are substantial and can be handled by splitting the aquifer into discrete units and performing the computations on each unit.

The IDW method operates with the assumption that conditions at points close to one another are more alike than conditions at points that are farther apart. The IDW method predicts values at unmeasured locations based on the measured values in proximity to those unmeasured locations. The measured values closest to the predicted location have greater influence on the predicted value than do the measured values that are further away. The key parameters for the IDW method are the search radius, the number of samples to use within this search radius, and the power value. We can determine an optimal value for the power parameter, which determines the strength of the influence that measured points have on a predicted value, by minimizing the root mean square prediction error. Using Python scripting, we can automate the parameter optimization and eliminate the need for manual user input.

The Kriging methods, like the IDW method, assigns weights to the measured point values surrounding an unmeasured location to calculate a predicted value. However, Kriging also factors in the spatial arrangement of the measured points in its weighting scheme under the assumption that this arrangement reflects a spatial correlation that in some way explains the distributions of values. Because of its statistical underpinnings, Kriging can provide an increased measure of the accuracy for the predictions.

Of these two methods, Kriging is more complicated to implement than IDW because it requires scrutiny of the spatial behavior of the phenomenon being represented through calculation of a semivariogram before selecting the optimal parameter values to generate the predictions. This scrutiny and parameter selection process is typically performed manually as it requires a high degree of professional judgment. One way of overcoming this complication is the application of Bayesian Kriging (called Empirical Bayesian Kriging in ArcGIS) methods.

Through an iterative process, the Bayesian Kriging method automatically calculates the parameters that other Kriging methods require the user to declare explicitly. During the interpolation process, the method is able to account for the error introduced by estimating the underlying semivariogram, which provides the user with some quantification of the uncertainty associated with the result. A primary disadvantage of the Bayesian Kriging method is that processing is slower than other Kriging methods; however, as listed in the ArcGIS Geostatistical Analyst extension documentation, advantages of the method include:

- Minimal manual interaction (automated by applying reasonable assumptions);
- Standard errors of prediction are more accurate than other Kriging methods; and,
- More accurate than other kriging methods for small datasets.

For the Nacatoch Aquifer, we will apply multiple interpolation approaches to the measured or calculated TDS concentrations. We will compare the interpolations to the measured and calculated values at the input points to determine the method most appropriate for the data. We will save the final interpolations as raster datasets in the geodatabase. Similarly, we will interpolate and store the top and bottom of the geologic units, thicknesses, specific yield values, and static water level of the aquifer within the geodatabase at the same extent and resolution as a pre-defined project raster snap grid.

Task 4.3. Quantification of the Fresh, Brackish, and Saline Groundwater Volume

Following interpolation of the point data to raster datasets in Task 4.2, we will use these datasets to calculate the volume of fresh, brackish, and saline groundwater. To

ensure the process is repeatable and consistent, we will develop tools in ArcGIS Model Builder for performing the calculations. Calculations will result in a raster dataset with each cell representing the volume of water within each area defined by the raster resolution.

The process will include calculating the volumes according to salinity classification zones developed by the U.S. Geological Survey (Winslow & Kister, 1956). Winslow and Kister based the classification on total dissolved solids where a concentration of 0 to 1,000 milligrams per liter is fresh, 1,000 to 3,000 milligrams per liter is slightly saline, 3,000 to 10,000 milligrams per liter is moderately saline, 10,000 to 35,000 milligrams per liter is very saline, and greater than 35,000 milligrams per liter is brine. The volumes within each salinity category will be summarized by county, groundwater conservation district, groundwater management area, regional water planning area, and river basin.

Task 4.4. Delineate Potential Brackish Groundwater Production Areas

Using information gathered from comments received during the first stakeholder meeting (see Task 1.2.1), we anticipate the TWDB will have guidance for definition and quantification of "hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers" (from RFQ paraphrasing House Bill 30). Using this guidance and additional criteria from the statute, we will use the developed datasets to delineate potential production areas. The following summarizes the requirements an area must meet to be designated:

- Average TDS concentration is more than 1,000 milligrams per liter;
- Sufficient hydrogeologic separation from areas in the same or another aquifer with an average TDS concentration of 1,000 milligrams per liter or less;
- Not currently used as a significant source of water supply for municipal, domestic, or agricultural purposes;
- Not part of a geologic stratum that is designated or used for wastewater injection through the use of injection or disposal wells permitted under Texas Water Code Chapter 27; and,
- Not within the Harris-Galveston Subsidence District and the Fort Bend Subsidence District.

We will use the criteria to define the three-dimensional spatial extent of potential production areas within the Nacatoch Aquifer. Each potential production area will be assigned a unique ID for relation to production area attributes (such as, hydraulic properties, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates). These production area attributes will be populated with values in a Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files during later evaluation work.

The potential production areas will be presented to the TWDB staff for discussion during Task 1.1.3. During this meeting, the areas will be prioritized for performing 30-year and 50-year production calculations.

Task 5. Evaluation of Potential Brackish Groundwater Production Areas

The Project Team will present the data acquisition, evaluation, and interpolation results at a stakeholder meeting coordinated by the TWDB (see Task 1.2.2). The presentation will provide information to stakeholders in the form of Microsoft PowerPoint slides and discussion by the Project Team leader. During the stakeholder meeting, the TWDB will solicit input on the potential brackish groundwater production areas that will define areas for conducting evaluations during this task.

SECTION 7: DETAILED SCOPE OF WORK

Using the defined and prioritized potential brackish groundwater production areas, the Project Team will perform model simulations to determine the potential effects of the pumping from the area on other groundwater resources. We anticipate applying the GAMs to evaluate the pumping effects for many, if not all, of the defined production areas. In areas that may not be reasonable represent a production area or where the production area is outside of the model boundary, we will develop a simple numerical model that reasonable represents the conceptual understanding the local aquifer conditions.

Evaluation of the areas will focus on developing the estimated volumes of brackish groundwater production in 30- and 50-year timeframes. During the evaluations we will populate the production area attribute tables developed during Task 4.4. The Project Team will develop complete metadata for all new GIS dataset developed during the evaluation of the production areas.

Task 6. Draft Project Report

The project report will detail the work conducted during the acquisition and evaluation of the geologic and water quality data. The report will also include thorough documentation of the tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater and techniques used to determine if a potential production area is hydrogeologically separated from fresh water aquifers. In the report we will organize the calculated volumes of groundwater within the aquifer and each TWDB-prioritized potential production area by salinity classification zone, county, groundwater conservation district, and groundwater management area. We will use the Formatting Guidelines for Texas Water Development Board Reports as our style guide for the report. In addition, we will work to ensure that the report follows the guidelines of the Texas Board of Professional Geoscientists.

We will provide eight hard copies of the draft report to the TWDB. In addition to the hard copies of the draft project report, we will provide a digital copy of the draft report in Microsoft Word format and PDF format, potential production area modeling files, the draft Microsoft Access database, and the draft project geodatabase (which will include: geologic formation top and bottom raster surfaces, net sand raster surfaces, salinity classification zone top and bottom raster surfaces, proposed production area top and bottom raster surfaces, well control point files, and project raster snap grid). Following delivery of the project report there will be a comment period (to be determined) during which the TWDB staff and stakeholders will be able to provide feedback on the project results.

Task 7. Final Project Report

At the end of the draft project report comment period, we will address each comment and incorporate a copy of the submitted comments into the final project report and other deliverables. We will complete the final project report and associated deliverables prior to August 31, 2017. We will identify individual authors responsible for the report and those individuals will sign and seal the report per Professional Engineer or Professional Geoscientist requirements, as applicable.

Task 8. TWDB Training (Optional)

The Project Team will provide instruction to TWDB staff to demonstrate specific methodologies and/or techniques utilized to determine volume calculations, salinity zones extents, or anything that may deemed necessary and appropriate for presentation within a training venue. This training will only be provided at the request of TWDB, on an as-needed basis.

Written Assurance

LBG-Guyton Associates assures that our Team's proposed water research does not duplicate previously completed or ongoing research.

SECTION 7: DETAILED SCOPE OF WORK

If a contract for this study is awarded to LBG-Guyton Associates, we will discontinue existing contracts for groundwater supply and availability studies with persons or entities other than TWDB and regional water planning groups, and will not engage in similar studies within the project area while working on the TWDB project without a prior no conflict of interest determination by TWDB and written authorization from TWDB.

Bibliography

Ashworth, J., 1988. Ground-Water Resources of the Nacatoch Aquifer, Austin, Texas: Texas Water Development Board Report 305.

Asquith, G. & Gibson, C., 1982. Basic Well Log Analysis for Geologists - AAPG Methods in Exploration Series Number 3. Tulsa(OK): The American Association of Petroleum Geologists.

Collier, H. A., 1993. Borehole Geophysical Techniques for Determining the Water Quality and Reservoir Parameters of Fresh and Saline Water Aquifers in Texas, Austin: Texas Water Development Board.
Estepp, J. D., 2010. Determining Groundwater Quality Using Geophysical Logs, Austin: Texas Commission on Environmental Quality.

Guyod, H., 1972. Application of Borehole Geophysics to the Investigation and Development of Groundwater Resources. Water Resources Bulletin, 8(1), pp. 161-174.

Ken E. Davis Associates, 1988. Survey of Methods to Determine Total Dissolved Solids Concentrations, Washington D.C.: U.S. Enviromental Protection Agency.

Kreitler, C. W. et al., 2013. Evaluation of Hydrochemical and Isotopic Data in Groundwater Management Areas 11, 12 and 13, Austin: Texas Water Development Board.

Kreitler, C. W. et al., 2013. Evaluation of Hydrochemical and Isotopic Data in Groundwater Management Areas 3 and 7, Austin: Texas Water Development Board.

LBG-Guyton Associates, 2003. Brackish Groundwater Manual for Texas Regional Water Planning Groups, Austin, Texas: Texas Water Development Board.

LBG-Guyton Associates, 2006. Site Selection for San Antonio Water System's Brackish Groundwater Resources in the Wilcox and Edwards Aquifers in the Vicinity of San Antonio, Texas, Austin: LBG-Guyton Associates.

LBG-Guyton Associates, 2008. Brackish Groundwater Exploration Guidance Manual, Austin, Texas: Texas Water Development Board.

LBG-Guyton Associates, 2009. Nacatoch Aquifer Groundwater Availability Model, Austin: LBG-Guyton Associates.

Masoomia, Z., Mesgaria, M. S. & Menhaj, M. B., 2011. Modeling uncertainties in sodium spatial dispersion using a computational intelligence-based kriging method. Computers & Geosciences, October, 37(10), p. 1545–1554.

McGowen, M. a. L. C., 1983. Depositional Systems in the Nacatoch Formation (Upper Cretaceous), Northeast Texas and Southwest Arkansas, Austin, Texas: University of Texas at Austin, Bureau of Economic Geology Report No. 137..

Meyer, J. E., 2014. Brackish Resources Aquifer Characterization System Database Data Dictionary, Austin: Texas Water Development Board.

Meyer, J. E., Croskrey, A., Wise, M. R. & Kalaswad, S., 2014. Brackish Groundwater in the Gulf Coast Aquifer, Lower

SECTION 7: DETAILED SCOPE OF WORK

Rio Grande Valley, Texas, Austin: Texas Water Development Board.

Ortuño, D. H., Averett, A. R., Clift, S. J. & Paine, J. G., 2012. Locating, Scanning, and Delivering Digital Geophysical Well Logs and Associated Data for Brackish Resources Aquifer Characterization System (BRACS), Austin: Texas Water Development Board.

Pilz, J., Pluch, P. & Spöck, G., 2005.
Bayesian Kriging with lognormal data and uncertain variogram parameters. In: Geostatistics for Environmental Applications: Proceedings of the Fifth European Conference on Geostatistics for Environmental Applications. Berlin: Springer, pp. 51-62.
Schlumberger, 2009. Log Interpretation Charts. Sugar Land, Texas: Schlumberger.

Turcan, Jr., A. N., 1966. Calculation of Water Quality from Electrical Logs Theory and Practice, Baton Rouge: Department of Conservation Louisiana Geological Survey and Louisiana Department of Public Works.

Winslow, A. G. & Kister, L. R., 1956. Saline-Water Resources of Texas, Washington D.C.: U.S. Geological Survey.

Wise, M. R., 2014. Queen City and Sparta Aquifers, Atascosa and McMullen Counties, Texas: Structure and Brackish Groundwater, Austin: Texas Water Development Board.

Young, S. C. et al., 2010. Hydrostratigraphy of the Gulf Coast Aquifer from the Brazos River to the Rio Grande, Austin: Texas Water Development Board.

NACATOCH AQUIFER - DETAILED SCOPE OF WORK

LBG-GUYTON ASSOCIATES EXPERTISE

		LBG Years of Experience					
	Area of Expertise	James Beach	John Ashworth	Mike Keester	Brant Konetchy	Kristie Laughlin	Bill Stein
A	General Hydrogeology	25	41	12	3	15	29
B	Hydrogeology of the Project aquifer	6	3	1	0	0	0
C	Interpreting and using geophysical well logs; as applicable to the Project	2	3	10	1	15	29
D	Using data from TWDB GAMs and other studies in the Project area	8	0	1	0	5	0
E	Groundwater modelling to evaluate potential production areas	3	20	12	0	0	0
F	GIS files, use, and metadata documentation	2	10	12	3	10	0
G	Communicating with the public	25	41	10	0	0	20
H	Technology transfer	14	10	10	1	5	29
I	Producing high-quality technical reports	25	41	12	1	20	29
J	Using TWDB BRACS and groundwater databases	18	41	12	1	10	24
K	Contract management	20	18	6	0	0	10
L	Ability to meet Project deadlines	25	44	12	3	30	29

COLLIER CONSULTING EXPERTISE

	Area of Expertise	Collier Years of Experience				
		Hughbert Collier	Lou Fleischhauer	Peter George	Peter Schulmeyer	Matthew Wise
A	General Hydrogeology	30	25	12	28	15
B	Hydrogeology of the Project aquifer	30	20	12	5	0
C	Interpreting and using geophysical well logs; as applicable to the Project	30	0	15	10	5
D	Using data from TWDB GAMs and other studies in the Project area	30	20	12	5	0
E	Groundwater modelling to evaluate potential production areas	0	0	0	20	0
F	GIS files, use, and metadata documentation	0	0	12	20	6
G	Communicating with the public	40	0	25	25	0
H	Technology transfer	30	0	25		0
I	Producing high-quality technical reports	30	30	25	20	15
J	Using TWDB BRACS and groundwater databases	30	15	6	5	6
K	Contract management	30	0	0	10	0
L	Ability to meet Project deadlines	30	30	25	28	15

BUREAU OF ECONOMIC GEOLOGY EXPERTISE

	Area of Expertise	BEG Years of Experience	
		Robert Reedy	Scott Hamlin
A	General Hydrogeology	22	30
B	Hydrogeology of the Project aquifer	1	0
C	Interpreting and using geophysical well logs; as applicable to the Project	0	30
D	Using data from TWDB GAMs and other studies in the Project area	0	4
E	Groundwater modelling to evaluate potential production areas	5	0
F	GIS files, use, and metadata documentation	20	12
G	Communicating with the public	0	30
H	Technology transfer	0	30
I	Producing high-quality technical reports	18	30
J	Using TWDB BRACS and groundwater databases	18	12
K	Contract management	0	8
L	Ability to meet Project deadlines	18	30

SECTION 8: ADDENDA

NOT APPLICABLE

APPENDIX A: PROJECT DESCRIPTIONS

Project Descriptions:

- **LBG-Guyton Associates**
- **Collier Consulting, Inc.**
- **Bureau of Economic Geology**

BRACKISH GROUNDWATER EXPLORATION GUIDANCE MANUAL

Texas Statewide

Key Services
- Brackish Aquifer Evaluation
- Water Well Drilling
- Water Quality Evaluation
- Regulatory Issues

Client
Upper Colorado River Authority
Texas Water Development Board

Client Contact
Mr. Sanjeev Kalaswad
Texas Water Development Board
Austin, TX
Tel: (512) 936-0838

The desalination of brackish groundwater is one of a number of innovative technologies that is generating much interest in meeting the ever-increasing water demands in Texas. Desalination is the process of removing dissolved minerals from water, thus making the water more palatable for consumption. The term brackish refers to water that is slightly to moderately saltier than fresh water, typically containing total dissolved solids (TDS) in concentrations ranging from 1,000 to 10,000 milligrams per liter (mg/l).

For desalinated brackish groundwater to be a viable water supply option, two principal hydrologic components must be met. First, the subsurface water-bearing formation (aquifer) must be capable of yielding a sufficient volume of water over the desired lifetime of the desalination facility. And second, the water chemistry (concentration and constituent makeup of the dissolved mineral content) of the brackish groundwater must be within a range such that desalination can be economically achieved at a reasonable cost compared to other water supply alternatives. The intent of a brackish groundwater exploration project is to evaluate these two components. This manual describes the following activities that may be expected during the exploration phase of a desalination project.

- Consideration of regulatory requirements by state agencies and groundwater conservation districts.
- Identification of potential brackish groundwater sources.
- Selection of specific test well exploration sites.
- Selection of a drilling contractor through a bid process.
- Design and installation of test wells.
- Data collection and geophysical surveys at the well site.
- Design, performance and evaluation of pumping tests.
- Water chemistry considerations and proper sampling procedures.
- Test well abandonment and site remediation.
- Use of limited data to predict long--term supply availability.

LBG GUYTON

EVALUATION OF BRACKISH GROUNDWATER RESOURCES

Texas Statewide

Key Services

- Regional Aquifer Evaluation
- GIS Data Set Development
- Brackish Groundwater
- Cost Estimation for Production and Treatment of Brackish Groundwater
- Regional Water Planning Issues

Client

Texas Water Development Board

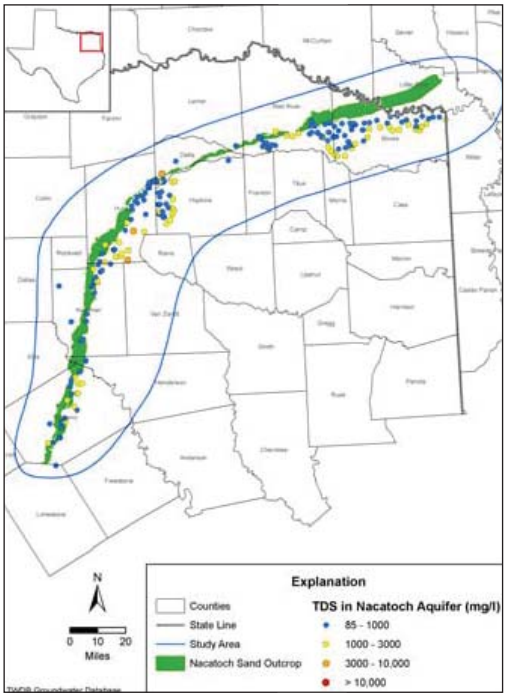
Client Contact

Dr. Robert Mace
Texas Water Development Board
Austin, TX
Tel: (512) 936-0861

LBG-Guyton Associates conducted an evaluation of the brackish water resources in all of the major and minor aquifers in the state of Texas. The purpose of the evaluation was to develop a comprehensive overview of the occurrence of brackish ground water in the state that might be used as water supplies through the use of desalination, and develop hydrogeologic and water quality maps that can be easily used to assess potential brackish water resources for planning purposes. The report focuses on the occurrence of brackish water, defined as ground water containing between 1,000 and 10,000 mg/L of total dissolved solids, and the general production capacity of the aquifers that contain brackish ground water.

The research also summarizes the significant engineering factors that should be considered in the development of water management strategies that include desalination of brackish ground water. In addition, the report outlined preliminary cost estimation approaches for production and treatment of brackish ground water for public water uses.

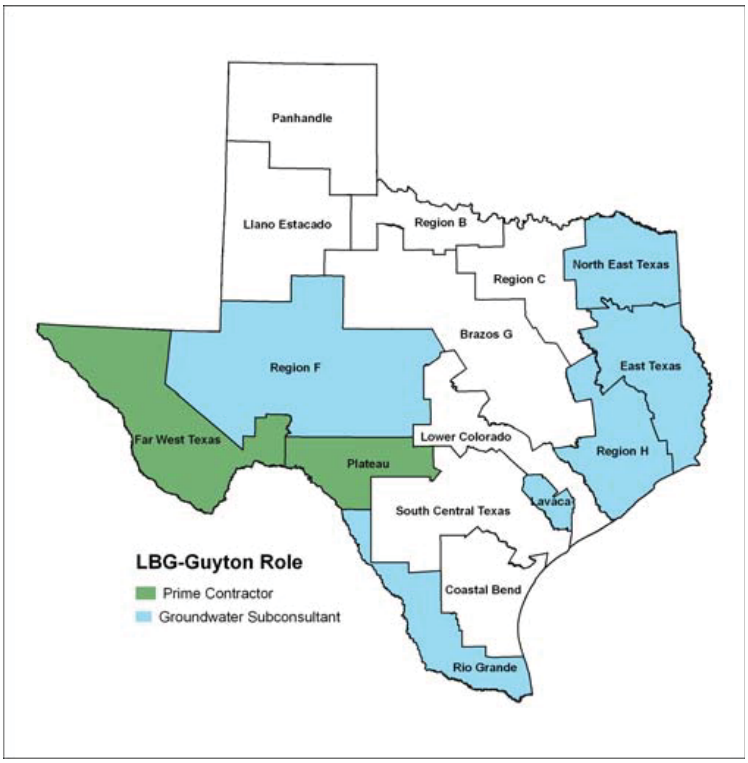
The reports includes maps developed for each of the aquifers through the use of GIS. These maps include the aquifer outline, available water chemistry data, and estimated isocontours for 1000, 3000, and 10000 mg/L TDS. These maps can be used to help identify potential areas where entities may want to consider using brackish ground water as a source of drinking water or as a supplemental source for existing supplies. In some cases the defined limits of an aquifer had to be revised to reflect areas that contain only brackish water that were previously not considered part of the aquifer.

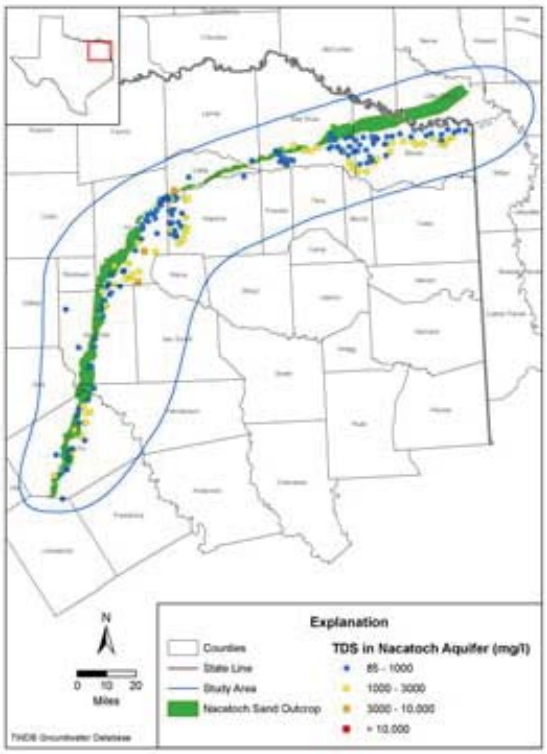


The major and minor aquifers that were included in the Brackish Water study underlie 81% of the state of Texas. The major aquifers evaluated include the Hueco and Mesilla Bolsons, Cenozoic Pecos Alluvium, Seymour, Trinity, Edwards-Trinity (Plateau), Carrizo-Wilcox, Ogallala, Edwards-Balcones Fault Zone, and Gulf Coast aquifers. The minor aquifers evaluated included the Dockum (Santa Rosa), West Texas Bolsons, Rustler, Marathon, Igneous, Capitan Reef, Bone Spring/Victorio, Rita Blanca, Edwards-Trinity (High Plains), Blaine and Whitehorse, river alluviums, Hickory, Ellenburger, Marble Falls, Lipan, Woodbine, Blossom, Nacatoch, Queen City/Sparta, Bigford/Laredo, and Yegua/Jackson aquifers.

Evaluation of brackish ground-water resources in each aquifer entailed a thorough review of published reports and data, assimilation of water quality information from available sources, including TWDB, TNRCC, UTBEG, RRC, and other public sources. For coastal aquifers such as the Carrizo-Wilcox and Gulf Coast, downdip water-quality cross-sections were developed to illustrate the variation in water quality.

The cost estimation methods presented in the report were based on recently published data as well recent data from several brackish groundwater treatment pilot tests. The report included cost estimation approaches for developing well fields for the production of source water for proposed brackish groundwater treatment projects.





EVALUATION OF GROUNDWATER QUALITY FOR TEXAS REGIONAL WATER PLANNING GROUPS

Regional Water Planning Groups D, E, F, I, J and M

Key Services

- Managing Large Data Sets
- Selection of Relevant Data
- Evaluation of Data With Respect to Drinking Water Standards
- Presentation of Multiple Data Sets in Table and Graphical Formats

Client

Texas Water Development Board
Austin, TX

LBG-Guyton has performed regional water quality studies for Regional Water Planning in regions D, E, F, I, J, and M. Wells with water quality results in the TWDB groundwater database within each region were identified and grouped by aquifer system.

The most recent water quality analyses from each well were selected for review and comparison to primary and secondary drinking water MCLs.

Water quality constituent analytical results from the wells were compared to primary and secondary drinking water MCLs as applicable. In the case of fluoride, the lower secondary MCL of 2 mg/L was used for comparison purposes. The standard water quality constituents studied were: sulfate, chloride, pH, TDS, nitrate, and fluoride. The infrequently-sampled water quality constituents studied were: alpha particles, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, and selenium.

The results of the regional water quality studies were presented in table form by aquifer. Also, numerous maps of the study results were prepared for each aquifer within each studied region, one each for a selected set of constituents of concern, with results scaled by color for ease of interpretation.

The report of the study for each region contained the results tables and maps, as well as a description of the methodology employed in selecting and evaluating the results.

NACATOCH AQUIFER GAM DEVELOPMENT

Nacatosh Aquifer, Northeast Texas

Key Services

- Data Collection and Evaluation
- Development of Groundwater Model
- Model Calibration and Sensitivity Analysis

Client

Texas Water Development Board

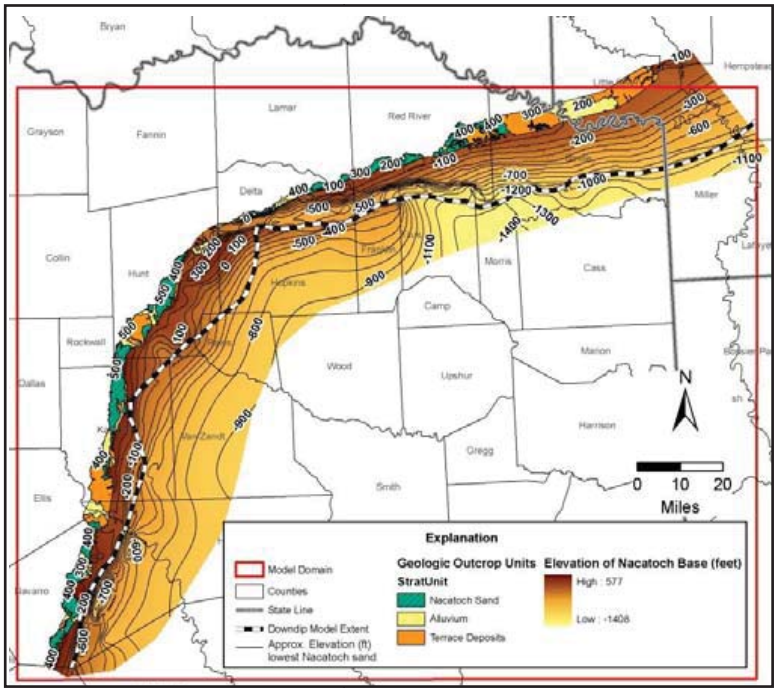
Client Contact

Cindy Ridgeway
Texas Water Development Board
Austin, TX
Tel: (512) 936-2386

LBG-Guyton Associates developed a regional groundwater availability model (GAM) for the Nacatoch Aquifer in northeast Texas. This two-year effort involved the collection of new data, integration of all new and existing data into GIS and groundwater model files, and the construction and calibration of a MODFLOW model of the aquifer system. All collected and developed spatial data for this project adhered to strict GIS source data geodatabase protocol and FGDC metadata standards required by the TWDB for GAM development.

A detailed conceptual model was developed for the groundwater flow system of the Nacatoch Aquifer. The Nacatoch Aquifer consists of Cretaceous marine sand and mud deposits bounded by underlying Cretaceous marl and overlying Tertiary shale and is hydrogeologically connected to Red River alluvial deposits. Groundwater in the Nacatoch Aquifer is derived from recharge from precipitation at its outcrop. Groundwater flow is predominantly downdip in a southeasterly direction. In recent times, the most significant water level declines have been due to municipal water usage but groundwater is also regionally pumped for irrigation.

The hydraulic properties of the Nacatoch Aquifer were spatially estimated by reviewing data from aquifer test data. Available hydraulic property data were statistically evaluated prior to model development, and initial estimates of hydraulic properties were developed for each model layer for use during model calibration.



The ground-water flow model was constructed using MODFLOW-2000. Regional in scale, both steady state (pre-development) and transient models were calibrated. Steady-state conditions were run for pre-1960 conditions. The transient model was calibrated for the period from 1980–1997. After the steady-state and transient models were calibrated, a sensitivity analysis on each major parameter in the model was performed. Model parameters were adjusted and the parameters having the most influence on the hydrologic system were defined.

REGIONAL WATER PLANNING FOR NORTHEAST TEXAS RWPG (REGION D)

Northeast Texas

Key Services

- Evaluation of groundwater resources of major and minor aquifers (including Nacatoch)
- GIS analyses of groundwater quality, historical water-level fluctuations and well yields
- GAM evaluations for availability and sustainability
- Stakeholder Interaction

Client

Bucher, Willis and Ratliff

Client Contact

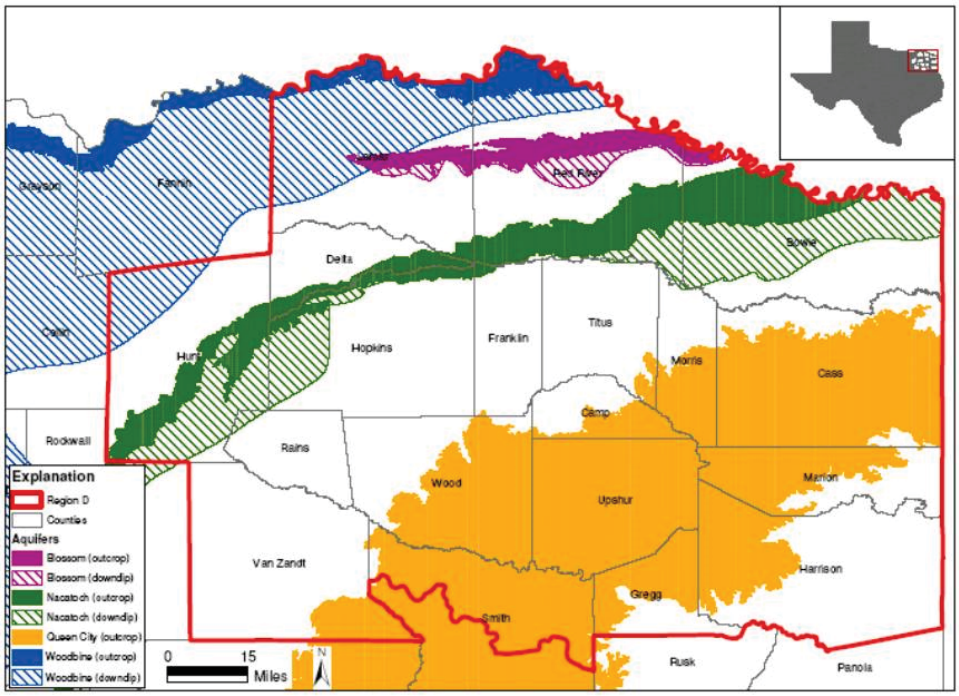
Mr. Ray Flemmons, PE
Bucher, Willis and Ratliff
Dallas Texas
Tel: (214) 373-7873

LBG-Guyton has been a subconsultant for the Northeast Texas Regional Water Planning Group (RWPG) during two rounds of regional water planning. Working closely with the consulting team and the RWPG stakeholders, LBG-Guyton successfully completed several groundwater related tasks for the planning group, including:

Groundwater Availability Assessment – All major and minor aquifers in the region were assessed to determine groundwater availability based on data from published reports or ground-water availability models (GAMs). Aquifers assessed for the planning included:

- Carrizo-Wilcox
- Trinity
- Queen City/Sparta
- Woodbine
- Nacatoch
- Blossom

If a GAM was available for the assessment, it was used to estimate annual ground-water availability under various levels of cumulative drawdown over a 50-year period. If a GAM was not available, published data and historical drawdowns and usage data was used to estimate annual ground-water availability. Groundwater supplies were compared to current and predicted water demands based on population projections and forecasts for each user group in the area. Shortages were identified and strategies were developed to meet shortages whenever possible.



Groundwater Quality Assessment – All available water chemistry data for the major and minor aquifer was assimilated, mapped, and statistically analyzed. Constituents included TDS, major cations and anions, and primary and secondary drinking water constituents.

Assessment of Springs – Springflow and aquifer discharge into streams and rivers was assessed by using the GAM to estimate the potential loss of flow due to increased groundwater pumpage for proposed strategies.

RELEVANT EXPERIENCE

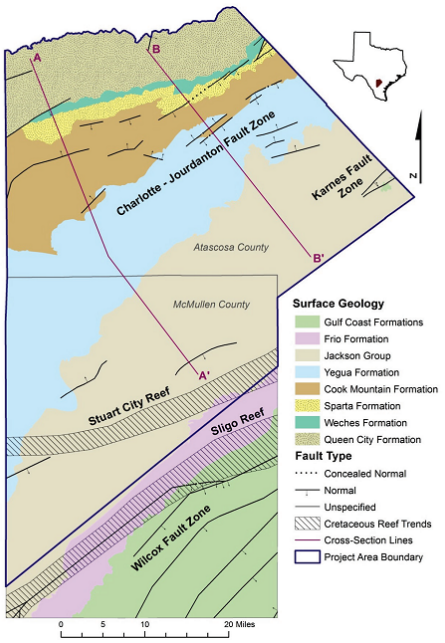
Reference

Robert E. Mace
Texas Water
Development Board
1700 North Congress
Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

Queen City and Sparta Aquifers, Atascosa and McMullen Counties, Texas: Structure and Brackish Groundwater

Mr. Wise examined the brackish groundwater resources of the Queen City and Sparta aquifers within Atascosa and McMullen counties while at the Texas Water Development Board (TWDB). This work was conducted as part of the Brackish Resources Aquifer Characterization System (BRACS) program and was published as TWDB Technical Note 14-01. The study includes data from the TWDB groundwater database and the BRACS database, which were used to characterize the aquifers for sand content, water chemistry, water quality, and water volumes.

Based on the results of the study, the total amount of brackish groundwater within the Queen City and Sparta aquifers in the study area was estimated at approximately 58 million acre-feet. Brackish groundwater is prevalent in each aquifer and occurs within their outcrop areas. Faulting appears to influence the spatial distribution of brackish groundwater in each aquifer to a significant degree.



Matthew R. Wise, 2014, Texas Water Development Board Technical Note 14-01.

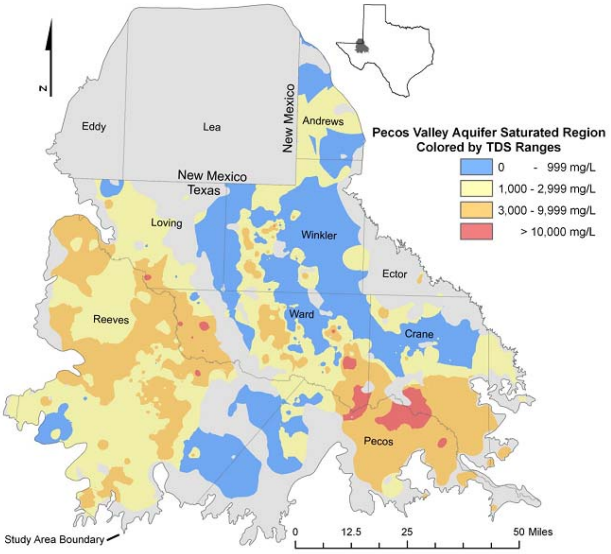
Pecos Valley Aquifer, West Texas: Structure and Brackish Groundwater

Reference

Robert E. Mace
Texas Water
Development Board
1700 North Congress
Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

Mr. Wise contributed to a study on the brackish groundwater resources of the Pecos Valley Aquifer while at TWDB. His part in the study included stratigraphic and net sand geophysical well log analyses as well as geologic cross-section preparation for aquifer characterization. This work served as the pilot study for the BRACS program and was published as TWDB Report 382.

The Pecos Valley Aquifer was estimated to contain approximately 85 million acre-feet of brackish groundwater. Based on the results of the study, the largest volumes of brackish groundwater are found in the central and western portions of the aquifer.



John E. Meyer, Matthew R. Wise, and Sanjeev Kalaswad, 2012, Texas Water Development Board Report 382.

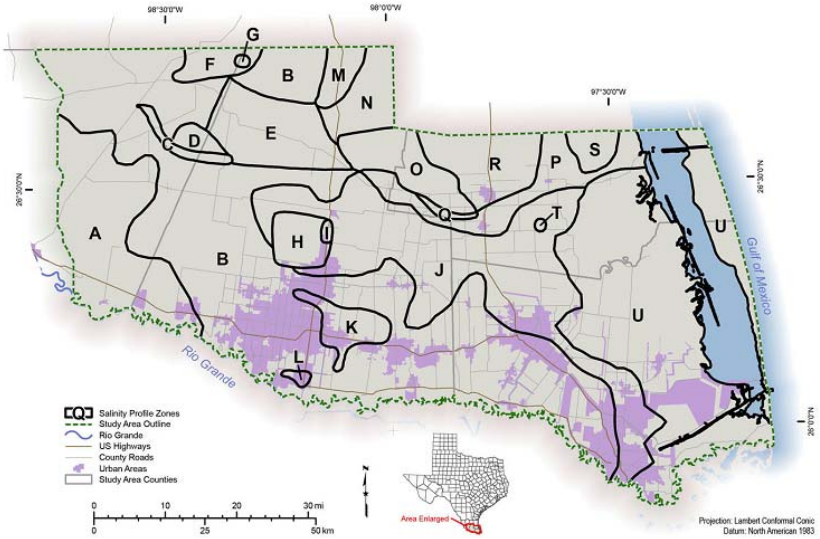
Brackish Groundwater in the Gulf Coast Aquifer, Lower Rio Grande Valley, Texas

Reference

Robert E. Mace
Texas Water Development Board
1700 North Congress Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

Mr. Wise contributed to a study on the brackish groundwater resources of the Gulf Coast Aquifer while at TWDB. His role in the study included compiling aquifer test data, creating geologic formation GIS maps, net sand geophysical well log analysis, and generating geologic formation net sand GIS maps. This study was undertaken due to the anticipated increase in water demand from expected population growth in the region.

The study results indicated that the Gulf Coast Aquifer is estimated to have approximately 152 million acre-feet of brackish groundwater in the study area. Based on this work, the Gulf Coast Aquifer has 21 geographic areas exhibiting unique groundwater salinity zone profiles extending from the surface down to the base of the aquifer within the study area.



John E. Meyer, Andrea Croskrey, Matthew R. Wise, Sanjeev Kalaswad, 2014, Texas Water Development Board Report 383.

RELEVANT EXPERIENCE

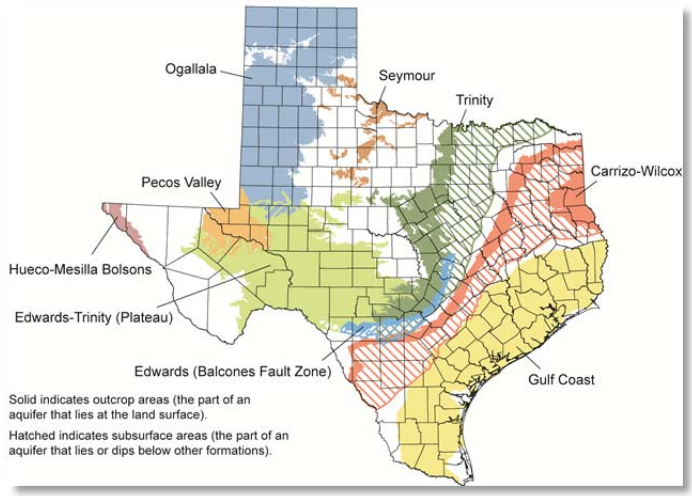
Aquifers of Texas

Reference
Rima Petrossian
Manager
Groundwater Technical Assistance
Texas Water Development Board
1700 North Congress Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

Dr. Peter George revised the original Aquifers of Texas report published 15 years earlier. Since the original publication, a great deal of information has become available through research at universities, state and federal agencies, and private environmental engineering firms as part of the TWDB's Groundwater Availability Modeling Program.

In addition to new research becoming available, the areal extent of the aquifers has changed since 1995. In the 2007 Texas State Water Plan the TWDB, based on Dr. George's recommendations, adjusted the boundaries of the Blaine, Bone Spring–Victorio Peak, Edwards (Balcones Fault Zone), Igneous, Lipan, Ogallala, Pecos Valley (formerly the Cenozoic Pecos Alluvium), Seymour, and Trinity aquifers. These changes are incorporated into the aquifer summaries presented in the report.

The aquifer summaries are short descriptions covering geology, hydrology, and water use, based largely on reports generated through the Groundwater Availability Modeling Program. The summaries are preceded by sections on the current status of groundwater in Texas.



George, P., Mace, R.E., and Petrossian, R., 2011, Aquifers of Texas: Texas Water Development Board Report 380, 172 p.

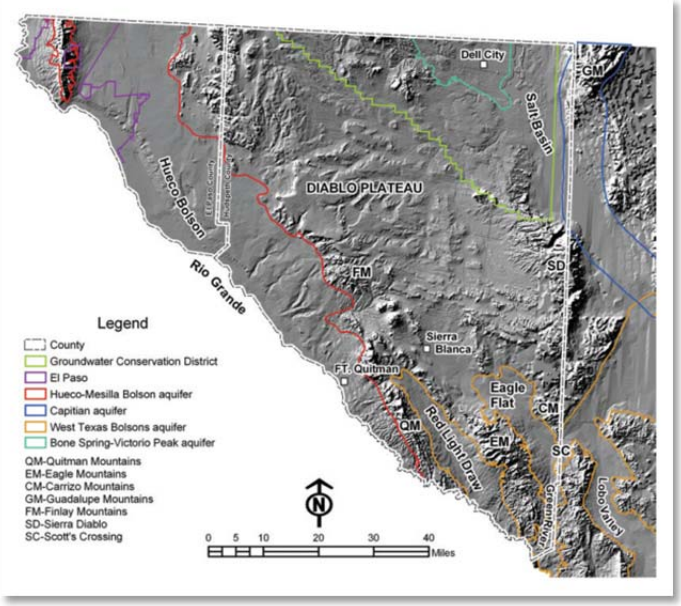
The Hydrogeology of Hudspeth County, Texas

Reference

Robert E. Mace
Texas Water Development Board
1700 North Congress Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

One of Dr. Peter George's first assignments while at the Texas Water Development Board (TWDB) was to examine the water resources of Hudspeth County. This was performed as part of the Priority Groundwater Management Area process. The study includes data from the TWDB groundwater database, which were used to characterize the county's groundwater in terms of availability and water quality.

Based on the characterization of the county's hydrogeology, Hudspeth County was not designated a PGMA but the boundary of the Bone Spring-Victorio Peak Aquifer was changed. The areal extent of the aquifer was increased after an analysis of the database.



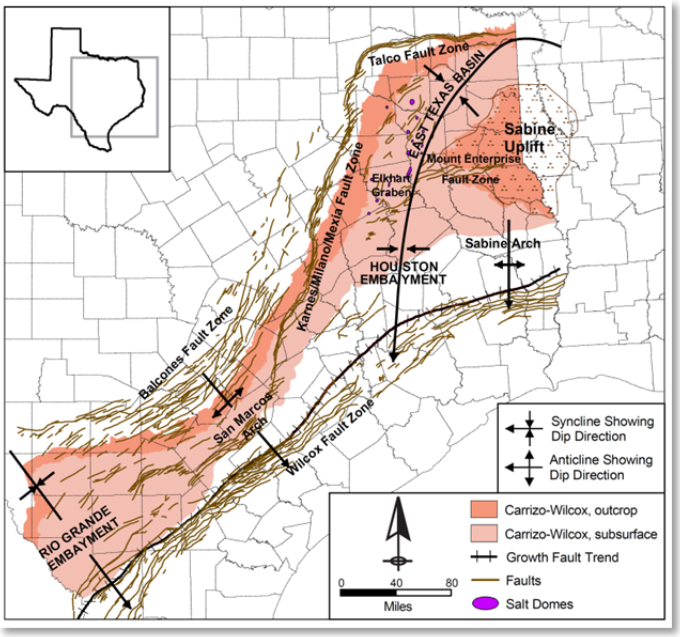
George, P., Mace, R.E., and Mullican, W.F., III, 2005, The hydrogeology of Hudspeth County, Texas: Texas Water Development Board Report 364, 95 p.

Geology of the Carrizo-Wilcox Aquifer

Reference

Robert E. Mace
Texas Water
Development Board
1700 North Congress
Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

Dr. Peter George contributed a study on the geology of the Carrizo-Wilcox Aquifer to a Texas Water Development Board publication on the aquifers of the Upper Coastal Plains of Texas. The study emphasizes the tectonic histories of the source areas in the Southern Rocky Mountains as the main driving mechanisms for the deposition of Wilcox Group sediments. Also, eustatic changes in sea level produced regional flooding surfaces that can be traced along the Texas coast. The surfaces are particularly useful for correlation purposes and for placing Wilcox Group rocks in a sequence stratigraphic context. Local deformation of Jurassic salt deposits in the form of salt diapirs influenced topography and, therefore, deposition of Wilcox strata, especially in East Texas. Local deformation in southwest Texas in the Rio Grande Embayment was the product of rapid deformation of sand-rich sediment on shale-rich prodelta muds, producing growth faulting and shale diapirs.



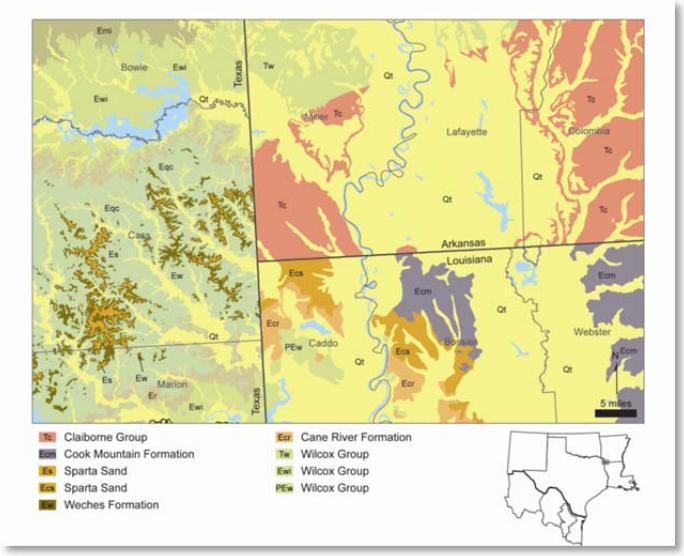
George, P. G., 2009, Geology of the Carrizo-Wilcox Aquifer, in Hutchison, W. R., Davidson, S. C., Brown, B. J., and Mace, R. E., eds., Aquifers of the Upper Coastal Plains of Texas: Texas Water Development Board Report 374, p. 17-34. .

Transborder Aquifers

Reference
Rima Petrossian
Manager
Groundwater Technical Assistance
Texas Water Development Board
1700 North Congress Avenue P.O. Box 13231
Austin, TX
(512) 463-7847

Dr. Peter George contributed to a study on shared aquifers bordering the State of Texas. His part in the study included stratigraphic interpretations, constructing maps, and analyzing groundwater chemistry, all for aquifer comparisons.

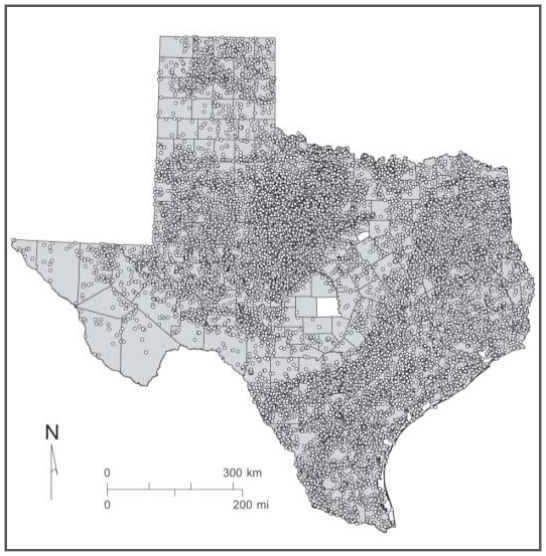
The need for the study comes from the fact that of the 30 aquifers recognized by the State of Texas, 23 aquifers are shared with one or more other states. These include aquifers in New Mexico, Oklahoma, Arkansas, and Louisiana in the United States, and Tamaulipas, Nuevo León, Coahuila de Zaragoza, and Chihuahua in Mexico.



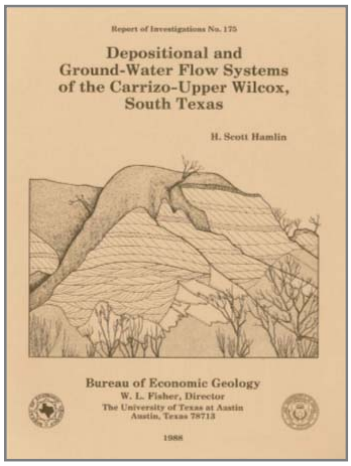
Petrossian, R., George, P.G., Backhouse, S., Davidson, S.C., Bradley, R.G., and Boghici, R., In Prep., Transborder Aquifers: Texas Water Development Board, Draft Report.

Ortuno, D. A., A. R. Averett, S. J. Clift, and J. G. Paine (2012), Locating, Scanning, and Delivering Digital Geophysical Well Logs and Associated Data for Brackish Resources Aquifer Characterization (BRACS). Contract Report to the Texas Water Development Board, 11 pages.

The Bureau of Economic Geology identified, located, and scanned geophysical logs to help characterize brackish groundwater resources of Texas, including key attributes of the geophysical logs in a database designed by TWDB as part of the Brackish Resources Aquifer Characterization System (BRACS) effort. As the designated repository for geophysical logs acquired by the oil and gas industry and submitted to the Railroad Commission of Texas (RRC), the Bureau maintains the largest collection of publicly accessible geophysical logs in Texas. The Integrated Core and Log Database (IGOR – accessed through http://igor.beg.utexas.edu/crc2/geologs.aspx), maintained by the Bureau, includes more than 300,000 well logs in digital or paper format. These logs, acquired over decades, formed the principal basis for the effort to identify the most useful and widely distributed data to support brackish aquifer characterization activities. The extensive and labor-intensive effort to identify criteria-matching logs from the unprocessed and uncataloged paper collection at the Bureau's Geophysical Log Facility (GLF) and the Core Research Center (CRC) required hiring, training, and managing more than a dozen temporary and student staff for the seven-month duration of the project. These staff processed approximately 1.4 million paper logs from the GLF and CRC archives, sorting each log by county and segregating logs that met the BRACS criteria for depth and log type.



Hamlin, H. S. (1988), Depositional and Ground-Water Flow Systems of the Carrizo-Upper Wilcox, South Texas. Bureau of Economic Geology Report of Investigations No. 175. 61 pages.

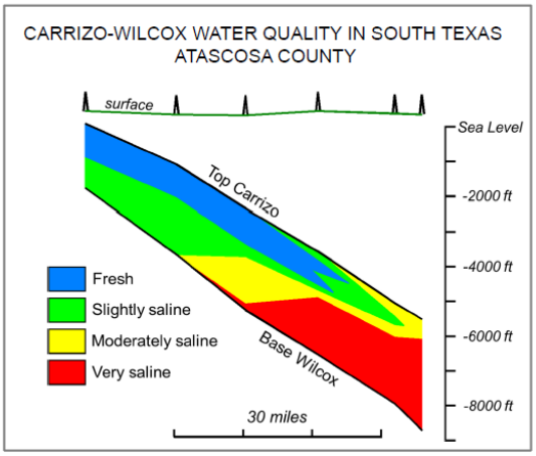


In the Rio Grande Embayment of South Texas, the Carrizo Formation (Lower Eocene) consists of two sand-rich fluvial depositional systems that grade basinward into several deltaic complexes within the upper part of the Wilcox Groups. Data from oil, gas, and water wells provide information on Carrizo fluvial and groundwater flow systems, and outcrop and core data helps define component lithofacies. Regional groundwater flow is controlled by topography, structural configuration, and, to a lesser extent, sandstone geometry. Rainfall recharges the aquifer at outcrop; groundwater flows gravitationally down structural/depositional dip and finally discharges upward, mainly along fault-related permeability pathways. Upward cross-formational leakage, driven by high fluid pressures, is common throughout much of the aquifer.

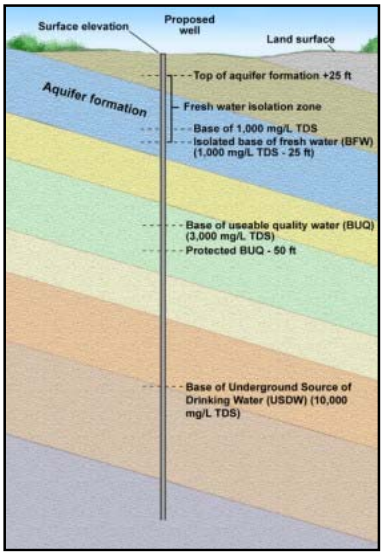
The updip Carrizo Sandstone contains fresh groundwater, small oil fields, and uranium deposits. The downdip upper Wilcox trend is an area of active hydrocarbon exploration and production.

de la Rocha, L., H. S. Hamlin, B. R. Scanlon, J.-P. Nicot, and I. Duncan. 2014. Characterization of Brackish Groundwater in the Carrizo-Wilcox Aquifer Case study: Eagle Ford Shale Play. *Prepared for:* Shell-UT Unconventional Research – SUTUR, Bureau of Economic Geology. 19 p. + plates

Because of the high demand for limited water resources, the oil industry is now re-evaluating its sources of water. Some companies are turning to brackish groundwater to reduce freshwater use. This study is an assessment of brackish groundwater resources in the Carrizo-Wilcox aquifer for producer operations in the Eagle Ford Shale play in South Texas. We used 338 geophysical well logs and information about the depositional history of the formations to correlate stratigraphic boundaries (Carrizo-Upper Wilcox, Middle Wilcox, and Lower Wilcox), map lithologies, and estimate groundwater salinity, and volume in 11 counties which represent the study area. Water quality analysis was based on concentrations of total dissolved solids (mg/L). Groundwater was classified into four broad categories; fresh (less than 1,000 mg/L), slightly-saline (1,000 - 3,000 mg/L), moderately-saline (3,000 - 10,000 mg/L), and very-saline (10,000 - 35,000 mg/L). Both slightly-saline and moderately saline were considered brackish groundwater (1,000 - 10,000 mg/L). Results show that groundwater availability and salinity vary areally and also with depth. The Carrizo-Wilcox aquifer is one of the richest aquifers of freshwater in the state of Texas (`~485 maf in storage). Volumetric calculations of isolated brackish groundwater indicate ~ 600 maf in storage, 1.3 times more brackish groundwater than fresh water in storage in the aquifer. This study provides valuable data for the use of brackish groundwater for shale gas and oil extraction in the Eagle Ford shale play, and thus reduces the demand for freshwater resources. Moreover, the methodology for mapping brackish groundwater in this aquifer can be used as a template for similar geologic systems in other regions with similar sediments.

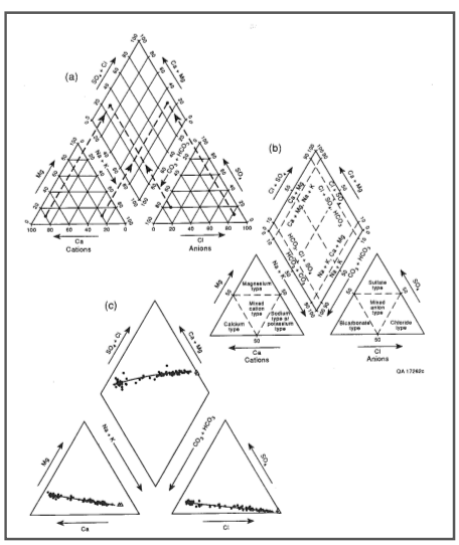


E. Collins, T. Tremblay, A. Averett, and J. Ortuno. Surface Casing Estimator Site (http://www.beg.utexas.edu/sce/index.html)



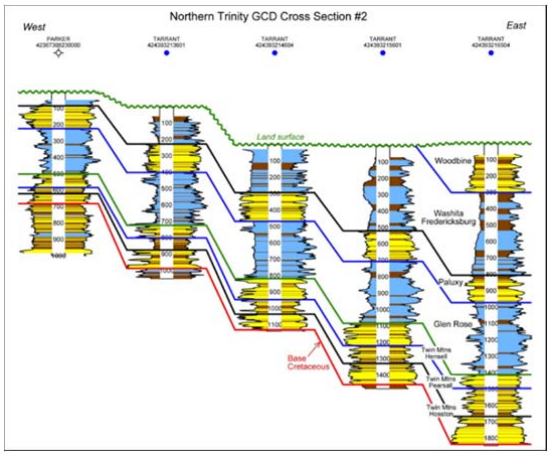
The Bureau's ongoing Surface Casing Estimator Site Project for the Railroad Commission of Texas Groundwater Advisory Unit is currently in its 12th year. This project involves construction of the Surface Casing Estimator Site (http://www.beg.utexas.edu/sce/index.html), a website that calculates estimated depths of groundwater and stratigraphic horizons related to possible groundwater protection determinations and surface-casing requirements in Texas, will be presented. The Estimator Site provides elevations and depths for the base of fresh water, base of usable-quality water, base of underground sources of drinking water (USDW), and the top and base of selected water-bearing stratigraphic units. It also displays well locations, land surveys, and images of geophysical logs. The site is intended to provide general, non-regulatory information to the public and to help operators plan wells and obtain a Groundwater Protection Determination Letter from the Railroad Commission of Texas Groundwater Advisory Unit (RRC GAU). Construction of the Estimator Site is an ongoing, multi-year effort that is supported by the RRC GAU. Project work involves review and interpretation of RRC GAU data and geophysical logs, input/guidance from RRC GAU staff, and construction and programing of Estimator Site data sets. The site currently provides non-regulatory estimates for groundwater horizons in 57 counties and allows viewing of more than 8,000 geophysical logs. The Bureau staff for this project include E. Collins, T. Tremblay, A. Averett, and J. Ortuno.

Richter, B. S., and C. W. Kreitler (1993), Geochemical Techniques for Identifying Sources of Ground-Water Salinization. Bureau of Economic Geology project to the Kerr Environmental Research Laboratory (USEPA) CRC Press, 258 pages.



Geochemical Techniques for Identifying Sources of Ground-Water Salinization offers a comprehensive look at the threat to the United States' freshwater resources due to salinization and outlines techniques that can be used to study the problem. The book reviews the seven major salt-water sources that commonly mix and deteriorate our fresh ground water (natural saline ground water, halite solution, sea-water intrusion, oil- and gas-field brines, agriculture effluents, saline seep, and road salting). Other topics covered are the characteristics of saltwater sources, geochemical parameters, and basic graphical and statistical methods that are frequently used in saltwater studies. The book also provides geographical charts showing the distribution of the major salt-water sources, illustrating which ones are potential sources in any given area in the United States, including the state of Texas.

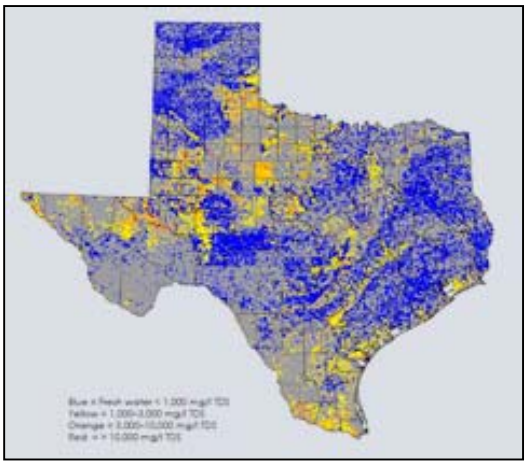
Revised Northern Trinity and Woodbine Groundwater Availability Model, Texas (INTERA and BEG)



Under an inter-local agreement between several GCDs, INTERA and BEG developed an updated GAM of the Northern Trinity and Woodbine aquifers. As part of the development of the conceptual model, INTERA reviewed the aquifers water quality, aquifer properties and developed the first consistent hydrostratigraphic framework from Oklahoma south to the Colorado River. As part of the study we analyzed over 500 pumping tests, and thousands of specific capacity tests to determine the spatial distribution of hydraulic conductivity for each of the formations comprising the Northern Trinity and Woodbine aquifers.

INTERA and BEG analyzed over 1,700 wells for water quality, to both determine hydrogeochemical facies (providing information about the likely evolution of the groundwater system) as well as to create maps of total dissolved solids and chloride by aquifer. Areas were identified in each formation comprising the Trinity Aquifer where brackish water exists. Water quality was also inferred from resistivity logs. Controls on aquifer groundwater quality were investigated from the context of recharge discharge mechanisms, aquifer hydraulic properties, aquifer mineralogy and impacts of faults and anthropogenic activities. The Northern Trinity and Woodbine Aquifer GAM was finalized in August of 2014 and has been accepted by the TWDB as the GAM for these aquifers.

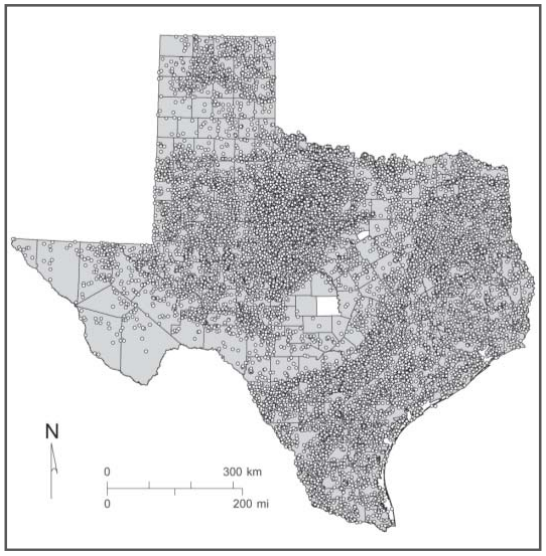
Mace, R. E., J.-P. Nicot, A. H. Chowdhury, A. R. Dutton, S. Kalaswad. 2006. Please Pass the Salt: Using Oil Fields for the Disposal of Concentrate from Desalination Plants. Texas Water Development Board Report #366. 212p.



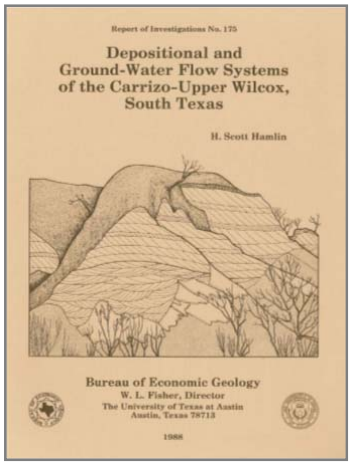
On contract to the Texas Water Development Board, BED evaluated the technical aspects of disposal of brine concentrate from brackish water desalination plants into depleted Texas oil and gas fields. This study is relevant to the proposed work in that it addressed the concern of precipitate formation and clay mobilization when imported water is mixed with formation water, both of which may effectively plug a reservoir. The study also evaluates injectivity (the rate at which a reservoir may physically accept injected fluids) in six distinct areas of Texas as well as the potential for injected fluid to migrate to shallower freshwater aquifers. The study concludes that the risk of freshwater aquifer contamination is minimal to non-existent, and that following simple chemical treatment of desalination plant concentrate, injection into depleted oil and gas fields should not present any problems outside the range already faced by industry, while injecting coproduced brackish water back into hydrocarbon producing

Ortuno, D. A., A. R. Averett, S. J. Clift, and J. G. Paine (2012), Locating, Scanning, and Delivering Digital Geophysical Well Logs and Associated Data for Brackish Resources Aquifer Characterization (BRACS). Contract Report to the Texas Water Development Board, 11 pages.

The Bureau of Economic Geology identified, located, and scanned geophysical logs to help characterize brackish groundwater resources of Texas, including key attributes of the geophysical logs in a database designed by TWDB as part of the Brackish Resources Aquifer Characterization System (BRACS) effort. As the designated repository for geophysical logs acquired by the oil and gas industry and submitted to the Railroad Commission of Texas (RRC), the Bureau maintains the largest collection of publicly accessible geophysical logs in Texas. The Integrated Core and Log Database (IGOR – accessed through http://igor.beg.utexas.edu/crc2/geologs.aspx), maintained by the Bureau, includes more than 300,000 well logs in digital or paper format. These logs, acquired over decades, formed the principal basis for the effort to identify the most useful and widely distributed data to support brackish aquifer characterization activities. The extensive and labor-intensive effort to identify criteria-matching logs from the unprocessed and uncataloged paper collection at the Bureau's Geophysical Log Facility (GLF) and the Core Research Center (CRC) required hiring, training, and managing more than a dozen temporary and student staff for the seven-month duration of the project. These staff processed approximately 1.4 million paper logs from the GLF and CRC archives, sorting each log by county and segregating logs that met the BRACS criteria for depth and log type.



Hamlin, H. S. (1988), Depositional and Ground-Water Flow Systems of the Carrizo-Upper Wilcox, South Texas. Bureau of Economic Geology Report of Investigations No. 175. 61 pages.



In the Rio Grande Embayment of South Texas, the Carrizo Formation (Lower Eocene) consists of two sand-rich fluvial depositional systems that grade basinward into several deltaic complexes within the upper part of the Wilcox Groups. Data from oil, gas, and water wells provide information on Carrizo fluvial and groundwater flow systems, and outcrop and core data helps define component lithofacies. Regional groundwater flow is controlled by topography, structural configuration, and, to a lesser extent, sandstone geometry. Rainfall recharges the aquifer at outcrop; groundwater flows gravitationally down structural/depositional dip and finally discharges upward, mainly along fault-related permeability pathways. Upward cross-formational leakage, driven by high fluid pressures, is common throughout much of the aquifer.

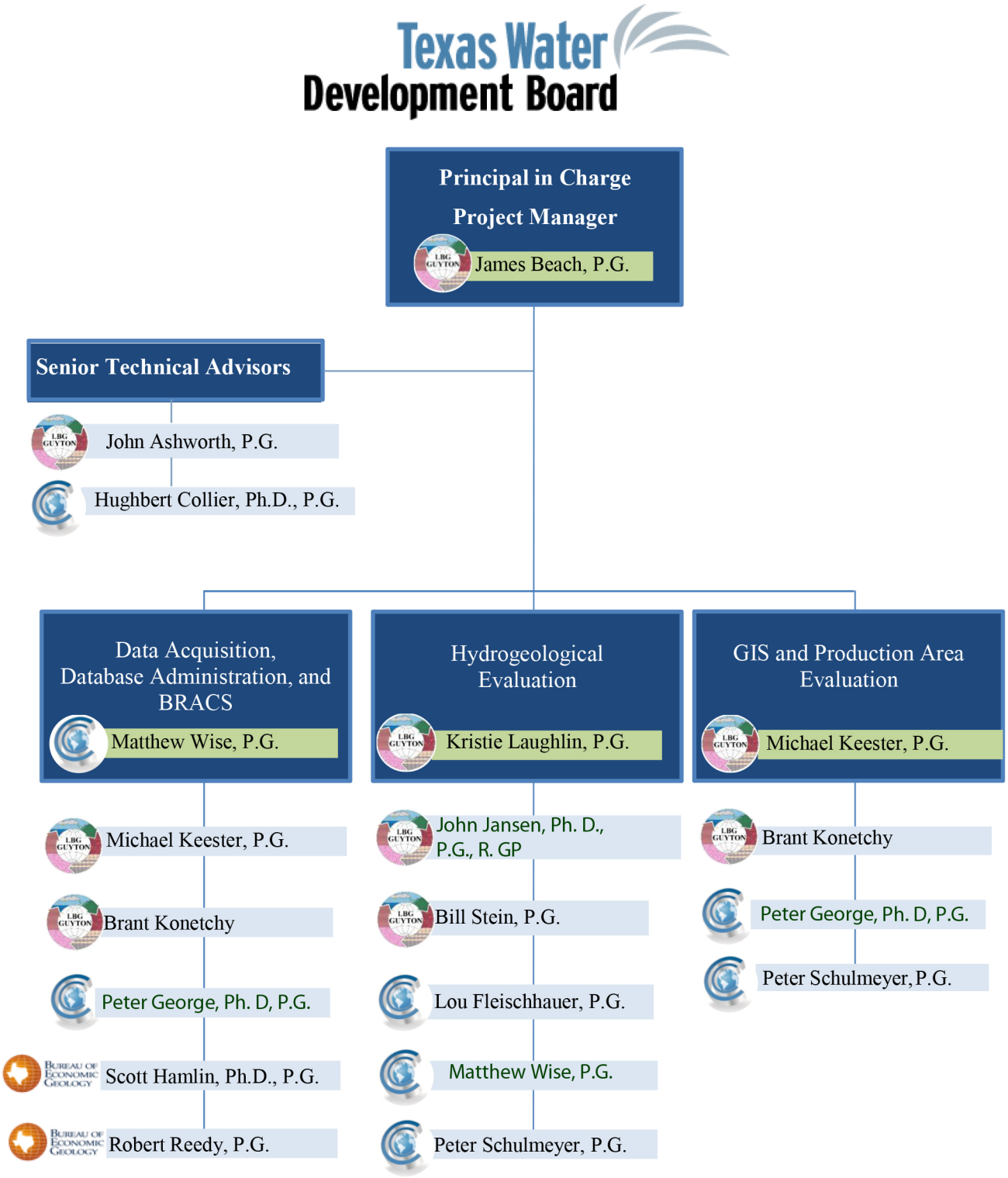
maintenance operations. The results of numerical modeling with SOMINEQ indicate that introducing desalination plant concentrate and subsequently mixing it with formation water should not present any technical problems outside those already commonly encountered in subsurface injections. Due to the abundance of depleted oil and gas fields in the state, this method of disposal is highly feasible and may be economically advantageous. *Figure maps six potential injection areas for disposal of brackish water desalination brine waste.*

APPENDIX B: PROJECT SCHEDULE

PROPOSED PROJECT SCHEDULE BY TASK

Task Number and Name	2016												2017							
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A
1 – Project Management																				
2 – Data Acquisition																				
3 – Hydrogeologic Evaluation																				
4 – GIS Dataset Development																				
5 – Production Area Evaluation																				
6 – Draft Project Report																				
7 – Final Project Report																				

APPENDIX C: ORGANIZATION CHART



APPENDIX D: RFQ DOCUMENT

`

REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008

FOR

SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

Class-Item Code(s): 918/55, 926/52

RESPONSES DUE:

NOVEMBER 24, 2015 12:00 PM

PLEASE NOTE:

This Request for Qualifications No. 580-16-RFQ0008 is revised and supersedes Request for Qualification No. 580-16-RFQ0007 and any other documents.

Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231
Contact: Tina Newstrom
Phone: 512-463-7825
Email: contracts@twdb.texas.gov

TABLE OF CONTENTS

SECTION I - OVERVIEW 1
1.1 OVERVIEW 1
1.2 CONTRACT TERM 1
1.3 COMPENSATION 1
1.4 BACKGROUND 1
SECTION II – STATEMENT OF WORK 2
2.1 DESCRIPTION OF SERVICES 2
2.2 SCOPE OF WORK 2
2.3 BRACKISH AQUIFERS 4
Project No. 1 4
Project No. 2 5
Project No. 3 5
Project No. 4 5
Project No. 5 6
Project No. 6 6
2.4 RESPONSE REQUIREMENTS FOP EVALUATION 6
SECTION III – DELIVERABLES 7
3.1 CONTRACT DELIVERABLES 7
SECTION IV – GENERAL INFORMATION 8
4.1 SOQ REQUIREMENTS 8
4.2 RESPONSE COSTS 10
4.3 TRAVEL EXPENSES 10
4.4 MEETINGS 10
4.5 SCHEDULE OF EVENTS: 10
4.6 REVISIONS TO SCHEDULE 10
4.7 INQUIRIES 10
4.8 RESPONSE SUBMISSION 11
4.10 OPENING 11
4.11 EVALUATION AND AWARD 11
SECTION V – GENERAL TERMS AND CONDITIONS 12
5.1 GENERAL TERMS 12
5.2 PATENTS OR COPYRIGHTS 12
5.3 CONTRACTOR ASSIGNMENTS 13

5.4 HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN 13
5.5 HUB CONTINUING PERFORMANCE 13
5.6 HUB RESOURCES AVAILABLE 13
5.7 RESPONDENT'S AFFIRMATION 14
5.8 EXECUTIVE ORDER 13224 15
5.9 FAMILY CODE REQUIREMENTS 15
5.10 ADDITIONAL TERMS 15
5.11 DISPUTE RESOLUTION 15
5.12 NON-APPROPRIATION OF FUNDS 15
5.13 PUBLIC INFORMATION ACT 15
5.14 TECHNOLOGY ACCESS CLAUSE 16
5.15 ETHICS 16
5.16 FRAUD STATEMENT 16
5.17 CONFLICT OF INTERESTS 17
5.18 CONTRACT ADMINISTRATION 17
5.19 CONTRACT REVISIONS 17
5.20 VENDOR PERFORMANCE 17
5.21 DEFAULT 17
5.22 FORCE MAJEURE 17
5.23 OWNERSHIP/INTELLECTUAL PROPERTY, INCLUDING RIGHTS TO DATA, DOCUMENTS AND COMPUTER SOFTWARE 18
5.24 DRUG FREE WORKPLACE POLICY 19
5.25 INSURANCE 19
5.26 ORDER PRECEDENCE 19
5.27 PROPRIETY INFORMATION 19
5.28 PUBLIC DISCLOSURE 20
5.29 SUBSTITUTIONS 20
5.30 TAXES 20
5.31 ACTS OR OMISSIONS 20
5.32 INFRINGEMENTS 21
5.33 TAXES/WORKERS' COMPENSATION/UNEMPLOYMENT INSURANCE – INCLUDING INDEMNITY 21
SECTION 1 EXECUTION OF RESPONSE Section 1-1
SECTION 2 COMPANY PROFILE SUMMARY AND HISTORY Section 2-1
SECTION 3 COMPANY REFERENCES Section 3-1

SECTION 3 COMPANY REFERENCES Section 3-2
SECTION 3 COMPANY REFERENCES Section 3-3
SECTION 4 RESUMES OF INDIVIDUALS Section 4-1
SECTION 5 HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN Section 5-1
SECTION 6 – OWNERSHIP OF BUSINESS ENTITY Section 6-1
SECTION 7 SCOPE OF WORK Section 7-1

SECTION I - OVERVIEW

1.1 OVERVIEW

The Texas Water Development Board (TWDB) request responses to this Request for Qualifications (RFQ) for the award of Services Contract(s) to conduct studies on six (6) Brackish Aquifers in Texas (hereafter referred to as "Project"). This RFQ is part of a requirement of House Bill 30, 84th Texas Legislative Session, for the TWDB to identify and designate brackish groundwater production zones in the aquifers of the state.

NOTE: Separate Statement of Qualifications (SOQ) is required to be submitted for each of the six (6) Projects as identified in Section II.

1.2 CONTRACT TERM

Service for each Project shall begin upon execution of the Contract. The completion date for three (3) of the Projects shall be August 31, 2016; and the remaining three (3) Projects shall be completed by August 31, 2017. Contract extensions for the studies will NOT be granted. The completion dates are identified in each Project.

NOTE: TWDB reserves the right to award each Project separately.

1.3 COMPENSATION

To be negotiated once the TWDB selects respondent(s) based on qualifications. Failure to arrive at mutually agreeable terms of a contract with the most qualified respondent shall constitute a rejection of the TWDB's offer and may result in subsequent negotiations with the next most qualified respondent. The TWDB reserves the right to reject any or all responses.

1.4 BACKGROUND

Planners and decision makers need reliable estimates of available fresh, brackish, and saline groundwater to better formulate water management strategies. Currently, the basis for determining the amount of brackish groundwater in Texas is decades-old data generated during a 2003 TWDB-funded study (LBG-Guyton, 2003, contract number 2001483395). The study helped lay the foundation for estimating brackish groundwater volumes in the state and documented that brackish groundwater is a tremendous asset in the state's water portfolio. However, the study was by design regional in scope, limited in areal extent, and narrow in its assessment of groundwater quality.

In 2009, the 81st Texas Legislature approved funding to establish the Brackish Resources Aquifer Characterization System (BRACS) program. The goal of the program is to map and characterize the brackish portions of the aquifers in Texas in sufficient detail to provide useful information and data to regional water planning groups and other entities interested in using brackish groundwater for desalination supplies. Since 2009, TWDB has completed three studies: the Pecos Valley Aquifer in West Texas (TWDB Report 382), Gulf Coast Aquifer in a four-county area in the Lower Rio Grande Valley (TWDB Report 383), and the Queen City and Sparta aquifers in part of a two-county area in south-central Texas (TWDB Technical Note 14-1). The TWDB also has two ongoing studies: the Carrizo-Wilcox Aquifer in a nine-county area in south-

central Texas scheduled for completion in spring 2016 and the Lipan Aquifer in a six-county area in West Texas scheduled for completion in summer 2016.

In 2015, the 84th Texas Legislature passed House Bill 30, directing the TWDB to conduct studies on and report to the legislature on a) four aquifers by December 1, 2016 and b) remaining aquifers in the state by December 1, 2022. This RFQ is for the Projects that require the TWDB to submit a report to the Texas Legislature by December 1, 2016, as well as additional studies. The Projects will also support implementation of House Bill 1232, (84th Texas Legislative Session), which requires mapping of confined and unconfined aquifers in the state by the TWDB.

SECTION II – STATEMENT OF WORK

2.1 DESCRIPTION OF SERVICES

The selected Contractor(s) will provide services, which shall include, but are not limited to, the requirements contained in this RFQ. Services set forth that contain the words "must" or "shall" are mandatory and must be provided as specified with no alterations, modifications or exceptions. Services set forth that contain the words "may" or "can" allow Respondents to offer alternatives to the manner in which the Services are provided. The selected Contractor(s) will provide assistance to the TWDB for activities described below for one or more of the Projects stated within this RFQ.

2.2 SCOPE OF WORK

General Requirements and Resource(s) for all six (6) Projects

To fulfill part of the requirements of House Bill 30, 84th Texas Legislature, 2015, the TWDB is requesting the Contractor to perform the following:

A. Delineate fresh, brackish, and saline groundwater both vertically and horizontally in the aquifers of the Project areas listed under The Projects.

B. Use the groundwater salinity classification developed by the U.S. Geological Survey (Winslow and Kister, 1956) to categorize the water delineated. The classification is based on the concentration of total dissolved solids (milligrams per liter) in water and includes the following: fresh (0 to 1,000); slightly saline (1,000 to 3,000); moderately saline (3,000 to 10,000); and very saline (10,000 to 35,000).

C. Quantify the volume of available fresh, brackish, and saline groundwater.

D. Delineate potential production areas that are separated by hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers. These potential production areas cannot include (a) an aquifer with an average total dissolved solids concentration of more than 1,000 milligrams per liter and which is serving as a significant source of water supply for municipal, domestic, or agricultural purposes, (b) a part of a geologic stratum that is designated or used for wastewater injection through the use of injection or disposal wells permitted under Texas Water Code Chapter 27, and/or (c) areas within the Harris-Galveston Subsidence District and the Fort Bend Subsidence District.

E. Meet with TWDB staff to discuss Contractor recommendations of potential production areas and develop a prioritized list of these areas for item 2.2G.

F. Meet with stakeholders to (1) explain TWDB's approach in implementing House Bill 30, (2) solicit feedback on what constitutes "significant impact", and (3) receive general comments concerning implementation of the legislation. *NOTE: Contractor(s) will not be making recommendations to the TWDB to designate brackish groundwater production zones; only the TWDB Executive Administrator will make these recommendations.*

G. Determine the volume of brackish groundwater that the potential production areas are capable of producing over a 30-year and a 50-year period without causing significant impact to water quality and quantity as described in item 2.2D.

H. **Resources**: The BRACS Database was developed to store and analyze well data for the completed BRACS studies. TWDB Open-File Report 12-02, Second Edition is a data dictionary for the BRACS Database. It describes the data objects or items in the database for the benefit of the user. In addition, previous and ongoing studies of the Groundwater Availability Modeling program have direct applicability to BRACS studies.

I. **Project Monitoring:** *At a minimum*, TWDB expects to meet with the Project Team (Contractor Meeting) four (4) times during the Project and conduct at least two (2) stakeholder meetings.

J. **Contractor Meetings shall include but not limited to:**
   1) Project initiation; the beginning of the Project.
   2) Discussion and approval of Project methodology; date to be determined by the Contractor.
   3) Discussion of potential production areas and prioritization for production calculations; date to be determined by the Contractor.
   4) Project completion; the end of the Project.

K. Additional technical meetings may be scheduled either in person, through a webinar, or teleconference venue to discuss Project progress and issues. TWDB staff may periodically visit the Contractor's work premises to assess progress on the Project.

L. Detailed monthly progress reports must be submitted to the TWDB outlining progress of the Project and include the original or adjusted schedule and detail how the Project is progressing relative to this yardstick. Project invoices cannot be processed without detailed descriptions of the progress made by tasks. Each of the Project tasks must be described in detail consistent with the budget description. The TWDB expects issues to be reported to the TWDB Project Manager immediately as they appear. Maintaining close coordination with TWDB throughout the Project will be critical.

M. A draft report documenting the technique(s) and approaches selected by the Contractor for geophysical well log interpretation of aquifer total dissolved solids concentration shall

be given to TWDB for review at a date determined by the Contractor. The report shall include information on the types of geophysical well logs available in the Project area, how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements (including specific examples), how the log correction factors are determined, and how the interpretation techniques will be applied across the entire salinity range within the aquifer. TWDB will have up to 10 business days to review the draft report, and the Contractor will schedule a meeting to discuss the techniques.

N. A meeting to discuss the potential production areas, at a date determined by the Contractor, shall be made prior to the end of the Project. Potential production areas will be prioritized for 30-year and 50-year pumping estimate task with input from stakeholders.

O. A formal presentation on the results of the Project shall be made to TWDB at the end of each Project.

P. **Stakeholder Meetings include but not limited to the following:**
1) For each Project, formal stakeholder meetings shall be scheduled and held.
2) The first general meeting was held October 26, 2015 from 10:00 am – 12:00pm in room 170 of the Stephen F. Austin Building in Austin, Texas. The general meeting was to explain TWDB's approach in implementing House Bill 30; solicit feedback on what constitutes "significant impact", and; receive general comments concerning implementation of the legislation.
3) The second meeting will be held at the end of the Project in the study area to provide information on the results of the Project and to solicit input on the potential production areas.

Q. TWDB will organize the meetings and invite stakeholders including at a minimum all the groundwater conservation districts within the Project area. The contractor will attend and make a presentation at the second stakeholder meeting.

R. Any meetings and/or conference calls will be held on regular business days (M - F) during regular business hours (8:00 am – 5:00 pm CT) upon agreed dates and times.

2.3 BRACKISH AQUIFERS

Project No. 1
Project Name: Gulf Coast Aquifer
Project Area: Gulf Coast Aquifer and adjacent strata (Catahoula Formation) that extend from the Texas-Louisiana border to the southern county lines of Brooks, Jim Hogg, and Kenedy counties and from the outcrop areas of these aquifers to the Gulf of Mexico.
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources:

"Hydrogeochemical evaluation of the Texas Gulf Coast Aquifer system and implications for developing groundwater availability models" (Young and others, 2014, TWDB contract 1148301233),
"Updating the hydrogeologic framework for the northern portion of the Gulf Coast Aquifer" (Young and others, 2012, TWDB contract 1004831113),
"Hydrostratigraphy of the Gulf Coast Aquifer from the Brazos River to the Rio Grande" (Young and others, 2010 TWDB contract 0804830795),
"Groundwater resource evaluation and availability model of the Gulf Coast Aquifer in the Lower Rio Grande Valley of Texas" (Chowdhury and Mace, 2007, TWDB Report 368),
"Groundwater availability model of the central Gulf Coast Aquifer system: numerical simulations through 1999" (Chowdhury and others, 2004),
"Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer system, Texas, 1891-2009" (Kasmarek, 2013, U.S. Geological Survey Scientific Investigations Report 2012-5154),
An alternative model "Groundwater management area 16 groundwater flow model" (Hutchison and others, 2011) was prepared for the Gulf Coast Aquifer.

TWDB is working on a groundwater model for the Gulf Coast Aquifer in groundwater management areas 15 and 16 scheduled for completion in December 2016.

Project No. 2
Project Name: Blaine Aquifer
Project Area: Blaine Aquifer, extent defined by the TWDB
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources: "Groundwater availability model for the Seymour Aquifer" (Ewing and others, 2004, TWDB contract) that includes Permian formations in layer 2.

Project No. 3
Project Name: Rustler Aquifer
Project Area: Rustler Aquifer, extent defined by the TWDB
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources: "Groundwater availability model report for the Rustler Aquifer" (Ewing and others, 2012 TWDB contract 0904831000)

Project No. 4
Project Name: Trinity Aquifer
Project Area: The northern and southern extent of Trinity Aquifer defined by the TWDB downdip until the total dissolved solids concentration in the aquifer transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources:
"Updated groundwater availability model of the northern Trinity and Woodbine Aquifers" (Kelley and others, 2014),

"Groundwater availability model for the Hill Country portion of the Trinity Aquifer System, Texas" (Jones and others, 2009), and
"Northern Trinity/Woodbine aquifer groundwater availability model" (R.W. Harden and Associates and others, 2004, TWDB contract 2003483483)

Project No. 5
Project Name: Blossom Aquifer
Project Area: Blossom Aquifer extent defined by the TWDB downdip until the groundwater total dissolved solids concentration transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources: TWDB Report 307

Project No. 6
Project Name: Nacatoch Aquifer
Project Area: Nacatoch Aquifer extent defined by the TWDB downdip until the groundwater total dissolved solids concentration transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources: "Nacatoch Aquifer groundwater availability model" (Beach and others, 2009, TWDB contract 0604830588).

2.4 RESPONSE REQUIREMENTS FOP EVALUATION

Respondents to this RFQ are required to indicate in Section 4.1.B(7)(d) of their response their abilities in the areas listed below (A-L). Please include years of experience, educational degrees and any professional certifications.

A. General hydrogeology;
B. Hydrogeology of the Project aquifer;
C. Interpreting and using geophysical well logs, as applicable to the Project;
D. Using data from TWDB Groundwater Availability Modeling Projects and other TWDB-contracted studies in the Project area;
E. Groundwater modeling in order to evaluate potential production areas;
F. Geographic Information System (GIS) files, use, and metadata documentation;
G. Communicating with the public;
H. Technology transfer;
I. Producing high-quality technical reports;
J. Using the TWDB BRACS and Groundwater databases;
K. Contract management including the ability to meet short and strict deadlines within budget; and
L. Demonstrate their ability to meet Project completion deadlines since there will be no contract extensions.

SECTION III – DELIVERABLES

3.1 CONTRACT DELIVERABLES

The Contractor shall deliver the following items to the TWDB on the date determined by each Project:

A. Updated data for the BRACS Database containing all new well records used in the Project.

B. Copies of water well reports, water quality reports, and geophysical well logs used in the study (unless those reports and logs already exist in the TWDB Groundwater or BRACS databases).

C. Three-dimensional GIS datasets that delineate groundwater salinity zones using ranges of concentrations of total dissolved solids of 0 to 1,000 milligrams per liter (fresh), 1,000 to 3,000 milligrams per liter (slightly saline), 3,000 to 10,000 milligrams per liter (moderately saline), and 10,000 to 35,000 milligrams per liter (very saline).

D. Three-dimensional GIS datasets that delineate potential production areas and the estimated volumes of brackish groundwater production in 30- and 50-year timeframes.

E. A technical report summarizing the study.

F. All geophysical well logs interpreted for total dissolved solids will be submitted to TWDB and all interpretation data values (input and output) will be documented in table(s) with links to well numbers, log numbers, depths, and names of geological formations in a Microsoft Access database format that can be linked to existing BRACS Database tables. Geophysical well log data obtained for the Project must be non-confidential and submitted in a Tagged Image Format (TIFF) and, if available, Log ASCII Standard (LAS) format. New well control will be added to the BRACS Database with complete attributes. Water quality data will be compatible with the Groundwater Database table design and should include the source of the data.

G. To develop new and updated maps of the water resources, the Project should use current information from a variety of non-proprietary databases and geophysical log repositories that are publicly available.

H. The tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater shall be thorough, use defensible scientific means and approaches, and shall be documented in the technical report. The technique(s) used to determine if a potential production area is hydrogeologically separated from fresh water aquifers shall be thoroughly documented in the technical report. Each potential production area will be assigned a unique ID, and all production area attributes (ID, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates) will be recorded in a

Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files.

I. The calculated volumes of groundwater within each aquifer and each TWDB-prioritized potential production area will be organized by salinity classification zone, county, groundwater conservation district, and groundwater management area. All GIS data shall be thoroughly documented with metadata including source, field descriptions, and units (as applicable) and use BRACS program-naming conventions and map Projection parameters. Geologic formation top and bottom raster surfaces, net sand raster maps, salinity classification zone top and bottom raster surfaces, proposed production area top and bottom raster surfaces, well control point files, and Project raster snap grid will be submitted to TWDB. All raster surfaces will share the same map Projection and snap grid attributes. TWDB must be able to replicate the volumes estimated and techniques used to determine the extents of each of the salinity classification zones. All potential production area modeling files will be submitted to TWDB.

J. Training for TWDB staff shall be provided, as needed or requested. Training may include, but not limited to how the volumes were estimated and the techniques used to determine the extents of salinity zones.

K. All draft and final reports shall be delivered in Microsoft Word and PDF formats. Draft deliverables will be submitted for review and comment by TWDB. These comments must be addressed in the Final Report and a copy of the comments must be incorporated into the final deliverables. Acceptance of the Final Report indicates the successful completion of the Project.

L. The BRACS program contract data requirements are available on the TWDB website at http://www.twdb.texas.gov/innovativewater/bracs/projects.asp and include information on GIS data and map Projection standards, BRACS Database standards, well report and geophysical well log file naming and organization standards, and other useful information.

SECTION IV – GENERAL INFORMATION

4.1 SOQ REQUIREMENTS

A. **SUBMISSIONS**: The Respondent shall submit one (1) original and six (6) double-sided, single-spaced copies of their SOQ on and one electronic copy for *each Project*; please indicate the Project No. on each response as listed in Section 2.3. You can submit a response for all or one of the Projects. However, a separate response is required for each Project and MUST indicate the Project No.:

1) ORIGINAL: One (1) complete ORIGINAL response (marked Original) which shall include a copy of the RFQ solicitation document along with the SOQ contents listed in paragraph B, below for each Project. The SOQ pages should be numbered and contain an organized, paginated table of contents corresponding to the section and pages of the response.

2) ELECTRONIC: One Portable Document Format files of the submission on a CD/DVD or USB drive.
3) Response may be tab indexed.
4) Responses must be delivered to the address noted in the RFQ.
5) Responses must be clearly marked **RESPONSE TO RFQ 580-16-RFQ0008**.
6) Responses must be complete and comprehensive.

B. **CONTENTS**: The Respondent shall submit all information listed below, in the order given, separated by labeled and tabbed sheets, as the response to this RFQ. The SOQ will only be considered if all items are submitted as required. Incomplete/late responses to this RFQ will not be considered. NOTE: Since there are six (6) Projects, a separate response for each Project is required and the Project No. MUST be indicated. ***You may make copies of any attachments and/or forms in the RFQ for submission purpose ONLY.***

1) Section 1: Signed/dated Execution of Response to the Request for Qualifications (SECTION 1)
2) Section 2: Company Profile Summary and History, two (2) pages maximum. Response should include the following:
   a. Legal company name, address, phone number, and legal status (corporation, partnership, joint venture, sole proprietorship)
   b. Legal name of each participant/potential user(s), their possible involvement with the Project, their phone number, and email address. Also include the contact person(s) information should questions come up regarding the response.
   c. Name, title, phone number and email address of person submitting the response with the authority to bind the company.
   d. Describe the general nature of previous work, the number of years in business, size and scope of operation.
3) Section 3: Company References - Provide references from a minimum of three (3) customers to whom the Respondent has provided services in the past 36 months similar to the scope of work described in this specification.
4) Section 4: Resumes of Individuals - Submit qualifications and experience of Project staff that will be directly involved, at any level, with this Project. ***PLEASE NOTE: Resumes do not count towards the two page maximum listed in Section 2.***
5) Section 5: Historically Underutilized Businesses Subcontracting Plan and applicable forms.
6) Section 6: Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity submitting the RFQ (if applicable).
7) Section 7: Scope of Work - A detailed Scope of Work (SOW) describing the following:
   a. Each task, a percent of effort per each task, a proposed time schedule for each task, and the amount of time each team member will spend on the Project. This SOW shall not exceed 20 pages, using Times New Roman 12 font.

b. A description of project-monitoring procedures; In addition, the contractor should demonstrate they are able to meet project completion deadlines since there will be no contract extensions.
c. A description of the project deliverables (reports, plans, or other products that the Board will receive;
d. Indicate abilities as listed in Section 2.4(A-L).

4.2 RESPONSE COSTS

Respondents are responsible for all costs in the preparation and delivery of their response to this RFQ to TWDB.

4.3 TRAVEL EXPENSES

This contract may include travel throughout the State of Texas to perform the tasks therein. Any and all travel expenses shall be in accordance with the state travel and per diem allowances detailed at https://fmx.cpa.state.tx.us/fmx/travel/index.php.

4.4 MEETINGS

Any meetings and/or conference calls will be held on regular business days (M - F) during regular business hours (8:00 am – 5:00 pm CT) upon agreed dates and times.

4.5 SCHEDULE OF EVENTS:

The solicitation process for this RFQ will proceed according to the following schedule:

EVENT	DATE (Central Time)
Issue Request for Qualifications	Tuesday, November 10, 2015
Deadline for Submission of SOW	Tuesday, November 24, 2015 12:00 pm
Expected Date of Award of Contract	January, 2016
Expected Contract Start Date	January, 2016

4.6 REVISIONS TO SCHEDULE

TWDB reserves the right to change the dates in the Schedule of Events above upon written notification to prospective Respondent(s) as an addendum posted on the Electronic State Business Daily.

4.7 INQUIRIES

A. All inquiries shall be submitted in writing to the attention of TWDB Contract Administration Staff via e-mail to contracts@twdb.texas.gov.

B. Except as otherwise provided in this Section, upon issuance of this RFQ, other employees and representatives of TWDB will not answer questions or otherwise discuss the contents of this RFQ with any potential Respondent or its representatives. Failure to observe this restriction may result in disqualification of any subsequent RFQ. This restriction does not preclude discussions unrelated to this RFQ.

4.8 RESPONSE SUBMISSION

A. All responses must be received and date stamped by TWDB by the deadline listed in the Schedule of Events above. TWDB will NOT accept late submittals.

B. Responses should be placed in a separate envelope or package and correctly identified with the RFQ number and submittal deadline/RFQ opening date and time. It is Respondent's responsibility to appropriately mark and deliver this response to TWDB by the specified date.

C. Telephone, facsimile or emailed responses will not be accepted.

D. Receipt of all addenda, if applicable, to this response should be acknowledged by returning a signed copy of each addendum with the submitted response**.**

NOTE: Failure to return the required items with the response will result in rejection of your Response. TWDB will not be responsible for locating or securing information that is not included in your Response.

4.9 DELIVERY OF SUBMISSION

Responses may be submitted to TWDB by one of the following methods:

U.S. Postal Service
Texas Water Development Board
Contracting & Purchasing
P.O. Box 13231
Austin, TX 78711-3231

Overnight/Express Mail or Hand Delivery
Texas Water Development Board
1700 North Congress Avenue, 6th Floor
Austin, TX 78701
Hours: 8:00 am to 5:00 pm (CT)

4.10 OPENING

Responses will be opened at 1700 North Congress Avenue, 6th Floor, Austin, TX, at the submittal deadline. Only Respondent's names will be read.

All submitted response's become the property of TWDB after the submittal deadline/opening date. Responses submitted shall constitute an offer for a period of ninety (90) days or until selection is made by TWDB, whichever occurs first.

4.11 EVALUATION AND AWARD

A. TWDB shall award a Contract to the vendor whose response is most qualified to perform the Statement of Work for the State of Texas.

B. A committee will be established by TWDB (including TWDB employees) to evaluate the responses.

C. The evaluation applies to ***each*** Project, which will be evaluated separately. ***TWDB reserves the right to award each Project separately***.

The evaluation committee will determine best value by applying the following criteria:

Points Available	Evaluation Criteria
0 – 70	Qualifications and Experience
0 – 90	Technical Approach
0 – 40	Project Organization and Management
0 – 30	Reports and Deliverables
0 – 20	Feasible Approach
250	**Total Points Possible**

D. TWDB may, at its discretion, elect to have Respondents provide oral presentations and respond to inquiries from the evaluation committee related to their SOQ.

E. Past Performance: A Respondent's past performance will be measured based upon pass/fail criteria, in compliance with applicable provisions of §2155.074, 2155.075, 2156.007, 2157.003, and 2157.125, Gov't Code. Respondents may fail this selection criterion for any of the following conditions:

1) A score of less than 90% in the Vendor Performance System;
2) Currently under a Corrective Action Plan through the CPA;
3) Having repeated negative Vendor Performance Reports for the same reason; or
4) Having purchase orders that have been cancelled in the previous 12 months for non-performance (i.e. late delivery, etc.).

Contractor performance information is located on the CPA web site at: http://comptroller.texas.gov/procurement/prog/vendor_performance/

SECTION V – GENERAL TERMS AND CONDITIONS

5.1 GENERAL TERMS

Any Contract awarded as a result of this RFQ will contain the general terms and conditions provided in this document. Subcontractors must also comply. In addition, any Contract awarded as a result of this RFQ shall be governed, construed, and interpreted under the laws of the State of Texas. The factors listed in Texas Government Code, Title 10, Subtitle D, Section 2155.074, 2155.144, 2156.007, and 2157.003 shall also be considered in making an award when specified. Any legal actions must be filed in Travis County, Texas.

5.2 PATENTS OR COPYRIGHTS

The Contractor agrees to protect the State and TWDB from claims involving infringement of patents or copyrights. TWDB will not consider any RFQ that bears a copyright. RFQ will be subject to the Texas Public Information Act, Texas Government Code, Chapter 552, and may be disclosed to the public upon request. Subject to the Act, Respondents may protect trade and confidential information from public release. Trade secrets or other confidential information,

submitted as part of a RFQ, shall be clearly marked at each page it appears. Such marking shall be in **boldface type at least 14 point font.**

5.3 CONTRACTOR ASSIGNMENTS

Respondent hereby assigns to TWDB any and all claims for overcharges associated with this Contract arising under the antitrust laws of the United States 15 U.S.C.A. Section 1, et seq. (1973), and the antitrust laws of the State of Texas, TEX. Bus. & Comm. Code Ann. Sec. 15.01, et seq. (1967).

5.4 HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN

It is the policy of TWDB to make a good faith effort to achieve the annual program goals by contracting directly with Historically Underutilized Businesses (HUBs) or indirectly through subcontracting opportunities in accordance with the Texas Government Code, Chapter 2161, Subchapter F, and HUB Rules promulgated by the Comptroller of Public Accounts (CPA), 34 TAC, Chapter 20.

HUBs are strongly urged to respond to this RFQ. Under Texas law, state agencies are required to make a good faith effort to assist HUBs in receiving certain percentages of the total value of contract awards. Vendors who meet the qualifications are strongly encouraged to apply for certification as HUBs.

TWDB has determined that subcontracting is probable under any Contract awarded as a result of this RFQ. ALL VENDORS RESPONDING TO THIS RFQ, INCLUDING THOSE THAT ARE HUB CERTIFIED OR THOSE WHO DO NOT PLAN TO SUBCONTRACT, MUST COMPLETE A HUB SUBCONTRACTING PLAN (HSP) IN ACCORDANCE WITH THE STATE'S POLICY ON UTILIZATION OF HUBs. THE HSP MUST BE INCLUDED AS PART OF THE RFQ TO THIS RFQ. FAILURE TO COMPLETE THE HSP AS INSTRUCTED MAY RESULT IN DISQUALIFICATION OF THE RFQ FROM CONSIDERATION. Please review the HSP forms carefully and allow sufficient time to identify and contact HUBs and allow them to respond. Note that Vendors must demonstrate a good faith effort to contract with new HUBs if currently proposed HUBs have performed as subcontractors to the Vendor for more than five (5) years. If the Vendor does not plan to subcontract, Vendor must state that fact in their plan. An original, signed paper copy of the HSP must be submitted in an envelope that is separate from the rest of the RFQ. The completed plan shall become a part of the contract that may be awarded as a result of this RFQ.

5.5 HUB CONTINUING PERFORMANCE

Any Contract(s) awarded as a result of this RFQ shall include reporting responsibilities related to HUB subcontracting. Awarded Vendors may not change any subcontractor without submitting a revised HUB Subcontracting Plan (HSP) to TWDB. Any change to a subcontractor and revised HSP must be approved in writing by TWDB prior to implementation.

5.6 HUB RESOURCES AVAILABLE

A list of certified HUBs is available on the Texas Comptroller of Public Accounts (CPA) Web site at: http://www.window.state.tx.us/procurement/cmbl/hubonly.html. For additional information, contact the CPA's HUB program office at Texas4hubs@cpa.state.tx.us. If Vendors

know of any businesses that may qualify for certification as a HUB, they should encourage those businesses to contact the CPA HUB program office.

5.7 RESPONDENT'S AFFIRMATION

Signing this response (SECTION 1 - Execution of Response to the Request for Qualifications) with a false statement is a material breach of Contract and shall void the submitted response or any resulting Contract(s), and the Respondent shall be removed from all bid lists. By signature hereon affixed on SECTION 1, the Respondent hereby certifies that:

A. The Respondent has not given, offered to give, nor intends to give at any time hereafter any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor, or service to a public servant in connection with the submitted bid;

B. Neither the Respondent nor the firm, corporation, partnership, or institution represented by the Respondent, or anyone acting for such firm, corporation or institution has violated the antitrust laws of this State or the Federal Antitrust Laws, nor communicated directly or indirectly this RFQ made to any competitor or any other person engaged in such line of business;

C. The Respondent is not a member of the TWDB, a TWDB staff member or a member of their immediate family;

D. Pursuant to Section 2155.004, Government Code, the Respondent has not received compensation for participation in the preparation of the specifications for this RFQ;

E. Pursuant to Section 231.006 (d), Family Code, re: child support, the Respondent certifies that the individual or business entity named in this bid is not ineligible to receive the specified payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate;

F. Under Section 2155.004 Government Code, the Respondent certifies that the individual or business entity named in this RFQ or Contract is not ineligible to receive the specified Contract and acknowledges that this Contract may be terminated and payment withheld if this certification is inaccurate;

G. The Respondent shall defend, indemnify, and hold harmless the State of Texas, all of its officers, agents and employees from and against all claims, actions, suits, demands, proceedings, costs, damages, and liabilities, arising out of, connected with, or resulting from any acts or omissions of Contractor or any agent, employee, subcontractor, or supplier of Respondent in the execution or performance of this contract;

H. Respondent agrees that any payments due under this contract will be applied towards any debt, including but not limited to delinquent taxes and child support that is owed to the State of Texas;

I. Respondent certifies that they are in compliance with Section 669.003 of the Government Code, relating to contracting with executive head of a State agency. If Section 669.003 applies, the Respondent will complete the following information in order for the bid to be evaluated:

Name of Former Executive: _____
Name of State Agency: _____
Date of Separation from State Agency: _____
Position with Respondent: _____
Date of Employment with Respondent: _____

J. Respondent agrees to comply with Government Code Section 2155.4441, pertaining to service contract use of products produced in the State of Texas; and

K. Respondent understands that acceptance of funds under this contract acts as acceptance of the authority of the State Auditor's Office, or any successor agency, to conduct an audit or investigation in connection with those funds. Respondent further agrees to cooperate fully with the State Auditor's Office or its successor in the conducting of the audit or investigation, including providing all records requested. Respondent will ensure that this clause concerning the authority to audit funds received indirectly by subcontractors through Respondent and the requirement to cooperate is included in any subcontract it awards.

5.8 EXECUTIVE ORDER 13224

The TWDB is federally mandated to adhere to the directions provided in the President's Executive Order (EO) 13224, Executive Order on Terrorist Financing – Blocking Property and Prohibiting Transactions with Persons Who Commit, Threaten to Commit, or Support Terrorism, effective 9/24/2001 and any subsequent changes made to it via cross-referencing Respondents/Contractors with the Federal General Services Administration's Excluded Parties List System (EPLS, http://www.sam.gov), which is inclusive of the United States Treasury's Office of Foreign Assets Control (OFAC) Specially Designated National (SDN) list.

5.9 FAMILY CODE REQUIREMENTS

Pursuant to Section 231.006 (c), Family Code, bid must include Names and Social Security Numbers of each person with at least 25% ownership of the business entity submitting the bid. Enter Name & Social Security Numbers for each person.

5.10 ADDITIONAL TERMS

Any terms and conditions attached to this RFQ will not be considered unless specifically referred to on this RFQ and may result in disqualification of this RFQ.

5.11 DISPUTE RESOLUTION

The dispute resolution process provided for in Chapter 2260 of the Texas Government Code must be used by the TWDB and the Respondent to attempt to resolve all disputes arising under this Contract.

5.12 NON-APPROPRIATION OF FUNDS

The State's funds are contingent on the availability of lawful appropriations by the Texas Legislature. If the Texas Legislature fails to continue funding for the payments due under an order referencing this Contract, the order will terminate as of the date that the funding expires, and TWDB will have no further obligation to make any payments.

5.13 PUBLIC INFORMATION ACT

Information, documentation, and other material in connection with this solicitation or any resulting Contract may be subject to public disclosure pursuant to Chapter 552 of the Texas Government Code (the "Public Information Act"). Any part of the RFQ that is of a confidential or proprietary nature must be clearly and prominently marked as such by the Respondent.

5.14 TECHNOLOGY ACCESS CLAUSE

The Respondent expressly acknowledges that State funds may not be expended in connection with the purchase of an automated information system unless that system meets certain statutory requirements relating to accessibility by persons with visual impairments. Accordingly, the Respondent represents and warrants to the qualified ordering entity that the technology provided to the qualified ordering entity for purchase is capable, either by virtue of features included within the technology or because it is readily adaptable by use with other technology, of:

A. Providing equivalent access for effective use by both visual and non-visual means;
B. Presenting information, including prompts used for interactive communications, in formats intended for both visual and non-visual use; and
C. Being integrated into networks for obtaining, retrieving, and disseminating information used by individuals who are not blind or visually impaired.

For purposes of this clause, the phrase "equivalent access" means a substantially similar ability to communicate with or make use of the technology, either directly by features incorporated within the technology or by other reasonable means such as assistive devices or services that would constitute reasonable accommodations under the Federal Americans with Disabilities Act or similar state or federal laws. Examples of methods by which equivalent access may be provided include, but are not limited to, keyboard alternatives to mouse commands and other means of navigating graphical displays and customizable display appearance.

5.15 ETHICS

Under Section 2155.003, Government Code, an individual who interacts with public purchasers in any capacity is required to adhere to the guidelines established in Section 1.2 of the State of Texas Procurement Manual, which outlines the ethical standards required of public purchasers, employees, and bidders who interact with public purchasers in the conduct of state business, and with any opinions of or rules adopted by the Texas Ethics Commission. Entities who are interested in seeking business opportunities with the State must be mindful of these restrictions when interacting with public purchasers of TWDB or purchasers of other state agencies. Specifically, a TWDB employee may not have an interest in, or in any manner be connected with a contract or bid for a purchase of goods or services by an agency of the state; or in any manner, including by rebate or gift, accept or receive from a person to whom a contract may be awarded, directly or indirectly, anything of value or a promise, obligation, or Contract for future reward or compensation. Entities who are interested in seeking business opportunities with the State must be mindful of these restrictions when interacting with public purchasers of TWDB or purchasers of other State agencies.

5.16 FRAUD STATEMENT

Respondents understand that the TWDB does not tolerate any type of fraud. The TWDB's policy is to promote consistent, legal, and ethical organizational behavior by assigning responsibilities and providing guidelines to enforce controls. Any violations of law, agency policies, or standards of ethical conduct will be investigated, and appropriate actions will be taken. Providers are expected to report any possible fraudulent or dishonest acts, waste, or abuse to the agency's Internal Audit division at 512-463-7978 or Nicole.Campbell@twdb.texas.gov.

5.17 CONFLICT OF INTERESTS

A RFQ will not be selected if it has a conflict of interest that will or may arise during the performance of its obligations under the Contract. For this reason, the submission in response to this RFQ must disclose all business interest and all relationships that could reasonably be considered to pose possible conflicts of interest in the offer's performance of contract obligations. In addition, Offers must represent and warrant in its response to this RFQ and in the contract that in the performance of services under the contract, (1) Respondent does not have and will not have any actual or potential conflict of interest, and (2) Respondent will take whatever reasonable actions may be necessary and prudent to avoid even the appearance of impropriety.

5.18 CONTRACT ADMINISTRATION

The TWDB shall designate a Project Manager for this Contract. The Project Manager will serve as the point of contact between the TWDB and the selected Contractor. The TWDB's Project Manager shall supervise the TWDB's review of contractor's technical work, deliverables, draft reports, the final report, payment requests, schedules, financial and budget administration, and similar matters. The Project Manager does not have any express or implied authority to vary the terms of the Contract, amend the Contract in any way or waive strict performance of the terms or conditions of the Contract.

5.19 CONTRACT REVISIONS

The contract may only be revised through a contract amendment process.

5.20 VENDOR PERFORMANCE

State agencies shall report a vendor's performance on any purchase of $25,000 or more from contracts administered by the commission or any other purchase made through an agency's delegated authority or a purchase made pursuant to the authority in Government Code, Title 10, Subtitle D or a purchase exemption from CPA/TPASS procurement rules and procedures.

5.21 DEFAULT

If Contractor is found to be in default under any provision of this Contract, TWDB may cancel the Contract without notice and either re-solicit or award the contract to the next best responsive and responsible Respondent. In the event of abandonment or default, Contractor will be responsible for paying damages to TWDB including but not limited to re-procurement costs, and any consequential damages to the State of Texas or TWDB resulting from Contractor's non-performance. The defaulting Contractor will not be considered in the re-solicitation and may not be considered in future solicitations for the same type of work, unless the specification or scope of work is significantly changed.

5.22 FORCE MAJEURE

Neither Contractor nor TWDB shall be liable to the other for any delay in, or failure of performance, of any requirement included in any PO resulting from this RFP caused by force majeure. The existence of such causes of delay or failure shall extend the period of performance until after the causes of delay or failure have been removed provided the non-performing party exercises all reasonable due diligence to perform. Force majeure is defined as acts of God, war, fires, explosions, hurricanes, floods, failure of transportation, or other causes that are beyond the

reasonable control of either party and that by exercise of due foresight such party could not reasonably have been expected to avoid, and which, by the exercise of all reasonable due diligence, such party is unable to overcome. Each party must inform the other in writing, with proof of receipt, within three (3) business days of the existence of such force majeure, or otherwise waive this right as a defense.

5.23 OWNERSHIP/INTELLECTUAL PROPERTY, INCLUDING RIGHTS TO DATA, DOCUMENTS AND COMPUTER SOFTWARE

For the purposes of this Contract, the term "Work" is defined as all reports, statistical analyses, work papers, work products, materials, approaches, designs, specifications, systems, documentation, methodologies, concepts, research, materials, intellectual property or other property developed, produced, or generated in connection with this Contract. All work performed pursuant to this Contract is made the exclusive property of TWDB. All right, title and interest in and to said property shall vest in TWDB upon creation and shall be deemed to be a work for hire and made in the course of the services rendered pursuant to this Contract. To the extent that title to any such work may not, by operation of law, vest in TWDB, or such work may not be considered a work made for hire, all rights, title and interest therein are hereby irrevocably assigned to TWDB. TWDB shall have the right to obtain and to hold in its name any and all patents, copyrights, registrations or such other protection as may be appropriate to the subject matter, and any extensions and renewals thereof. Contractor must give TWDB and/or the State of Texas, as well as any person designated by TWDB and/or the State of Texas, all assistance required to perfect the rights defined herein without any charge or expense beyond those amounts payable to Contractor for the services rendered under this Contract.

Contractor shall maintain and retain supporting fiscal and any other documents relevant to showing that any payments under this Contract funds were expended in accordance with the laws and regulations of the State of Texas, including but not limited to, requirements of the Comptroller of the State of Texas and the State Auditor. Contractor shall maintain all such documents and other records relating to this Contract and the State's property for a period of four (4) years after the date of submission of the final invoices or until a resolution of all billing questions, whichever is later. Contractor shall make available at reasonable times and upon reasonable notice, and for reasonable periods, all documents and other information related to the "Work" as defined in paragraph 11.30 of this Contract. Contractor and the subcontractors shall provide the State Auditor with any information that the State Auditor deems relevant to any investigation or audit. Contractor must retain all work and other supporting documents pertaining to this Contract, for purposes of inspecting, monitoring, auditing, or evaluating by TWDB and any authorized agency of the State of Texas, including an investigation or audit by the State Auditor.

Contractor shall cooperate with any authorized agents of the State of Texas and shall provide them with prompt access to all of such State's work as requested. Contractor's failure to comply with this Section shall constitute a material breach of this Contract and shall authorize the TWDB and the State of Texas to immediately assess appropriate damages for such failure. Pursuant to Government Code, §2262.003 the acceptance of funds by Contractor or any other entity or person directly under this Contract, or indirectly through a subcontract under this Contract, shall constitute acceptance of the authority of the State Auditor to conduct an audit or

investigation in connection with those funds. Contractor acknowledges and understands that the acceptance of funds under this Contract shall constitute consent to an audit by the State Auditor, Comptroller or other agency of the State of Texas. Contractor shall ensure that this paragraph concerning the State's authority to audit funds received indirectly by subcontractors through Contractor and the requirement to cooperate is included in any subcontract it awards. Furthermore, under the direction of the legislative audit committee, an entity that is the subject of an audit or investigation by the State Auditor must provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit.

5.24 DRUG FREE WORKPLACE POLICY

The contractor shall comply with the applicable provisions of the Drug-Free Work Place Act of 1988 (Public Law 100-690, Title V, Subtitle D; 41 U.S.C. 701 ET SEQ.) and maintain a drug-free work environment; and the final rule, government-wide requirements for drug-free work place (grants), issued by the Office of Management and Budget and the Department of Defense (32 CFR Part 280, Subpart F) to implement the provisions of the Drug-Free Work Place Act of 1988 is incorporated by reference and the contractor shall comply with the relevant provisions thereof, including any amendments to the final rule that may hereafter be issued.

5.25 INSURANCE

Contractor represents and warrants that it will, within five (5) business days of executing this agreement, provide TWDB with current certificates of insurance or other proof acceptable to TWDB of the following insurance coverage: Standard Workers Compensation Insurance covering all personnel who will provide services under this Contract;

Commercial General Liability Insurance, personal injury and advertising injury with, at a minimum, the following limits: $500,000 minimum each occurrence; $1,000,000 per general aggregate. Contractor represents and warrants that all of the above coverage is with companies licensed in the state of Texas, with "A" rating from Best, and authorized to provide the corresponding coverage. Contractor also represents and warrants that all policies contain endorsements prohibiting cancellation except upon at least thirty (30) days prior written notice to TWDB. Contractor represents and warrants that it shall maintain the above insurance coverage during the term of this Contract, and shall provide TWDB with an executed copy of the policies immediately upon request.

5.26 ORDER PRECEDENCE

In the event of conflicts or inconsistencies between this contract and its exhibits or attachments, such conflicts or inconsistencies shall be resolved by reference to the documents in the following order of priority: Signed Contract (or Notice of Award), Attachments to the Contract (or Notice of Award), Request for Proposals, and Respondent's Response to Request for Proposals.

5.27 PROPRIETY INFORMATION

The TWDB is a government agency subject to the Texas Public Information Act (PIA), Chapter 552, Gov't Code. The Proposal and other information submitted to the TWDB by the Respondent are subject to release as public information. The Proposal and other submitted information shall be presumed to be subject to disclosure unless a specific exception to disclosure under the PIA applies. If it is necessary for the Respondent to include proprietary or otherwise confidential

information in its Proposal or other submitted information, the Respondent must clearly label that proprietary or confidential information and identify the specific exception to disclosure in the PIA. Merely making a blanket claim that the entire Proposal is protected from disclosure because it contains some proprietary information is not acceptable, and shall make the entire Proposal subject to release under the PIA. In order to trigger the process of seeking an Attorney General opinion on the release of proprietary or confidential information, the specific provisions of the Proposal that are considered by the Respondent to be proprietary or confidential must be clearly labeled as described above. Any information which is not clearly identified as proprietary or confidential shall be deemed to be subject to disclosure pursuant to the PIA.

All contracts shall include the following language**:** "**Contractor is required to make any information created or exchanged with the state pursuant to this contract, and not otherwise excepted from disclosure under the Texas Public Information Act, available in a format that is accessible by the public at no additional charge to the state**." In addition to this recommended language, the Comptroller also advises that in order to ***comply with the new statutory requirements***, each state governmental entity should supplement this provision with the additional terms agreed upon by the parties regarding the specific format by which the vendor is required to make the information accessible by the public.

5.28 PUBLIC DISCLOSURE

No public disclosures or news releases pertaining to this contract shall be made without prior written approval of TWDB.

5.29 SUBSTITUTIONS

Substitutions are not permitted without written approval of TWDB.

5.30 TAXES

Contractor represents and warrants that it shall pay all taxes or similar amounts resulting from this Contract, including, but not limited to, any federal, State, or local income, sales or excise taxes of Contractor or its employees. TWDB shall not be liable for any taxes resulting from this Contract.

5.31 ACTS OR OMISSIONS

Vendor shall indemnify and hold harmless the State of Texas and Customers, AND/OR THEIR OFFICERS, AGENTS, EMPLOYEES, REPRESENTATIVES, CONTRACTORS, ASSIGNEES, AND/OR DESIGNEES FROM ANY AND ALL LIABILITY, ACTIONS, CLAIMS, DEMANDS, OR SUITS, AND ALL RELATED COSTS, ATTORNEY FEES, AND EXPENSES arising out of, or resulting from any acts or omissions of the Vendor or its agents, employees, subcontractors, Order Fulfillers, or suppliers of subcontractors in the execution or performance of the Contract and any Purchase Orders issued under the Contract. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM.

5.32 INFRINGEMENTS

a) Vendor shall indemnify and hold harmless the State of Texas and Customers, AND/OR THEIR EMPLOYEES, AGENTS, REPRESENTATIVES, CONTRACTORS, ASSIGNEES, AND/OR DESIGNEES from any and all third party claims involving infringement of United States patents, copyrights, trade and service marks, and any other intellectual or intangible property rights in connection with the PERFORMANCES OR ACTIONS OF VENDOR PURSUANT TO THIS CONTRACT. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM. VENDOR SHALL BE LIABLE TO PAY ALL COSTS OF DEFENSE INCLUDING ATTORNEYS' FEES. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL.

b) Vendor shall have no liability under this section if the alleged infringement is caused in whole or in part by: (i) use of the product or service for a purpose or in a manner for which the product or service was not designed, (ii) any modification made to the product without Vendor's written approval, (iii) any modifications made to the product by the Vendor pursuant to Customer's specific instructions, (iv) any intellectual property right owned by or licensed to Customer, or (v) any use of the product or service by Customer that is not in conformity with the terms of any applicable license agreement.

c) If Vendor becomes aware of an actual or potential claim, or Customer provides Vendor with notice of an actual or potential claim, Vendor may (or in the case of an injunction against Customer, shall), at Vendor's sole option and expense; (i) procure for the Customer the right to continue to use the affected portion of the product or service, or
(ii) modify or replace the affected portion of the product or service with functionally equivalent or superior product or service so that Customer's use is non-infringing.

5.33 TAXES/WORKERS' COMPENSATION/UNEMPLOYMENT INSURANCE – INCLUDING INDEMNITY

1) VENDOR AGREES AND ACKNOWLEDGES THAT DURING THE EXISTENCE OF THIS CONTRACT, VENDOR SHALL BE ENTIRELY RESPONSIBLE FOR THE LIABILITY AND PAYMENT OF VENDOR'S AND VENDOR'S EMPLOYEES' TAXES OF WHATEVER KIND, ARISING OUT OF THE PERFORMANCES IN THIS CONTRACT. VENDOR AGREES TO COMPLY WITH ALL STATE AND FEDERAL LAWS APPLICABLE TO ANY SUCH PERSONS, INCLUDING LAWS REGARDING WAGES, TAXES, INSURANCE, AND WORKERS' COMPENSATION. THE CUSTOMER AND/OR THE STATE SHALL NOT BE LIABLE TO THE VENDOR, ITS EMPLOYEES, AGENTS, OR OTHERS FOR THE PAYMENT OF TAXES OR THE PROVISION OF UNEMPLOYMENT INSURANCE AND/OR WORKERS' COMPENSATION OR ANY BENEFIT AVAILABLE TO A STATE EMPLOYEE OR EMPLOYEE OF ANOTHER GOVERNMENTAL ENTITY CUSTOMER.

2) VENDOR AGREES TO INDEMNIFY AND HOLD HARMLESS CUSTOMERS, THE STATE OF TEXAS AND/OR THEIR EMPLOYEES, AGENTS, REPRESENTATIVES, CONTRACTORS, AND/OR ASSIGNEES FROM ANY AND ALL LIABILITY, ACTIONS, CLAIMS, DEMANDS, OR SUITS, AND ALL RELATED COSTS, ATTORNEYS' FEES, AND EXPENSES, RELATING TO TAX LIABILITY, UNEMPLOYMENT INSURANCE AND/OR WORKERS'
COMPENSATION IN ITS PERFORMANCE UNDER THIS CONTRACT. VENDOR SHALL BE LIABLE TO PAY ALL COSTS OF DEFENSE INCLUDING ATTORNEYS' FEES. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM.

SECTION 1 EXECUTION OF RESPONSE

FOR PROJECT NO. _____

Company Name: _____

Address: _____

_____

_____

Phone Number: _____

I, _____, am the above-referenced company's representative and I am authorized to submit this response and sign future contract documents. By signing, vendor certifies that if a Texas address is shown as the address, the vendor qualifies as a Texas Resident Bidder as defined in Texas Administrative Code, Title 34, Part 1, Chapter 20.

_____ _____
Authorized Signature Date

SECTION 2 COMPANY PROFILE SUMMARY AND HISTORY

FOR PROJECT NO. _____

(To be provided by Respondent)

SECTION 3 COMPANY REFERENCES

FOR PROJECT NO. _____

REFERENCE #1

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3 COMPANY REFERENCES

FOR PROJECT NO. _____

REFERENCE #2

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3 COMPANY REFERENCES

FOR PROJECT NO. _____

REFERENCE #3

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 4 RESUMES OF INDIVIDUALS

FOR PROJECT NO. _____

(To be provided by Respondent)

SECTION 5 Historically Underutilized Businesses Subcontracting Plan

FOR PROJECT NO. _____

Please see SECTION IV, GENERAL INFORMATION, No. 4.1-B5

All HUB Subcontracting Plan Forms must be completed and submitted with the Response.

The forms are entitled and can be found at:

HUB Subcontracting Plan Form
HUB Subcontracting Plan Form, SECTION 2 continuation sheet
HUB Subcontracting Plan Good Faith Effort - Method A (Attachment A)
HUB Subcontracting Plan Good Faith Effort - Method B (Attachment B)
HUB Subcontracting Opportunity Notification Form

http://comptroller.texas.gov/procurement/prog/hub/hub-subcontracting-plan/

SECTION 6 – OWNERSHIP OF BUSINESS ENTITY

(if applicable)

FOR PROJECT NO. _____

Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity Submitting the RFQ

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

SECTION 7 SCOPE OF WORK

FOR PROJECT NO. _____

(To be provided by Respondent)

EXHIBIT B

SCOPE OF WORK

Task 1 Project Management, Meetings, and Communication
The project will require coordination between the Project Team, TWDB staff, and interested stakeholders. To monitor work efficiently amongst the Project Team, the project manager will use GanttProject, an open source project planning and tracking software, as the tool for tracking and managing tasks and deadlines. Use of the project management software will allow us to update TWDB staff and stakeholders quickly with a quantifiable assessment of the project completion status. As part of our coordination with the Project Team, TWDB staff, and stakeholders, we will provide updates on the project status in the form of a Gantt chart with each monthly status report.

The project will be complete prior to CONTRACT EXPIRATION DATE and the draft final report will be completed by THE STUDY COMPLETION DATE.

Meetings with TWDB Staff
We anticipate four meetings with TWDB staff during the course of the project. However, we understand that we or the TWDB may need to schedule additional technical meetings either in person, through a webinar, or teleconference to discuss Project progress and issues. We also are aware that TWDB staff may periodically visit the Project Team's offices to assess progress on the Project. All meetings and/or conference calls will be held on regular business days (Monday through Friday) during regular business hours (8:00 a.m. to 5:00 p.m. CT) upon agreed dates and times. The following tasks describe the anticipated meetings.

<u>TWDB Meeting 1: Project Kickoff Meeting</u>
We will meet with the TWDB within two weeks following signing of the contract for a project kickoff meeting. We anticipate that this meeting will focus on schedule refinements TWDB interaction, and data acquisition and evaluation.

<u>TWDB Meeting 2: Discussion and Approval of Project Methodology Meeting</u>
After reaching 75 percent completion of Task 2, we will meet with TWDB staff to discuss the status of the compiled data. Prior to this meeting, the Team will submit to the TWDB staff a draft report documenting the techniques and approaches selected for geophysical well log interpretation of aquifer total dissolved solids concentration (see Task 2.5). This meeting will allow the Project Team and the TWDB to collaborate on the identification of potential data gaps that we can address prior to completion of the project. In addition, we will discuss revised or additional evaluation that the compiled data may dictate.

<u>TWDB Meeting 3: Discussion of Potential Production Areas Meeting</u>
The Project Team will meet with the TWDB staff in the afternoon on the same day of the second stakeholder meeting to discuss the potential production areas and prioritization for production calculations. During this meeting, we anticipate focusing on the apparent water quality at specific

locations within the study area, the spatial and temporal trends in water quality with regard to salinity, the areas that meet criteria for potential production areas, and the application of methods for evaluating the potential production areas.

TWDB Meeting 4: Final Draft Report Completion

This meeting will involve presentation of the final report and project results. During this meeting the Project Team will demonstrate the three-dimensional GIS datasets developed during the project that illustrates the salinity zones. The Team will also discuss the results of the evaluations conducted for the defined potential production areas.

Stakeholder Meetings

Stakeholders will be able to provide data and important insights that the data may not readily reflect. We anticipate two stakeholder meetings as described below. For the stakeholder meetings, we understand that the TWDB staff will organize the meetings and invite stakeholders. The Project Team will attend and present information and results at the second stakeholder meeting.

Stakeholder Meeting 1: Discussion of House Bill 30 (Meeting Conducted on October 26, 2015)

The first stakeholder meeting discussed in the RFQ occurred on October 26, 2015. During this first meeting, the TWDB staff discussed House Bill 30 and sought input on key phrases in the bill. Specifically, the TWDB staff sought stakeholder input regarding the meaning of "significant impact" and "significant source." In addition, TWDB staffed posed the question of how they should define "hydrogeologic barriers sufficient to prevent significant impacts?" Comments on these phrases were accepted through October 30, 2015 and will help guide the evaluations to be conducted during the latter part of the study.

Stakeholder Meeting 2: Solicitation of Input on Potential Production Areas

LBG-Guyton will determine the date and will need to provide a one-month notice to TWDB to set up the second stakeholder meeting. Following completion of Task 4, the TWDB will coordinate the stakeholder meeting to present the results of the salinity delineations and solicit input on the potential production areas. During this meeting the Project Team will present a summary of the data collected, the methodology for evaluating the salinity of the groundwater in the aquifer, the three-dimensional datasets develop that quantify the estimated groundwater salinity throughout the aquifer, and discuss potential production areas to determine the 30 and 50-year volumes of brackish groundwater production and the effect that production may have on other areas or aquifers.

Monthly Progress Reports to TWDB

The Team's project manager will summarize progress by providing the TWDB with monthly progress reports for the duration of the project. The project manager will document any problems or unexpected data shortfalls in each report, and if necessary, will call to discuss problems with the TWDB project manager. The progress reports will include a Gantt chart showing the original or adjusted schedule with and detail how the Project is progressing.

The Team's project manager will provide detailed descriptions of the progress made by task and correlate the progress descriptions with the submitted invoice.

Task 1 Deliverables

Detailed monthly progress reports will be submitted to the TWDB outlining:

- Original or adjusted schedule and relative progress
- Project invoices
- Consistent with the budget description
- Issues that may arise

Meetings:

- Stakeholder Meeting 1: Already held on October 26, 2015 in Austin, TX to explain TWDB's approach in implementing House Bill 30, solicit feedback on what constitutes "significant impact", and receive general comments concerning implementation of the legislation.
- TWDB Meeting 1: Project Initiation Meeting
- TWDB Meeting 2: Discussion and approval of Project methodology; date to be determined by the Contractor
- Presentation for the second stakeholder meeting one week before the scheduled meeting.
- Stakeholder Meeting 2: Presentation and discussion of Potential Production Areas with stakeholders in the morning; date to be determined by the Contractor. The Contractor will set the date and TWDB will organize the meeting and invite stakeholders.
- TWDB Meeting 3: Discuss prioritization areas for production calculations with TWDB staff in the afternoon on the same day of the stakeholder meeting.
- TWDB Meeting 4: Project completion; formal presentation at the end of the Project.

Additional technical meetings may be scheduled either in person, through a webinar, or teleconference venue to discuss project progress and issues. TWDB staff may periodically visit the Contractor's work premises to assess progress on the project.

Task 2 Hydrogeologic Data Acquisition and Compilation

In addition to data available from the TWDB (BRACS Database, Groundwater Database, and Submitted Driller's Report Database), we will also scour data sources such as the Texas Railroad Commission, the Texas Commission on Environmental Quality, Bureau of Economic Geology, General Land Office of Texas, U.S. Geological Survey, Environmental Protection Agency, Log Libraries, and local stakeholders (such as, conservation districts, municipalities, public water suppliers, etc.). During this task we will compile all data obtained into the Brackish Resources Aquifer Characterization System (BRACS) Microsoft Access database format (Meyer, 2014) and Groundwater Database format, as applicable.

The Project Team has extensive experience in the Nacatoch Aquifer, providing a distinct advantage for data assimilation. LBG-Guyton Associates developed a regional groundwater availability model (GAM) for the Nacatoch Aquifer (LBG-Guyton Associates, 2009). This two year effort involved the collection of data, integration files, and the construction and calibration of

a MODFLOW model of the aquifer system. All collected and developed spatial data for this project adhered to strict GIS source data geodatabase protocol and FGDC metadata standards required by the TWDB for GAM development. Staff of LBG-Guyton also authored "Ground-Water Resources of the Nacatoch Aquifer," TWDB Report 305 (Ashworth, 1988). The report includes the determination of the occurrence, availability, quality, and quantity of groundwater from the Nacatoch Aquifer. The Bureau of Economic Geology, a member of the Project Team, also authored "Depositional Systems in the Nacatoch Formation (Upper Cretaceous) Northeast Texas and Southwest Arkansas" (McGowen, 1983). This study was designed to determine the depositional framework of the basin during deposition of the Nacatoch Formation. The Project Team has developed a clear and robust understanding of locally available data, developed strong relationships with local stakeholders, and has developed tools and methods for efficient evaluation of the aquifer conditions within the Nacatoch Aquifer.

The Project Team will prepare and implement a quality control plan that will include specific checklists for use during work progression and will address the following:

- **Verification** – Part of our standard quality control procedure is to verify data entered into a database against the original source data, if available. Data imported from an internal agency database or an outside database will be compared against the post-imported database to check records for accuracy and ensure that duplication of data has not occurred.
- **Level of confidence** – Mapping and visualization requires significant data, but in some parts of the study area the available data are limited measure of confidence for all new data to inform subsequent evaluations with regard to quality and uncertainty of the data point. We will develop procedures to screen the validity of data and rank them according to specified levels of confidence in data accuracy. We can then use these confidence rankings during interpolation and mapping to help estimate potential errors associated with low-confidence data. We will coordinate with the TWDB in this effort.
- **Self-validation** – We will build a series of automated checks into the system for self-validation. Examples may include instrument reporting ranges, historic data for a sampling location (where available), expected ranges of values, correlations between measurements (for example, chlorides and total dissolved solids), missing data fields, consistency of units, or the identification of duplicate records. This is an efficient method proven for validating data and identifying outliers.

Brackish Resources Aquifer Characterization System Database

The BRACS Database will be our starting point for data acquisition and compilation. Our work will focus on enhancing and building upon the work conducted by others to develop and maintain the current database (Ortuño, et al., 2012; Meyer, 2014). We will not modify the current BRACS Database, but will work with the TWDB BRACS group to ensure seamless synchronization with the most recent BRACS Database format.

Groundwater Availability Model and Model Datasets

The groundwater availability model (GAM) developed for the Nacatoch Aquifer (LBG-Guyton Associates, 2009) provides a robust repository of data relative to the hydrogeologic framework for

the aquifer. In addition to the model itself, work associated with the development of the GAM included compilation of data used to define the geologic structure, lithology, and movement of groundwater. We will compile the GAM data with the existing BRACS data and crosscheck the data to ensure we do not include duplicates in the final datasets. LBG-Guyton, Bureau of Economic Geology, and Collier have performed significant hydrogeologic evaluations, brackish studies, well completion, and aquifer testing in aquifers throughout Texas and realize some of the limitations of the existing structure interpretations, hydraulic properties, and water quality information. The Project Team will use the publically available data to enhance this study.

Two key components to the volumetric calculation of groundwater are the static water level and specific yield of the aquifer. We will incorporate the specific yield data compiled for and included in the GAM into the project database for reinterpolation, if needed, during our evaluations. The Project Team will also use GAM simulated water levels from the end of the model calibration period for each model to perform calculations.

Water Quality Sample Data

The TWDB Groundwater Database is a regularly updated database containing groundwater quality data. For public water systems, we will review the TCEQ Safe Drinking Water Information System to obtain source water quality data. We will supplement these datasets with water quality data available from the U.S. Geological Survey National Water Information System. The team will work with local Districts, water authorities, and well owners to collect any additional data for inclusion in the dataset.

We will also collect data from the U.S. Geological Survey Produced Water Database, which will provide information on the composition of water in deeper portions of the geologic units. We will also be able to use the total dissolved solids (TDS) data to aid in calibrating salinity calculations from geophysical logs.

For these datasets, we will use well identification numbers, well location, well completion, and sample results to identify duplicate samples. We will remove duplicates from the dataset, but the well identifier from the non-BRACS database will be added to the BRACS foreign key table to relate it back to the BRACS well ID. During the acquisition process we will work diligently to ensure the reliability of the sample data. Format of the data will be compatible with the Groundwater Database table design. Water quality reports not currently in the BRACS Database will be cataloged and related to the BRACS well ID.

Geophysical Logs and Well Reports

There are several opportunities for obtaining nonproprietary geophysical logs and well reports. For many public supply wells, we will work to obtain geophysical logs from TCEQ. In addition, we will work with local Districts and well owners to obtain additional well logs or reports. We will also gather logs for oil and gas wells from the Railroad Commission and Bureau of Economic Geology (Groundwater Advisory Unit and Integrated Core and Log Database) that are additional to those previously delivered to the TWDB as part the work by Ortuño, et al. (2012).

For reports and logs obtained that is in addition to those already in the BRACS Database, we will catalog the well logs and relate the log to the BRACS well ID in the database. As with the samples, we will use information from the log header to compare each log and ensure we do not create duplicates in the database. For logs not currently in digital format, we will scan the log to a Tagged Image File Format (TIFF) to allow rapid access via hyperlink in the BRACS Database. If available, we will also include the geophysical log data in Log ASCII Standard (LAS) format. We will assure all geophysical well logs and interpretation data values are documented in BRACS Database table format with links to well numbers, log numbers, depths, and names of geological formations.

Draft Evaluation Technique and Approach Report

While acquiring and compiling data for evaluating the brackish groundwater resource, the Project Team will prepare a draft report documenting the techniques and approaches proposed for geophysical well log interpretation of aquifer total dissolved solids concentration. The report will include information on the types of geophysical well logs available in the project area, how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements, how the log correction factors are determined, and how the interpretation techniques will be applied across the entire salinity range within the aquifer. We will submit this draft report to the TWDB staff for review at least four weeks prior to the Discussion and Approval of Project Methodology Meeting

Task 2 Deliverables

A draft report documenting the technique(s) and approaches for geophysical well log interpretation of aquifer total dissolved solids concentration. The report shall:

- Identify types of geophysical well logs available in the area,
- Describe how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements
- Describe how the log correction factors are determined, and
- Describe how the interpretation techniques will be applied across the entire salinity range within the aquifer
- TWDB will have up to 10 business days to review the draft report, and the Contractor will schedule a meeting to discuss the techniques.

Task 3. Hydrogeologic Evaluation

During and subsequent to compilation of available data, the Project Team will apply their intimate knowledge of the Nacatoch Aquifer. Project Team members will focus on their area of expertise while the project manager will facilitate coordination amongst the experts.

In many areas, we expect a high degree of uncertainty associated with the data. To incorporate the data uncertainty into our evaluations we anticipate applying Bayesian kriging (Pilz, et al., 2005) or fuzzy kriging (Masoomia, et al., 2011), as the data dictate, to interpolate the water quality data at well sites to the defined grid in the study area. Our evaluations will begin with determining the vertical distribution of water quality at well sites throughout the study area. The following during

Task 3 to develop the water quality information for the geologic units penetrated by well.

Geologic Framework

The current Nacatoch Aquifer GAM (Beach, 2009) provides an excellent basis for the geologic and hydrologic framework of the aquifer and confining units. Nonetheless, as regional models, the GAMs necessarily provide only a rough approximation of the geologic structure and lithology. While it is beyond the scope of this project to develop additional conceptual models for the area, we will identify and record structural and lithologic characteristics, as evidenced by geophysical log data that are not currently recorded in existing datasets. As applicable, we will extend the aquifer surface in the downdip direction beyond the extent of the existing GAM to allow calculating volumes of higher salinity groundwater than the current surface would permit.

To evaluate the lithologic characteristics, we will apply the four-class system discussed by Young, et al. (2010, p. 81) to representative geophysical logs. In addition, we will use select geophysical logs containing a gamma ray curve to calculate the shale percentage based on the log signature. Using these two methods will allow the Project Team to evaluate the lithology at select locations and form a preliminary assessment of potential conceptual models especially with regard to how the lithology affects apparent groundwater quality.

With the derived information, we will also be able to calculate net sand thicknesses within defined intervals for use in subsequent volumetric calculations of stored groundwater.

Water Quality Sample Data

To conduct our evaluation of the collected water in LBG-Guyton Associates Evaluation of Hydrochemical and Isotopic Data in Groundwater Management Areas 11, 12 and 13 (Kreitler, et al., 2013). As discussed in that report, with regard to water quality data the Team used the following criteria as the standard for eliminating potentially erroneous information:

- A well must have total depth estimate or documented completion intervals;
- A site must have a location accuracy of one minute or better; and,
- A water quality analysis must have a charge balance within five percent.

LBG-Guyton Associates applied the same criteria in evaluating data quality in work performed in Groundwater Management Areas 3 and 7 (Kreitler, et al., 2013). For this project, we will follow these established protocols to assess the reliability of all data acquired to supplement our existing dataset. Importantly, we will not remove any of the compiled data from the database; rather, we will assign a reliability flag to the sample in order to eliminate potential duplication of data compilation and assessment work in the future.

Once we have evaluated the reliability of the data, we will have a final XYZCt water quality sample dataset. That is, we will have a value (C) for various constituents and TDS at a spatial location (XYZ – latitude, longitude, elevation) at a specified time (t) for each reliable water quality sample. While the focus of this project is the TDS of the groundwater resources, we will use this final dataset to prepare Piper diagrams and Stiff diagram maps that will illustrate spatial changes in overall water quality and TDS. Brackish treatment approaches and the type of anions

and cations in the water. Providing these summaries will help stakeholders develop preliminary treatment methods and cost estimates. If data are sufficient, we will prepare these illustrations for time intervals that will provide insight into the temporal changes in water quality throughout the study area. In addition, we will use the most recent and reliable data available to identify the representative TDS values for use in future modeling and analyses, including volumetric calculations.

Geophysical Logs

Geophysical logs will provide the majority of the data for the aquifers. Unlike a water quality sample, which is only representative of the interval from which the sample was collected, a geophysical log provides essentially continuous measurements of the solid, liquid, and gas properties in and near a borehole across all of the formations penetrated. In a study such as this one, we will use these signatures to develop estimates of the salinity concentration of water in sand and clayey sand layers.

The Project Team will apply our unique expertise to the evaluation of geophysical logs for estimating formation water salinity. Mr. Wise will apply his direct experience as coauthor of BRACS reports (Wise, 2014; Meyer, et al., 2014) to serve as technical lead for the evaluations. In addition, Dr. Hughbert Collier (1993), author of TWDB Report 343, will lend his extensive experience regarding the quantification of groundwater salinity from geophysical logs to the project.

There are several methods for developing estimates of salinity from geophysical logs (Turcan, Jr., 1966; Guyod, 1972; Ken E. Davis Associates, 1988; Collier, 1993; Estepp, 2010). As listed in the BRACS database, these methods include (Estepp, 2010):

- The SP (Spontaneous Potential) Method
- The Alger Harrison Method
- The Estepp Method
- The Mean Ro Method
- The Rwa Method

The BRACS Database notes that these methods, as applied within the BRACS Database, are most applicable to waters with TDS concentrations less than 10,000 milligrams per liter (mg/L). In waters with TDS concentrations greater than 10,000 mg/L TDS, sodium (Na) and chloride (Cl) ions typically dominate the solution and will control its resistivity. In fact, while other ions (for example calcium, magnesium, bicarbonate, and sulfate) affect the resistivity of the formation water, their influence is most significant in fresh water, but their concentrations can be converted to represent a NaCl solution.

During our analysis of geophysical logs, we will conduct all calculations to determine the concentration in parts per million (ppm) of an equivalent NaCl solution. By focusing on the determination of an equivalent NaCl solution salinity, we will be able to make a direct calculation of the salinity from the formation water resistivity as calculated from log signatures. That is, we

can use derived formulas, such as those used to create reference charts (Schlumberger, 2009, p. 8), for calculating formation water salinity in ppm using methods discussed below. For each geophysical log, we will use as many methods as are applicable. The logging curves available for each geophysical log image will dictate the methods used. As discussed by Ortuño, et al. (2012), the majority of the geophysical signatures provided as a deliverable for their project contained an SP curve followed in quantity by conductivity then resistivity curves. When porosity curves are available, we will incorporate those measurements into the formation factor calculations (see below). We anticipate being able to develop resistivity of water estimates throughout the sand zones identified during Task 3.1 using these three curves. We will then convert the water resistivity to salinity of a NaCl solution.

All calculations will begin with the information provided on the log header. If it is available, from the header for each well we will obtain its identification, location, elevation, measuring point, total depth, mud resistivity and temperature, mud filtrate resistivity and temperature, mud density, and bottom-hole temperature. For the resistivity of the mud filtrate, we will crosscheck the value entered on the log header by recalculating the filtrate resistivity based on the mud density and resistivity (Schlumberger, 2009, p. 4). These data will be critical for subsequent calculations.

One drawback of the SP method is its sensitivity to clay or shale in and near the sand zone. To overcome some of the sensitivity we will apply a bed thickness correction factor to the SP reading. While charts are available for determining the correction factor (Schlumberger, 2009, pp. 52-55), for expediency and the mud resistivity, flushed zone resistivity, and bed thickness to determine the correction factor. We will multiply the correction factor and the SP deflection to determine the static SP, which we will then use to calculate the resistivity of the water at the formation temperature (Asquith & Gibson, 1982, p. 29).

We will use the deep conductivity and resistivity curves in 100 percent water saturated sand zones to calculate the resistivity of the formation water directly. In the zones that are 100 percent saturated with water, the true formation resistivity is equal to the deep resistivity and the resistivity of the formation water is equal to the deep resistivity divided by a formation factor (Asquith & Gibson, 1982, p. 99). However, the formation factor can vary greatly and is dependent on the porosity, tortuosity, and cementation of the formation. While standard values for tortuosity and cementation are presented in the literature (Asquith & Gibson, 1982, p. 44), we anticipate calibrating these components versus measured TDS values to obtain specific coefficients for the studied aquifers.

Where data permit, we will prepare plots of the salinity calculations versus the TDS values from water quality samples. These plots will allow for developing equations relating salinity of the equivalent NaCl solution to TDS that are applicable to specific aquifers, sand zones, or geographic areas, as appropriate. In addition, the plots will allow us to crosscheck and calibrate the constants in the salinity calculations. These equations will allow us (LBG-Guyton Associates, 2006).

An advantage of calculating the salinity from geophysical logs is the opportunity to calculate salinity at multiple points within the sand zones. The many calculations will allow the Project Team to apply a statistical analysis (for example mean, median, or mode) to the multiple values for later use in volumetric calculations. Following verification of the results, we will compile the calculated values in the BRACS Database format. In addition, we will prepare box-and-whisker plots to illustrate the statistical salinity characteristics at various locations in the aquifers.

Task 3 Deliverables

1. Copies of water well reports, water quality reports, and geophysical well logs used in the study that were not already in the BRACS Database
2. Tools, files and/or scripts used to delineate salinity zones and volumes.
3. Figure showing the study area for the report
4. Figure showing the stratigraphy for the final report
5. Figure showing the salinity zones for the final report
6. Table showing the volumes of different groundwater salinity classes
7. Salinity Zone GIS datasets
8. Volume calculations
9. Description of the study area for the final report
10. Description of the salinity zones for the final report
11. Description of the volumes for the final report

Task 4 Geographic Information System (GIS) Dataset Development

The dataset developed during Task 2 and evaluations conducted during Task 3 will provide information located primarily at point locations in the study area. That is, the information developed will represent the aquifer at specific well locations rather than conditions across wide areas of the aquifer. Calculation of the three-dimensional delineation of groundwater salinity will require some form of interpolation. Interpolation is required because TDS values will be available at specific points, but we will need to develop estimates of the water quality at all locations in the aquifer. Performing an interpolation will enable the assignment of probable TDS concentrations over large geographic regions from the comparatively small number of data points.

Convert BRACS Database to ESRI Geodatabase Format

The Project Team will compile and integrate pertinent geologic and hydrogeologic data from the datasets into a GIS geodatabase to facilitate technical analysis and organize, store, and document the information used to delineate fresh, brackish (slightly saline and moderately saline), and very saline groundwater in the Nacatoch Aquifer.

We will use the standard data model framework developed by the TWDB for geologic structure and groundwater modeling projects to accomplish this task. The ArcGIS geodatabase supports a model of spatially-related feature classes, as well as more complex related GIS datasets that can be added in the future, if desired (for example, surface soils and precipitation distribution),

relationships (for example, estimated recoverable groundwater, water level declines versus local water well production), and relevant geoprocessing tools.

Within the geodatabase, a geology feature dataset will contain all of the point, line, and polygon feature classes and a water quality dataset will contain sample results, calculated salinity of an equivalent NaCl solution, and calculated TDS values as point data. The Project Team will manage raster data within the geodatabase as a raster catalog. Any scanned hardcopy water quality maps will be georeferenced and managed within the geodatabase raster catalog. The stratigraphic GIS data sets will include well location, well depth, log type, and aquifer top and bottom elevations and depth from land surface. The Team will develop metadata for each data layer that documents data descriptions, spatial characteristics, attribute information, data structure, data reliability, relevant dates, sources, field descriptions, units (as applicable), and contact information. We will develop the metadata within the editor in ESRI ArcCatalog and will comply with Federal Geographic Data Committee standards, in particular ISO 19139:2007. In addition, we will use BRACS program-naming conventions and map projection parameters for all datasets.

Interpolate Data to Enable Water Volume Calculations

The Project Team has extensive experience in the application of a variety of approaches to interpolating concentrations of various chemicals and solutes in groundwater. For this application, we anticipate focusing on the inverse distance weighted (IDW) and Kriging interpolation methods. The Team will assume that vertical are either 1) minor and can be neglected or 2) are substantial and can be handled by splitting the aquifer into discrete units and performing the computations on each unit.

The IDW method operates with the assumption that conditions at points close to one another are more alike than conditions at points that are farther apart. The IDW method predicts values at unmeasured locations based on the measured values in proximity to those unmeasured locations. The measured values closest to the predicted location have greater influence on the predicted value than do the measured values that are further away. The key parameters for the IDW method are the search radius, the number of samples to use within this search radius, and the power value. We can determine an optimal value for the power parameter, which determines the strength of the influence that measured points have on a predicted value, by minimizing the root mean square prediction error. Using Python scripting, we can automate the parameter optimization and eliminate the need for manual user input.

The Kriging methods, like the IDW method, assigns weights to the measured point values surrounding an unmeasured location to calculate a predicted value. However, Kriging also factors in the spatial arrangement of the measured points in its weighting scheme under the assumption that this arrangement reflects a spatial correlation that in some way explains the distributions of values. Because of its statistical underpinnings, Kriging can provide an increased measure of the accuracy for the predictions.

Of these two methods, Kriging is more complicated to implement than IDW because it requires scrutiny of the spatial behavior of the phenomenon being represented through calculation of a semivariogram before selecting the optimal parameter values to generate the predictions. This scrutiny and parameter selection process is typically performed manually as it requires a high degree of professional judgment. One way of overcoming this complication is the application of Bayesian Kriging (called Empirical Bayesian Kriging in ArcGIS) methods.

Through an iterative process, the Bayesian Kriging method automatically calculates the parameters that other Kriging methods require the user to declare explicitly. During the interpolation process, the method is able to account for the error introduced by estimating the underlying semivariogram, which provides the user with some quantification of the uncertainty associated with the result. A primary disadvantage of the Bayesian Kriging method is that processing is slower than other Kriging methods; however, as listed in the ArcGIS Geostatistical Analyst extension documentation, advantages of the method include:

- Minimal manual interaction (automated by applying reasonable assumptions);
- Standard errors of prediction are more accurate than other Kriging methods; and,
- More accurate than other kriging methods for small datasets.

For the Nacatoch Aquifer, we will apply multiple interpolation approaches to the measured or calculated TDS concentrations. We will compare the interpolations to the measured and calculated values at the input points to determine the method most appropriate for the data. We will save the final interpolations as raster datasets in the geodatabase. Similarly, we will interpolate and store the top and bottom of the geologic units, thicknesses, specific yield values, and static water level of the aquifer within the geodatabase at the same extent and resolution as a predefined project raster snap grid.

Quantification of the Fresh, Brackish, and Saline Groundwater Volumes

Following interpolation of the point data to raster datasets in Task 4.2, we will use these datasets to calculate the volume of fresh, brackish, and saline groundwater. To ensure the process is repeatable and consistent, we will develop tools in ArcGIS Model Builder for performing the calculations. Calculations will result in a raster dataset with each cell representing the volume of water within each area defined by the raster resolution.

The process will include calculating the volumes according to salinity classification zones developed by the U.S. Geological Survey (Winslow & Kister, 1956). Winslow and Kister based the classification on total dissolved solids where a concentration of 0 to 1,000 milligrams per liter is fresh, 1,000 to 3,000 milligrams per liter is slightly saline, 3,000 to 10,000 milligrams per liter is moderately saline, 10,000 to 35,000 milligrams per liter is very saline, and greater than 35,000 milligrams per liter is brine. The volumes within each salinity category will be summarized by county, groundwater conservation district, groundwater management area, regional water planning area, and river basin.

Delineate Potential Production Areas

Using information gathered from comments received during the first stakeholder meeting (see Task 1.2.1), we anticipate the TWDB will have guidance for definition and quantification of "hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers" (from RFQ paraphrasing House Bill 30). Using this guidance and additional criteria from the statute, we will use the developed datasets to delineate potential production areas. The following summarizes the requirements an area must meet to be designated:

- Average TDS concentration is more than 1,000 milligrams per liter;
- Sufficient hydrogeologic separation from areas in the same or another aquifer with an average TDS concentration of 1,000 milligrams per liter or less;
- Not currently used as a significant source of water supply for municipal, domestic, or agricultural purposes;
- Not part of a geologic stratum that is designated or used for wastewater injection through the use of injection or disposal wells permitted under Texas Water Code Chapter 27; and,
- Not within the Harris-Galveston Subsidence District and the Fort Bend Subsidence District.

We will use the criteria to define the three-dimensional spatial extent of potential production areas within the Nacatoch Aquifer. Each potential production area will be assigned a unique ID for relation to production area attributes (such as, hydraulic properties, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates). These production area attributes will be populated with values in a Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files during later evaluation work.

The potential production areas will be presented to the TWDB staff for discussion during Task 1.1.3. During this meeting, the areas will be prioritized for performing 30-year and 50-year production calculations.

Task 4 Deliverables

1. All GIS and GAM files used in a project shall be provided to TWDB.
2. All GIS and GAM files will be summarized in an appendix in the technical report listing file names, type, and folder structure. See TWDB Report 383 for examples.
3. All GIS files will have descriptive metadata documenting the content, data structure, source(s), date(s), quality, and other pertinent characteristics of the data using the Federal Geographic Data Committee (FGDC) metadata editor within ESRI's ArcCatalog.
4. All GIS file creation techniques will be described either in the technical report appendix for GIS files or in the section on a particular topic, such as net sand.
5. All interpolation techniques will be described either in an appendix of the technical report for or in a section on a particular topic.

Task 5 Evaluation of Potential Production Areas
The Project Team will present the data acquisition, evaluation, and interpolation results at a stakeholder meeting coordinated by the TWDB (see Task 1.2.2). The presentation will provide information to stakeholders in the form of Microsoft PowerPoint slides and discussion by the Project Team leader. During the stakeholder meeting, the TWDB will solicit input on the potential production areas that will define areas for conducting evaluations during this task.

Using the defined and prioritized potential production areas, the Project Team will perform model simulations to determine the potential effects of the pumping from the area on other groundwater resources. We anticipate applying the GAMs to evaluate the pumping effects for many, if not all, of the defined production areas. In areas that may not be reasonable represent a production area or where the production area is outside of the model boundary, we will develop a simple numerical model that reasonable represents the conceptual understanding the local aquifer conditions.

Evaluation of the areas will focus on developing the estimated volumes of brackish groundwater production in 30- and 50-year timeframes. During the evaluations we will populate the production area attribute tables developed during Task 4.4. The Project Team will develop complete metadata for all new GIS dataset developed during the evaluation of the production areas.

Task 5 Deliverables
1. Tools, files and/or scripts used to estimate the capacity of Potential Production Areas over 30-year and 50-year periods, without causing a significant impact, as defined in Task 4
2. Description of capacity of Potential Production Areas over 30 and 50 year periods, without causing a significant impact, as defined in Task 4, for the final report
3. Table and graph of capacity of Potential Production Areas over 30 and 50 year periods, without causing a significant impact, as defined in Task 4, for the final report

Task 6 Draft Project Report
The project report will detail the work conducted during the acquisition and evaluation of the geologic and water quality data. The report will also include thorough documentation of the tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater and techniques used to determine if a potential production area is hydrogeologically separated from fresh water aquifers. In the report we will organize the calculated volumes of groundwater within the aquifer and each TWDB prioritized potential production area by salinity classification zone, county, groundwater conservation district, and groundwater management area. We will use the Formatting Guidelines for Texas Water Development Board Reports as our style guide for the report. In addition, we will work to ensure that the report follows the guidelines of the Texas Board of Professional Geoscientists.

We will provide seven hard copies of the draft report to the TWDB. In addition to the hard copies of the draft project report, we will provide a digital copy of the draft report in Microsoft Word format and PDF format, potential production area modeling files, the draft Microsoft Access database, and the draft project geodatabase (which will include: geologic formation top and bottom raster surfaces, net sand raster surfaces, salinity classification zone top and bottom raster

surfaces, proposed production area top and bottom raster surfaces, well control point files, and project raster snap grid). Following delivery of the project report there will be a comment period (to be determined) during which the TWDB staff and stakeholders will be able to provide feedback on the project results.

Task 6 Deliverables

1. The CONTRACTOR will submit the draft report by THE STUDY COMPLETION DATE. All draft reports shall be delivered in Microsoft Word and PDF formats.
2. TWDB will have 30 days to review and provide comments.
3. The CONTRACTOR will have 30 days to address TWDB's comments. These comments must be addressed in the Final Report and a copy of the comments and the CONTRACTORS responses must be incorporated into the final deliverables.

Task 7 Final Project Report

At the end of the draft project report comment period, we will address each comment and incorporate a copy of the submitted comments into the final project report and other deliverables.. We will identify individual authors responsible for the report and those individuals will sign and seal the report per Professional Engineer or Professional Geoscientist requirements, as applicable.

Task 7 Deliverables

1. Updated data for the BRACS Database containing all new well records used in the Project.
2. Copies of water well reports, water quality reports, and geophysical well logs used in the study (unless those reports and logs already exist in the TWDB Groundwater or BRACS databases).
3. Three-dimensional GIS datasets that delineate groundwater salinity zones using ranges of concentrations of total dissolved solids of 0 to 1,000 milligrams per liter (fresh), 1,000 to 3,000 milligrams per liter (slightly saline), 3,000 to 10,000 milligrams per liter (moderately saline), and 10,000 to 35,000 milligrams per liter (very saline).
4. Three-dimensional GIS datasets that delineate potential production areas and the estimated volumes of brackish groundwater production in 30- and 50-year timeframes.
5. A technical report summarizing the study. See Exhibit D for formatting guidelines and Exhibit H for the report outline.
6. All geophysical well logs interpreted for total dissolved solids will be submitted to TWDB and all interpretation data values (input and output) will be documented in table(s) with links to well numbers, log numbers, depths, and names of geological formations in a Microsoft Access database format that can be linked to existing BRACS Database tables. Geophysical well log data obtained for the Project must be non-confidential and submitted in a Tagged Image File Format (TIFF) and, if available, Log ASCII Standard (LAS) format. New well control will be added to the BRACS Database with complete attributes. Water quality data

will be compatible with the Groundwater Database table design and should include the source of the data.

7. To develop new and updated maps of the water resources, the Project should use current information from a variety of non-proprietary databases and geophysical log repositories that are publicly available.
8. The tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater shall be thorough, use defensible scientific means and approaches, and shall be documented in the technical report. The technique(s) used to determine if a Potential Production Areas is hydrogeologically separated from fresh water aquifers shall be thoroughly documented in the technical report. Each Potential Brackish Production Areas will be assigned a unique ID, and all production area attributes (ID, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates) will be recorded in a Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files.
9. The calculated volumes of groundwater within each aquifer and each TWDB-prioritized Potential Production Areas will be organized by salinity classification zone, county, groundwater conservation district, and groundwater management area. All GIS data shall be thoroughly documented with metadata including source, field descriptions, and units (as applicable) and use BRACS program-naming conventions and map Projection parameters. Geologic formation top and bottom raster surfaces, net sand raster maps, salinity classification zone top and bottom raster surfaces, proposed production area top and bottom raster surfaces, well control point files, and Project raster snap grid will be submitted to TWDB. All raster surfaces will share the same map Projection and snap grid attributes. TWDB must be able to replicate the volumes estimated and techniques used to determine the extents of each of the salinity classification zones. All Potential Production Areas modeling files will be submitted to TWDB.
10. Training for TWDB staff shall be provided, as needed or requested. Training may include, but not limited to how the volumes were estimated and the techniques used to determine the extents of salinity zones.
11. Final reports shall be delivered in Microsoft Word and PDF formats. TWDB comments must be addressed in the Final Report and a copy of the comments must be incorporated into the final deliverables. Acceptance of the Final Report indicates the successful completion of the Project.

Task 8. TWDB Training

The Project Team will provide instruction to TWDB staff to demonstrate specific methodologies and/or techniques utilized to determine volume calculations, salinity zones extents, or anything that may deemed necessary and appropriate for presentation within a training venue. This training will be provided at the request of TWDB, on an as needed basis.

EXHIBIT C
TASK AND EXPENSE BUDGETS

TASK BUDGET

TASK	DESCRIPTION	AMOUNT
1	Project Management, Meetings, and Communication	16,000.00
2	Hydrogeologic Data Acquisition and Compilation	26,000.00
3	Hydrogeologic Evaluation	34,000.00
4	Geographic Information System (GIS) Dataset Development	24,000.00
5	Evaluation of Potential Brackish Groundwater Production Areas	14,000.00
6	Draft Project Report	27,000.00
7	Final Project Report	9,000.00
8	TWDB Training	0.00
TOTAL		**$150,000.00**

EXPENSE BUDGET

CATEGORY	AMOUNT
Salaries & Wages[1]	$55,000.00
Fringe[2]	8,300.00
Travel[3]	500.00
Other Expenses[4]	1,000.00
Subcontract Services	70,000.00
Overhead[5]	8,000.00
Profit	7,200.00
TOTAL	**$150,000.00**

[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, 2015, 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.

EXHIBIT D

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.
2. 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.

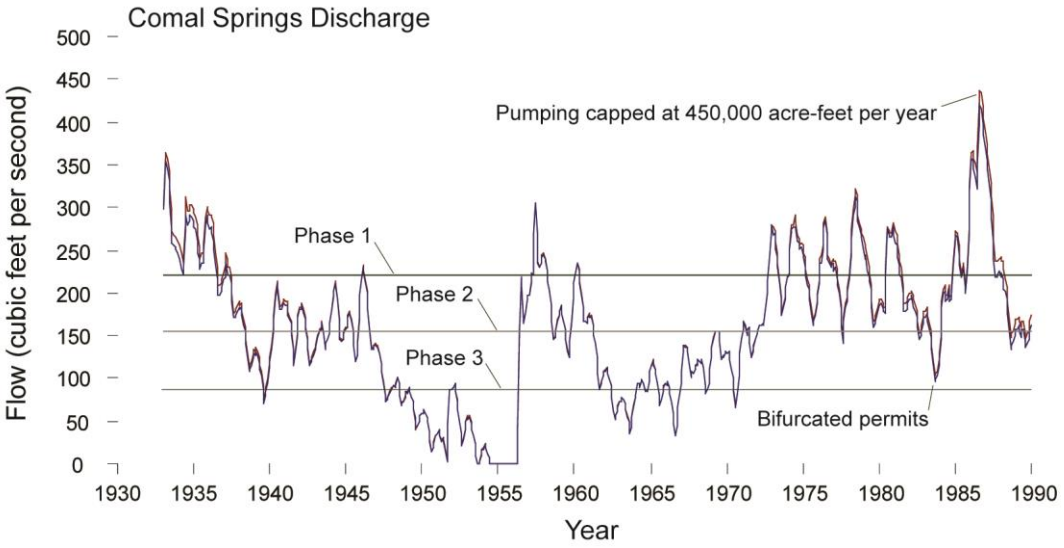


Figure 1. A sample figure showing only the information needed to help the reader understand the data. Font size for figure callouts or labels should never be less than 6 point.

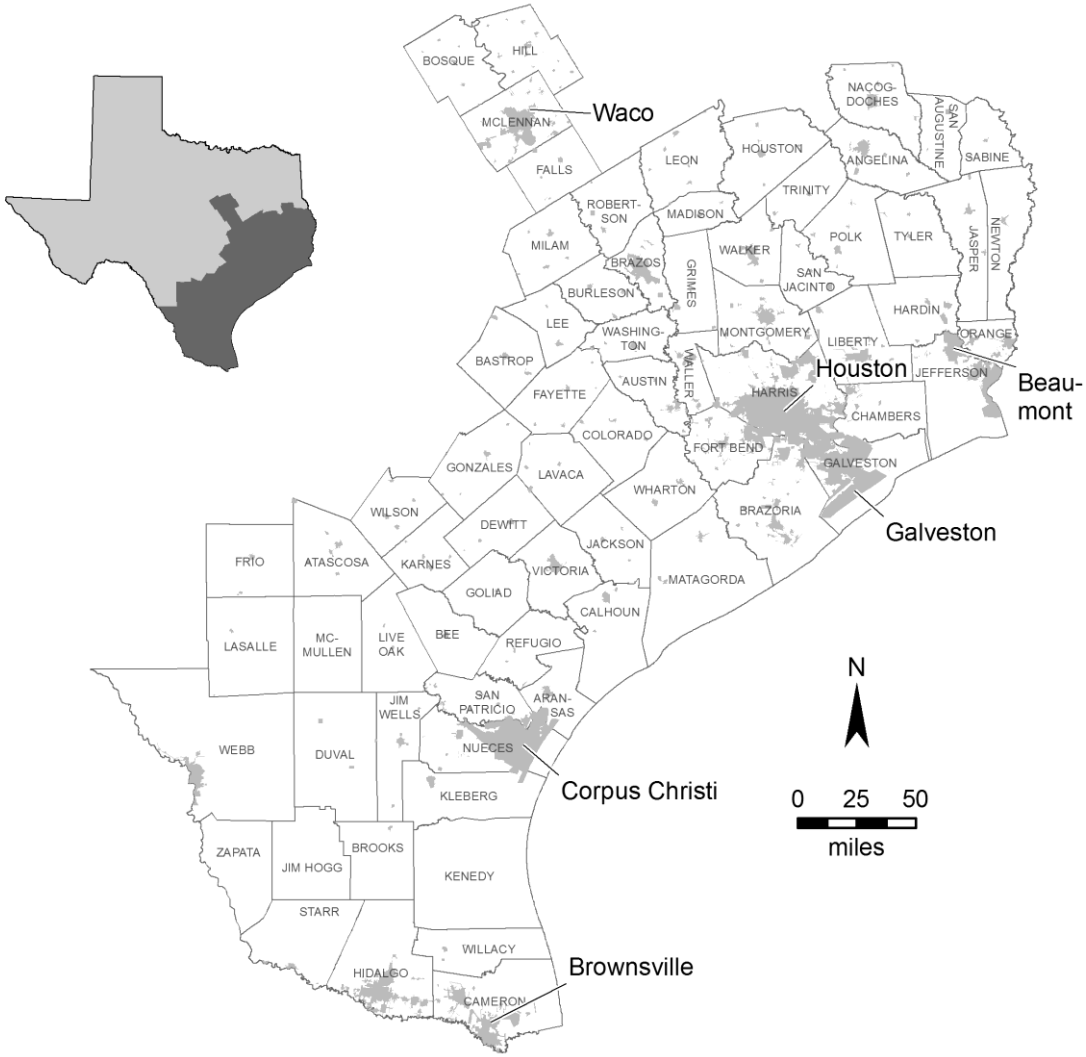


Figure 2. A sample subject area map, giving the reader enough information to understand the location being discussed in this conference. For map figures, be sure to include a north arrow to orient the reader, a scale, and, if needed, a submap that places the figure in greater geographic context. Be sure 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.

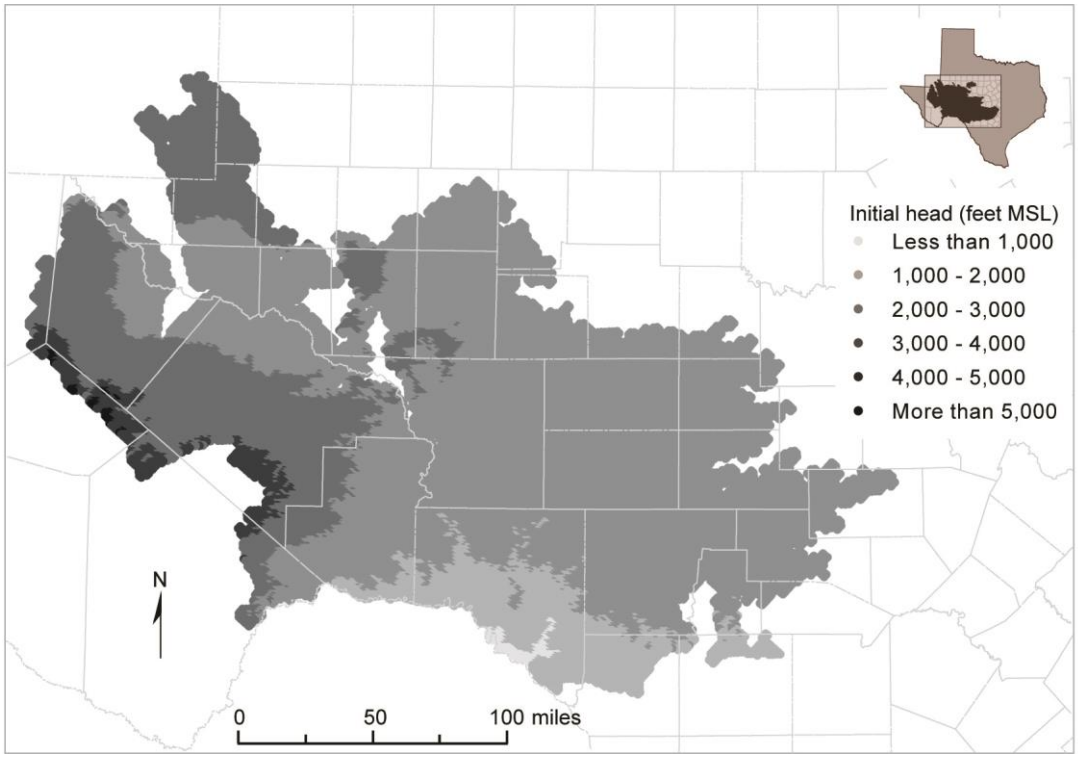


Figure 3. Initial hydraulic heads used in model simulations for layer 1. Note the use of grayscale shading to show differences.

EXHIBIT E

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 F

HUB SUBCONRACTING PLAN PROGRESS ASSESSMENT REPORT

(Use current form located at:
http://www.window.state.tx.us/procurement/prog/hub/hub-forms/)

Rev. 09/15

HUB Subcontracting Plan (HSP)

QUICK CHECKLIST

While this HSP Quick Checklist is being provided to merely assist you in readily identifying the sections of the HSP form that you will need to complete, it is very important that you adhere to the instructions in the HSP form and instructions provided by the contracting agency.

➤ **If you will be awarding all of the subcontracting work you have to offer under the contract to only Texas certified HUB vendors, complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors.
- ☐ Section 2 c. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you do not have a *continuous contract** in place for more than five (5) years *meets or exceeds* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors or only to Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you do not have a *continuous contract** in place for more than five (5) years *does not meet or exceed* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - No
- ☐ Section 4 - Affirmation
- ☐ GFE Method B (Attachment B) - Complete an Attachment B for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will not be subcontracting any portion of the contract and will be fulfilling the entire contract with your own resources (i.e., employees, supplies, materials and/or equipment, including transportation and delivery), complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - No, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources.
- ☐ Section 3 - Self Performing Justification
- ☐ Section 4 - Affirmation

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Rev. 09/15

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.13 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.14(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION-1 RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ **- Yes** ☐ **- No**

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

Enter your company's name here: _____ Requisition #: _____

SECTION-2: RESPONDENT's SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods, services, transportation and delivery will be subcontracted**. Note: In accordance with 34 TAC §20.11, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - *Yes*, I will be subcontracting portions of the contract. (If *Yes*, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - *No*, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods, services, transportation and delivery. (If *No*, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%
6		%	%	%
7		%	%	%
8		%	%	%
9		%	%	%
10		%	%	%
11		%	%	%
12		%	%	%
13		%	%	%
14		%	%	%
15		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

(Note: If you have more than fifteen subcontracting opportunities, a continuation sheet is available online at http://window.state.tx.us/procurement/prog/hub/hub-subcontracting-plan/).

c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, Item b.

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to Item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements**."

☐ - *Yes* (If *Yes*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - *No* (If *No*, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: _____ Requisition #: _____

SECTION-2 RESPONDENT's SUBCONTRACTING INTENTIONS (CONTINUATION SHEET)

This page can be used as a continuation sheet to the HSP Form's page 2, Section 2, Item b. Continue listing the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract* in place for more than five (5) years.	**Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract* in place for more than five (5) years.**	**Percentage of the contract expected to be subcontracted to non-HUBs.**
16		%	%	%
17		%	%	%
18		%	%	%
19		%	%	%
20		%	%	%
21		%	%	%
22		%	%	%
23		%	%	%
24		%	%	%
25		%	%	%
26		%	%	%
27		%	%	%
28		%	%	%
29		%	%	%
30		%	%	%
31		%	%	%
32		%	%	%
33		%	%	%
34		%	%	%
35		%	%	%
36		%	%	%
37		%	%	%
38		%	%	%
39		%	%	%
40		%	%	%
41		%	%	%
42		%	%	%
43		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	**%**	**%**	**%**

***Continuous Contract**: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include transportation and delivery under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.*

Enter your company's name here: _____ Requisition #: _____

SECTION-3 SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.)

If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment, to include transportation and delivery.

SECTION-4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at http://www.window.state.tx.us/procurement/prog/hub/hub-forms/progressassessmentrpt.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature	Printed Name	Title	Date (mm/dd/yyyy)

Reminder:

- If you responded "Yes" to SECTION 2, Items c or d, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded "No" SECTION 2, Items c and d, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for each of the subcontracting opportunities you listed in SECTION 2, Item b.

HSP Good Faith Effort - Method A (Attachment A)

Rev. 09/15

Enter your company's name here: _____ Requisition #: _____

IMPORTANT: If you responded "*Yes*" to **SECTION 2, Items c** or **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method A (Attachment A)" for each of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at http://window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

HSP Good Faith Effort - Method B (Attachment B)

Rev. 09/15

Enter your company's name here: _____ Requisition #: _____

IMPORTANT*:** If you responded "No***" to **SECTION 2, Items c** and **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at http://window.state.tx.us/procurement/prog/hub/hub-forms/hub-sbcont-plan-gfe-achm-b.pdf.

SECTION B-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: _____ Description: _____

SECTION B 2: MENTOR PROTÉGÉ PROGRAM

If respondent is participating as a Mentor in a State of Texas Mentor Protégé Program, submitting its Protégé (Protégé must be a State of Texas certified HUB) as a subcontractor to perform the subcontracting opportunity listed in **SECTION B-1**, constitutes a good faith effort to subcontract with a Texas certified HUB towards that specific portion of work.

Check the appropriate box (Yes or No) that indicates whether you will be subcontracting the portion of work you listed in SECTION B-1 to your Protégé.

☐ - Yes (If *Yes*, continue to SECTION B-4.)

☐ - No / Not Applicable (If *No* or *Not Applicable*, continue to SECTION B-3 and SECTION B-4.)

SECTION B 3: NOTIFICATION OF SUBCONTRACTING OPPORTUNITY

When completing this section you MUST comply with items a, b, c and d, thereby demonstrating your Good Faith Effort of having notified Texas certified HUBs and trade organizations or development centers about the subcontracting opportunity you listed in SECTION B-1. Your notice should include the scope of work, information regarding the location to review plans and specifications, bonding and insurance requirements, required qualifications, and identify a contact person. When sending notice of your subcontracting opportunity, you are encouraged to use the attached HUB Subcontracting Opportunity Notice form, which is also available online at http://www.window.state.tx.us/procurement/prog/hub/hub-subcontracting-plan.

Retain supporting documentation (i.e., certified letter, fax, e-mail) demonstrating evidence of your good faith effort to notify the Texas certified HUBs and trade organizations or development centers. Also, be mindful that a working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.

a. Provide written notification of the subcontracting opportunity you listed in SECTION B-1, to three (3) or more Texas certified HUBs. Unless the contracting agency specified a different time period, you must allow the HUBs at least seven (7) working days to respond to the notice prior to you submitting your bid response to the contracting agency. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

b. List the **three (3) Texas certified HUBs** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the company's Texas Vendor Identification (VID) Number, the date you sent notice to that company, and indicate whether it was responsive or non-responsive to your subcontracting opportunity notice.

Company Name	Texas VID (Do not enter Social Security Numbers.)	Date Notice Sent (mm/dd/yyyy)	Did the HUB Respond?
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No

c. Provide written notification of the subcontracting opportunity you listed in SECTION B-1 to two (2) or more trade organizations or development centers in Texas to assist in identifying potential HUBs by disseminating the subcontracting opportunity to their members/participants. Unless the contracting agency specified a different time period, you must provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response to the contracting agency. A list of trade organizations and development centers that have expressed an interest in receiving notices of subcontracting opportunities is available on the Statewide HUB Program's webpage at http://www.window.state.tx.us/procurement/prog/hub/mwb-links-1/.

d. List **two (2) trade organizations or development centers** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the date when you sent notice to it and indicate if it accepted or rejected your notice.

Trade Organizations or Development Centers	Date Notice Sent (mm/dd/yyyy)	Was the Notice Accepted?
		☐ - Yes ☐ - No
		☐ - Yes ☐ - No

HSP Good Faith Effort - Method B (Attachment B) Cont.

Rev. 09/15

Enter your company's name here: _____ Requisition #: _____

SECTION B-4: SUBCONTRACTOR SELECTION

Enter the item number and description of the subcontracting opportunity you listed in **SECTION 2, Item b,** of the completed HSP form for which you are completing the attachment.

a. Enter the item number and description of the subcontracting opportunity for which you are completing this Attachment B continuation page.

Item Number: _____ Description: _____

b. List the subcontractor(s) you selected to perform the subcontracting opportunity you listed in **SECTION B-1**. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "**A**" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

c. If any of the subcontractors you have selected to perform the subcontracting opportunity you listed in **SECTION B-1** is **not** a Texas certified HUB, provide written justification for your selection process (attach additional page if necessary):

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to **all** the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity it (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

Rev. 09/15

HUB Subcontracting Opportunity Notification Form

In accordance with Texas Gov't Code, Chapter 2161, each state agency that considers entering into a contract with an expected value of $100,000 or more shall, before the agency solicits bids, proposals, offers, or other applicable expressions of interest, determine whether subcontracting opportunities are probable under the contract. The state agency I have identified below in Section B has determined that subcontracting opportunities are probable under the requisition to which my company will be responding.

34 Texas Administrative Code, §20.14 requires all respondents (prime contractors) bidding on the contract to provide notice of each of their subcontracting opportunities to at least three (3) Texas certified HUBs (who work within the respective industry applicable to the subcontracting opportunity), and allow the HUBs at least seven (7) working days to respond to the notice prior to the respondent submitting its bid response to the contracting agency. In addition, at least seven (7) working days prior to submitting its bid response to the contracting agency, the respondent must provide notice of each of its subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code, §20.11(19)(C).

We respectfully request that vendors interested in bidding on the subcontracting opportunity scope of work identified in Section C, Item 2, reply no later than the date and time identified in Section C, Item 1. Submit your response to the point-of-contact referenced in Section A.

SECTION: A PRIME CONTRACTOR'S INFORMATION

Company Name: _____ State of Texas VID #: _____

Point-of-Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

SECTION: B CONTRACTING STATE AGENCY AND REQUISITION INFORMATION

Agency Name: _____

Point-of-Contact: _____ Phone #: _____

Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

SECTION: C SUBCONTRACTING OPPORTUNITY RESPONSE DUE DATE, DESCRIPTION, REQUIREMENTS AND RELATED INFORMATION

1. Potential Subcontractor's Bid Response Due Date:

If you would like for our company to consider your company's bid for the subcontracting opportunity identified below in Item 2,

we must receive your bid response no later than _____ (Central Time) on _____ (Date (mm/dd/yyyy)).

In accordance with 34 TAC §20.14, each notice of subcontracting opportunity shall be provided to at least three (3) Texas certified HUBs, and allow the HUBs at least seven (7) working days to respond to the notice prior to submitting our bid response to the contracting agency. In addition, at least seven (7) working days prior to us submitting our bid response to the contracting agency, we must provide notice of each of our subcontracting opportunities to two (2) or more trade organizations or development centers (in Texas) that serves members of groups (i.e., Asian Pacific American, Black American, Hispanic American, Native American, Woman, Service Disabled Veteran) identified in Texas Administrative Code, §20.11(19)(C).

(A working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.)

2. Subcontracting Opportunity Scope of Work:

3. Required Qualifications: ☐ - Not Applicable

4. Bonding/Insurance Requirements: ☐ - Not Applicable

5. Location to review plans/specifications: ☐ - Not Applicable

EXHIBIT G

Brackish Resources Aquifer Characterization System Program

Contract Data Requirements

Revision Date: October 22, 2015

1. **Well Control**
    a. All data and information provided to TWDB must be non-confidential.
    b. All well attributes shall be added to the BRACS Database.
    c. All well reports, geophysical well logs, and other well information used in a project shall be provided to TWDB.
        i. Digital formats: well reports, PDF; Geophysical well logs, TIFF or LAS (if available).
    d. Data storage folder structure
        i. All well reports and geophysical well logs must be filed using this folder structure.
        ii. Water well and supporting data will be filed in a folder named DrillerWellLogs with subfolders named by state_county codes.
        iii. Geophysical well logs will be filed in a folder named GeophysicalWellLogs with subfolders named by state_county codes.
        iv. State_County code: example 42_029 for Bexar County. TWDB has a Microsoft Excel spreadsheet with the state and county codes.
    e. Digital file names
        i. Q-logs from the Railroad Commission of Texas Groundwater Advisory Unit: Example: Q123_029.tif. If there are multiple logs per well, add log1, log2, … to file name as a suffix. If more than one well is assigned the same Q number, add letters a, b, c, … to Q number, example Q123a_029.tif, Q123b_029.tif.
        ii. All other well control must have the State and County code prefix added to the filename (Example: 42029_123456.pdf.
        iii. The digital file name, file type, and folder name will be recorded in the BRACS Database table tblGeophysicalLog_Header or tblBracsWaterWellReports.

2. **BRACS Database**
    a. All new well control will be added to a copy of the BRACS Database.
    b. New data tied to existing well control in the BRACS Database, such as geology records (lithology; stratigraphic picks; salinity zones) will have applicable tables updated.

c. Use Brackish Resources Aquifer Characterization System Database Data Dictionary (TWDB Open File Report 12-02, Second Edition, September 2014) to understand table relationships, field names, and data types.
d. New well control provided by a contractor will begin with a specified well _id. Coordinate with TWDB BRACS staff for this starting well_id number. As a contractor appends new well control to their copy of the BRACS Database, TWDB staff will continue to update the official BRACS Database. When the project is complete, TWDB staff will take all new project well control records and append them to the official BRACS Database.

3. GIS files

a. All GIS files will be compatible with ESRI ArcGIS version 10.2.
b. Map projection.
Texas State Mapping System, Albers Equal Area. The ESRI projection parameters are:

Projection: Albers
False_Easting: 4921250.0
False_Northing: 19685000.0
Central_Meridian: -100.0
Standard_Parallel_1: 27.5
Standard_Parallel_2: 35.0
Latitude_Of_Origin: 31.25
Linear Unit: Foot_US (0.3048006096012192)

Geographic Coordinate System: GCS_North_American_1983
Angular Unit: Degree (0.0174532925199433)
Prime Meridian: Greenwich (0.0)
Datum: D_North_American_1983
Spheroid: GRS_1980
Semimajor Axis: 6378137.0
Semiminor Axis: 6356752.314140356
Inverse Flattening: 298.257222101

c. A project snap grid raster will be developed for each project using the Texas State Mapping System, Albers Equal Area projection. Each GIS raster file developed for a project will be snapped to this grid to ensure every grid cell in all rasters stack on top of each other without any offset. TWDB staff will create a snap grid slightly larger than the project area with a random integer cell value.
d. Standard GIS file naming conventions are essential. Refer to TWDB Report 383 for examples and table tblGisFile_NamingConventions in the BRACS Database for a broad range of codes. Contractor will provide TWDB with a list of new codes developed by the Contractor.

e. All GIS files will be summarized in an appendix in the technical report listing file names, type, and folder structure (see TWDB Report 383 for examples).
f. All GIS files will have descriptive metadata documenting the content, data structure, source(s), date(s), quality and other pertinent characteristics of the data using the Federal Geographic Data Committee (FGDC) metadata editor within ESRI's ArcCatalog.
g. All GIS file creation techniques will be described either in the technical report appendix for GIS files or in the section on a particular topic, such as net sand.
h. All well point files will contain field(s) with well identification numbers, such as the BRACS Database well_id, Groundwater Database state_well_number, Submitted Driller's Report track_number, API_number, or TCEQ Public Water Supply water_source code.
i. All GIS files (and subsequent map figures or tables) depicting groundwater salinity will use the color scheme shown in list item 5.
j. The TWDB Groundwater Availability Modeling (GAM) county shapefile will be used for mapping.
k. The TWDB 30 meter Digital Elevation Model (DEM) will be used for all elevations of well points and geologic formation surfaces. Should a better quality DEM become available for a project area, consult with TWDB staff and, if approved, provide the DEM to TWDB as a deliverable.

4. Groundwater salinity classification

a. Contractor will use the classification by Winslow, A.G., and Kister, L.R., 1956, Saline-Water Resources of Texas, U. S. Geological Survey Water Supply Paper 1365, 105 p.

Groundwater salinity classification	Salinity zone code	Total dissolved solids concentration (units: milligrams per liter)	
Fresh	FR	0 to 1,000	Blue
Slightly saline	SS	1,000 to 3,000	Yellow
Moderately saline	MS	3,000 to 10,000	Orange
Very saline	VS	10,000 to 35,000	Pink
Brine	BR	Greater than 35,000	Purple

b. The salinity zone code will be used for GIS file naming.
c. Technical report figures showing salinity zones or well control showing total dissolved solids concentration will use these colors.

d. Slightly and moderately saline (total dissolved solids concentration 1,000 to 10,000 milligrams per liter) groundwater is considered as brackish groundwater..

5. Water quality data

a. All water quality data that is not in the TWDB Groundwater Database will be provided to TWDB as a deliverable. Paper documents will be scanned in PDF format and filed in the appropriate state and county folder in the DrillerWellLogs folder. Water quality well control will be added to the BRACS Database, and a digital file name for the PDF well documents will be added to the table tblBracsWaterWellReports.

b. Water quality data will be evaluated to ensure that samples are accurately assigned to the correct aquifer and/or geologic formation using a systematic and reproducible technique.

c. Water quality data, if not in the TWDB Groundwater Database, will be appended to tables tblBRACSWaterQuality and tlbBRACSInfrequentConstituents in the BRACS Database.

6. Geophysical well log data

a. All new geophysical well log data used for a project will be provided to TWDB as a deliverable. Paper documents will be scanned in TIFF format and filed in the appropriate state_county code folder in the GeophysicalWellLogs folder. Well control will be added to the BRACS Database, the digital file name and additional attributes will be added to the table tblGeophysicalLog_Header, and log tools will be added to the table tblGeophysicalLog_Suite.

7. Methodology for interpreting total dissolved solids from geophysical well logs

a. The methods (computational, empirical) used to interpret total dissolved solids concentrations from geophysical well logs will be fully documented in the technical report. All well records, input and output values, correction factors, and assumptions will be recorded in the BRACS Database. Links to water quality samples for specific depth zones within an aquifer will be provided with the geophysical well log record. If a new technique (or modification of an existing technique) is used, tables will be designed to link to the existing BRACS Database design to store the above mentioned parameters. Contractor will provide a data dictionary description for the new table design. All geophysical well logs, if not in the BRACS Database, will be provided to TWDB.

b. A number of geophysical well log interpretation techniques are described in:

Estepp, J.D., 1998, Evaluation of ground-water quality using geophysical logs: Texas Natural Resource Conservation Commission, unpublished report, 516 p.

8. Geologic formation lithology and stratigraphy

a. Geologic formation lithology and stratigraphic top/bottom depth values will be appended to the table tblWell_Geology.
b. Geologic formation lithology from driller well reports is converted to a simplified lithology using the BRACS Database table tblLkLithologicName_to_SimplifiedLithologicName. This table is updated as new terms are encountered.
c. Interpretation of sand/clay from geophysical well logs will use a four-tier classification system consisting of the following terms and sand percentages
    i. sand (100 percent sand)
    ii. sand with clay (65 percent sand)
    iii. clay with sand (35 percent sand)
    iv. clay (0 percent sand)

9. Well identification names and numbers

a. New well control added to the BRACS Database will have all well identification names or numbers added to the BRACS Database table tblBRACS_ForeignKey.
b. The BRACS Database table tblLkFK_ID_Name is a list of types of foreign keys. This table is updated as new sources of data are encountered. Consult with TWDB staff if this table needs updating during a project.
c. Wells used in a project cross section will have a record added to the BRACS Database table tblBRACS_ForeignKey.

10. Well locations

a. Latitude and longitude in decimal degree format will be used for each well.
b. NAD 83 horizontal datum will be used for each well.
c. Elevations using 30 meter DEM will be used.
d. Location attributes will be recorded in the BRACS Database table tblWell_Location.

11. Technical report

a. Use Times New Roman 12 point font.
b. Use one-inch margins.
c. Technical report will use the "Formatting Guidelines for Texas Water Development Board Reports" by Mace and others, 2007 http://www.twdb.texas.gov/about/contract_admin/index.asp

d. No abbreviations will be used in the report except BRACS, GIS, or TWDB. These abbreviations will be spelled out at first use.
e. Use proper grammar and spelling.
f. References must be listed in a separate section of the report and proper citations made within the text.
g. All GIS files used for figures will be provided as a deliverable.
h. The TWDB contract number will appear on the cover page.

EXHIBIT H

Brackish Resources Aquifer Characterization System Program

Outline for Report

Revision Date: January 13, 2016

Table of Contents

1. Executive summary
2. Introduction
3. Project deliverables
4. Project area
5. Hydrogeologic setting
6. Groundwater salinity zones
   - 6.1. Slightly saline zones
   - 6.2. Moderately saline zones
   - 6.3. Very saline zones
   - 6.4. Brine zones
7. Previous investigations
8. Data collection and analysis
9. Aquifer hydraulic properties
10. Water quality data
    - 10.1. Dissolved minerals
    - 10.2. Radionuclides
11. Net sand analysis
12. Groundwater volume methodology
13. Geophysical well log analysis and methodology
14. Potential brackish groundwater production area analysis and modeling methodology
    - 14.1. Pumping analysis and results for 30-and 50-year periods
15. Future improvements
16. Conclusions
17. Acknowledgments
18. References
19. Appendices
    - 19.1. Geographic information system datasets
    - 19.2. GIS file name codes

List of Figures

List of Tables

EXHIBIT I

Original Request for Qualifications

`

Texas Water Development Board

REQUEST FOR QUALIFICATIONS NO. 580-16-RFQ0008

FOR

SERVICES ASSOCIATED TO STUDY BRACKISH AQUIFERS IN TEXAS

Class-Item Code(s): 918/55, 926/52

RESPONSES DUE:

NOVEMBER 25, 2015 12:00 PM

PLEASE NOTE:

This Request for Qualifications No. 580-16-RFQ0008 is revised and supersedes Request for Qualification No. 580-16-RFQ0007 and any other documents.

Texas Water Development Board
P.O. Box 13231
Austin, TX 78711-3231
Contact: Tina Newstrom
Phone: 512-463-7825
Email: contracts@twdb.texas.gov

TABLE OF CONTENTS

SECTION I - OVERVIEW **1**
1.1 OVERVIEW 1
1.2 CONTRACT TERM 1
1.3 COMPENSATION 1
1.4 BACKGROUND 1
SECTION II – STATEMENT OF WORK **2**
2.1 DESCRIPTION OF SERVICES 2
2.2 SCOPE OF WORK 2
2.3 BRACKISH AQUIFERS 4
Project No. 1 4
Project No. 2 5
Project No. 3 5
Project No. 4 5
Project No. 5 6
Project No. 6 6
2.4 RESPONSE REQUIREMENTS FOP EVALUATION 6
SECTION III – DELIVERABLES **7**
3.1 CONTRACT DELIVERABLES 7
SECTION IV – GENERAL INFORMATION **8**
4.1 RFQ REQUIREMENTS 8
4.2 RESPONSE COSTS 10
4.3 TRAVEL EXPENSES 10
4.4 MEETINGS 10
4.5 SCHEDULE OF EVENTS: 10
4.6 REVISIONS TO SCHEDULE 10
4.7 INQUIRIES 10
4.8 RESPONSE SUBMISSION 11
4.9 DELIVERY OF SUBMISSION 11
4.10 OPENING 11
4.11 EVALUATION AND AWARD 11

SECTION V – GENERAL TERMS AND CONDITIONS 12
5.1 GENERAL TERMS 12
5.2 PATENTS OR COPYRIGHTS 12
5.3 CONTRACTOR ASSIGNMENTS 13
5.4 HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN 13
5.5 HUB CONTINUING PERFORMANCE 13
5.6 HUB RESOURCES AVAILABLE 13
5.7 RESPONDENT'S AFFIRMATION 14
5.8 EXECUTIVE ORDER 13224 15
5.9 FAMILY CODE REQUIREMENTS 15
5.10 ADDITIONAL TERMS 15
5.11 DISPUTE RESOLUTION 15
5.12 NON-APPROPRIATION OF FUNDS 15
5.13 PUBLIC INFORMATION ACT 15
5.14 TECHNOLOGY ACCESS CLAUSE 16
5.15 ETHICS 16
5.16 FRAUD STATEMENT 16
5.17 CONFLICT OF INTERESTS 17
5.18 CONTRACT ADMINISTRATION 17
5.19 CONTRACT REVISIONS 17
5.20 VENDOR PERFORMANCE 17
5.21 DEFAULT 17
5.22 FORCE MAJEURE 17
5.23 OWNERSHIP/INTELLECTUAL PROPERTY, INCLUDING RIGHTS TO DATA, DOCUMENTS AND COMPUTER SOFTWARE 18
5.24 DRUG FREE WORKPLACE POLICY 19
5.25 INSURANCE 19
5.26 ORDER PRECEDENCE 19
5.27 PROPRIETY INFORMATION 19
5.28 PUBLIC DISCLOSURE 20
5.29 SUBSTITUTIONS 20
5.30 TAXES 20
5.31 ACTS OR OMISSIONS 20
5.32 INFRINGEMENTS 21

5.33 TAXES/WORKERS' COMPENSATION/UNEMPLOYMENT INSURANCE – INCLUDING INDEMNITY 21

ATTACHMENT A **1**

EXECUTION OF RESPONSE 1

SECTION 2 – COMPANY PROFILE SUMMARY AND HISTORY **1**

SECTION 3 – COMPANY REFERENCES **1**

SECTION 3 – COMPANY REFERENCES ERROR! BOOKMARK NOT DEFINED.

SECTION 4 – RESUMES OF INDIVIDUALSERROR! BOOKMARK NOT DEFINED.

SECTION 5 **5**

HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN **5**

SECTION 6 **6**

SECTION I - OVERVIEW

1.1 OVERVIEW

The Texas Water Development Board (TWDB) request responses to this Request for Qualifications (RFQ) for the award of Services Contract(s) to conduct studies on six (6) Brackish Aquifers in Texas (hereafter referred to as "Project"). This RFQ is part of a requirement of House Bill 30, 84th Texas Legislative Session, for the TWDB to identify and designate brackish groundwater production zones in the aquifers of the state.

NOTE: Separate Statement of Qualifications (SOQ) is required to be submitted for each of the six (6) Projects as identified in Section II.

1.2 CONTRACT TERM

Service for each Project shall begin upon execution of the Contract. The completion date for three (3) of the Projects shall be August 31, 2016; and the remaining three (3) Projects shall be completed by August 31, 2017. Contract extensions for the studies will NOT be granted. The completion dates are identified in each Project.

NOTE: TWDB reserves the right to award each Project separately.

1.3 COMPENSATION

To be negotiated once the TWDB selects respondent(s) based on qualifications. Failure to arrive at mutually agreeable terms of a contract with the most qualified respondent shall constitute a rejection of the TWDB's offer and may result in subsequent negotiations with the next most qualified respondent. The TWDB reserves the right to reject any or all responses.

1.4 BACKGROUND

Planners and decision makers need reliable estimates of available fresh, brackish, and saline groundwater to better formulate water management strategies. Currently, the basis for determining the amount of brackish groundwater in Texas is decades-old data generated during a 2003 TWDB-funded study (LBG-Guyton, 2003, contract number 2001483395). The study helped lay the foundation for estimating brackish groundwater volumes in the state and documented that brackish groundwater is a tremendous asset in the state's water portfolio. However, the study was by design regional in scope, limited in areal extent, and narrow in its assessment of groundwater quality.

In 2009, the 81st Texas Legislature approved funding to establish the Brackish Resources Aquifer Characterization System (BRACS) program. The goal of the program is to map and characterize the brackish portions of the aquifers in Texas in sufficient detail to provide useful information and data to regional water planning groups and other entities interested in using brackish groundwater for desalination supplies. Since 2009, TWDB has completed three studies: the Pecos Valley Aquifer in West Texas (TWDB Report 382), Gulf Coast Aquifer in a four-county area in the Lower Rio Grande Valley (TWDB Report 383), and the Queen City and Sparta aquifers in part of a two-county area in south-central Texas (TWDB Technical Note 14-1). The TWDB also has two ongoing studies: the Carrizo-Wilcox Aquifer in a nine-county area in south-

central Texas scheduled for completion in spring 2016 and the Lipan Aquifer in a six-county area in West Texas scheduled for completion in summer 2016.

In 2015, the 84th Texas Legislature passed House Bill 30, directing the TWDB to conduct studies on and report to the legislature on a) four aquifers by December 1, 2016 and b) remaining aquifers in the state by December 1, 2022. This RFQ is for the Projects that require the TWDB to submit a report to the Texas Legislature by December 1, 2016, as well as additional studies. The Projects will also support implementation of House Bill 1232, (84th Texas Legislative Session), which requires mapping of confined and unconfined aquifers in the state by the TWDB.

SECTION II – STATEMENT OF WORK

2.1 DESCRIPTION OF SERVICES

The selected Contractor(s) will provide services, which shall include, but are not limited to, the requirements contained in this RFQ. Services set forth that contain the words "must" or "shall" are mandatory and must be provided as specified with no alterations, modifications or exceptions. Services set forth that contain the words "may" or "can" allow Respondents to offer alternatives to the manner in which the Services are provided. The selected Contractor(s) will provide assistance to the TWDB for activities described below for one or more of the Projects stated within this RFQ.

2.2 SCOPE OF WORK

General Requirements and Resource(s) for all six (6) Projects

To fulfill part of the requirements of House Bill 30, 84th Texas Legislature, 2015, the TWDB is requesting the Contractor to perform the following:

A. Delineate fresh, brackish, and saline groundwater both vertically and horizontally in the aquifers of the Project areas listed under The Projects.

B. Use the groundwater salinity classification developed by the U.S. Geological Survey (Winslow and Kister, 1956) to categorize the water delineated. The classification is based on the concentration of total dissolved solids (milligrams per liter) in water and includes the following: fresh (0 to 1,000); slightly saline (1,000 to 3,000); moderately saline (3,000 to 10,000); and very saline (10,000 to 35,000).

C. Quantify the volume of available fresh, brackish, and saline groundwater.

D. Delineate potential production areas that are separated by hydrogeologic barriers sufficient to prevent significant impacts to water availability or water quality in any part of the same or other fresh water aquifers. These potential production areas cannot include (a) an aquifer with an average total dissolved solids concentration of more than 1,000 milligrams per liter and which is serving as a significant source of water supply for municipal, domestic, or agricultural purposes, (b) a part of a geologic stratum that is designated or used for wastewater injection through the use of injection or disposal wells permitted under Texas Water Code Chapter 27, and/or (c) areas within the Harris-Galveston Subsidence District and the Fort Bend Subsidence District.

E. Meet with TWDB staff to discuss Contractor recommendations of potential production areas and develop a prioritized list of these areas for item 2.2G.

F. Meet with stakeholders to (1) explain TWDB's approach in implementing House Bill 30, (2) solicit feedback on what constitutes "significant impact", and (3) receive general comments concerning implementation of the legislation. *NOTE: Contractor(s) will not be making recommendations to the TWDB to designate brackish groundwater production zones; only the TWDB Executive Administrator will make these recommendations.*

G. Determine the volume of brackish groundwater that the potential production areas are capable of producing over a 30-year and a 50-year period without causing significant impact to water quality and quantity as described in item 2.2D.

H. **Resources**: The BRACS Database was developed to store and analyze well data for the completed BRACS studies. TWDB Open-File Report 12-02, Second Edition is a data dictionary for the BRACS Database. It describes the data objects or items in the database for the benefit of the user. In addition, previous and ongoing studies of the Groundwater Availability Modeling program have direct applicability to BRACS studies.

I. **Project Monitoring:** *At a minimum*, TWDB expects to meet with the Project Team (Contractor Meeting) four (4) times during the Project and conduct at least two (2) stakeholder meetings.

J. **Contractor Meetings shall include but not limited to:**
1) Project initiation; the beginning of the Project.
2) Discussion and approval of Project methodology; date to be determined by the Contractor.
3) Discussion of potential production areas and prioritization for production calculations; date to be determined by the Contractor.
4) Project completion; the end of the Project.

K. Additional technical meetings may be scheduled either in person, through a webinar, or teleconference venue to discuss Project progress and issues. TWDB staff may periodically visit the Contractor's work premises to assess progress on the Project.

L. Detailed monthly progress reports must be submitted to the TWDB outlining progress of the Project and include the original or adjusted schedule and detail how the Project is progressing relative to this yardstick. Project invoices cannot be processed without detailed descriptions of the progress made by tasks. Each of the Project tasks must be described in detail consistent with the budget description. The TWDB expects issues to be reported to the TWDB Project Manager immediately as they appear. Maintaining close coordination with TWDB throughout the Project will be critical.

M. A draft report documenting the technique(s) and approaches selected by the Contractor for geophysical well log interpretation of aquifer total dissolved solids concentration shall

be given to TWDB for review at a date determined by the Contractor. The report shall include information on the types of geophysical well logs available in the Project area, how the interpreted total dissolved solids concentration from geophysical well log analysis relates to existing aquifer water chemistry as determined by direct measurements (including specific examples), how the log correction factors are determined, and how the interpretation techniques will be applied across the entire salinity range within the aquifer. TWDB will have up to 10 business days to review the draft report, and the Contractor will schedule a meeting to discuss the techniques.

N. A meeting to discuss the potential production areas, at a date determined by the Contractor, shall be made prior to the end of the Project. Potential production areas will be prioritized for 30-year and 50-year pumping estimate task with input from stakeholders.

O. A formal presentation on the results of the Project shall be made to TWDB at the end of each Project.

P. **Stakeholder Meetings include but not limited to the following:**
1) For each Project, formal stakeholder meetings shall be scheduled and held.
2) The first general meeting was held October 26, 2015 from 10:00 am – 12:00pm in room 170 of the Stephen F. Austin Building in Austin, Texas. The general meeting was to explain TWDB's approach in implementing House Bill 30; solicit feedback on what constitutes "significant impact", and; receive general comments concerning implementation of the legislation.
3) The second meeting will be held at the end of the Project in the study area to provide information on the results of the Project and to solicit input on the potential production areas.

Q. TWDB will organize the meetings and invite stakeholders including at a minimum all the groundwater conservation districts within the Project area. The contractor will attend and make a presentation at the second stakeholder meeting.

R. Any meetings and/or conference calls will be held on regular business days (M - F) during regular business hours (8:00 am – 5:00 pm CT) upon agreed dates and times.

2.3 BRACKISH AQUIFERS

Project No. 1
Project Name: Gulf Coast Aquifer
Project Area: Gulf Coast Aquifer and adjacent strata (Catahoula Formation) that extend from the Texas-Louisiana border to the southern county lines of Brooks, Jim Hogg, and Kenedy counties and from the outcrop areas of these aquifers to the Gulf of Mexico.
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources:

"Hydrogeochemical evaluation of the Texas Gulf Coast Aquifer system and implications for developing groundwater availability models" (Young and others, 2014, TWDB contract 1148301233),
"Updating the hydrogeologic framework for the northern portion of the Gulf Coast Aquifer" (Young and others, 2012, TWDB contract 1004831113),
"Hydrostratigraphy of the Gulf Coast Aquifer from the Brazos River to the Rio Grande" (Young and others, 2010 TWDB contract 0804830795),
"Groundwater resource evaluation and availability model of the Gulf Coast Aquifer in the Lower Rio Grande Valley of Texas" (Chowdhury and Mace, 2007, TWDB Report 368),
"Groundwater availability model of the central Gulf Coast Aquifer system: numerical simulations through 1999" (Chowdhury and others, 2004),
"Hydrogeology and simulation of groundwater flow and land-surface subsidence in the northern part of the Gulf Coast Aquifer system, Texas, 1891-2009" (Kasmarek, 2013, U.S. Geological Survey Scientific Investigations Report 2012-5154),
An alternative model "Groundwater management area 16 groundwater flow model" (Hutchison and others, 2011) was prepared for the Gulf Coast Aquifer.

TWDB is working on a groundwater model for the Gulf Coast Aquifer in groundwater management areas 15 and 16 scheduled for completion in December 2016.

Project No. 2
Project Name: Blaine Aquifer
Project Area: Blaine Aquifer, extent defined by the TWDB
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources: "Groundwater availability model for the Seymour Aquifer" (Ewing and others, 2004, TWDB contract) that includes Permian formations in layer 2.

Project No. 3
Project Name: Rustler Aquifer
Project Area: Rustler Aquifer, extent defined by the TWDB
Project Timeline: This Project must be completed no later than August 31, 2016. Contract extensions will not be granted.
Additional resources: "Groundwater availability model report for the Rustler Aquifer" (Ewing and others, 2012 TWDB contract 0904831000)

Project No. 4
Project Name: Trinity Aquifer
Project Area: The northern and southern extent of Trinity Aquifer defined by the TWDB downdip until the total dissolved solids concentration in the aquifer transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources:
"Updated groundwater availability model of the northern Trinity and Woodbine Aquifers" (Kelley and others, 2014),

"Groundwater availability model for the Hill Country portion of the Trinity Aquifer System, Texas" (Jones and others, 2009), and
"Northern Trinity/Woodbine aquifer groundwater availability model" (R.W. Harden and Associates and others, 2004, TWDB contract 2003483483)

Project No. 5
Project Name: Blossom Aquifer
Project Area: Blossom Aquifer extent defined by the TWDB downdip until the groundwater total dissolved solids concentration transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources: TWDB Report 307

Project No. 6
Project Name: Nacatoch Aquifer
Project Area: Nacatoch Aquifer extent defined by the TWDB downdip until the groundwater total dissolved solids concentration transitions to at least 10,000 milligrams per liter.
Project Timeline: This Project must be completed no later than August 31, 2017. Contract extensions will not be granted.
Additional Resources: "Nacatoch Aquifer groundwater availability model" (Beach and others, 2009, TWDB contract 0604830588).

2.4 RESPONSE REQUIREMENTS FOP EVALUATION

Respondents to this RFQ are required to indicate in Section 4.1.B(7)(d) of their response their abilities in the areas listed below (A-L). Please include years of experience, educational degrees and any professional certifications.

A. General hydrogeology;
B. Hydrogeology of the Project aquifer;
C. Interpreting and using geophysical well logs, as applicable to the Project;
D. Using data from TWDB Groundwater Availability Modeling Projects and other TWDB-contracted studies in the Project area;
E. Groundwater modeling in order to evaluate potential production areas;
F. Geographic Information System (GIS) files, use, and metadata documentation;
G. Communicating with the public;
H. Technology transfer;
I. Producing high-quality technical reports;
J. Using the TWDB BRACS and Groundwater databases;
K. Contract management including the ability to meet short and strict deadlines within budget; and
L. Demonstrate their ability to meet Project completion deadlines since there will be no contract extensions.

SECTION III – DELIVERABLES

3.1 CONTRACT DELIVERABLES

The Contractor shall deliver the following items to the TWDB on the date determined by each Project:

A. Updated data for the BRACS Database containing all new well records used in the Project.

B. Copies of water well reports, water quality reports, and geophysical well logs used in the study (unless those reports and logs already exist in the TWDB Groundwater or BRACS databases).

C. Three-dimensional GIS datasets that delineate groundwater salinity zones using ranges of concentrations of total dissolved solids of 0 to 1,000 milligrams per liter (fresh), 1,000 to 3,000 milligrams per liter (slightly saline), 3,000 to 10,000 milligrams per liter (moderately saline), and 10,000 to 35,000 milligrams per liter (very saline).

D. Three-dimensional GIS datasets that delineate potential production areas and the estimated volumes of brackish groundwater production in 30- and 50-year timeframes.

E. A technical report summarizing the study.

F. All geophysical well logs interpreted for total dissolved solids will be submitted to TWDB and all interpretation data values (input and output) will be documented in table(s) with links to well numbers, log numbers, depths, and names of geological formations in a Microsoft Access database format that can be linked to existing BRACS Database tables. Geophysical well log data obtained for the Project must be non-confidential and submitted in a Tagged Image Format (TIFF) and, if available, Log ASCII Standard (LAS) format. New well control will be added to the BRACS Database with complete attributes. Water quality data will be compatible with the Groundwater Database table design and should include the source of the data.

G. To develop new and updated maps of the water resources, the Project should use current information from a variety of non-proprietary databases and geophysical log repositories that are publicly available.

H. The tools and techniques used for determining the extent and volumes of the required ranges of total dissolved solids in the groundwater shall be thorough, use defensible scientific means and approaches, and shall be documented in the technical report. The technique(s) used to determine if a potential production area is hydrogeologically separated from fresh water aquifers shall be thoroughly documented in the technical report. Each potential production area will be assigned a unique ID, and all production area attributes (ID, volume of brackish groundwater subdivided by salinity classification zones, 30-year and 50-year production calculation estimates) will be recorded in a

Microsoft Access database table, in supporting GIS files (top, bottom, and lateral extent), and in groundwater modeling files.

I. The calculated volumes of groundwater within each aquifer and each TWDB-prioritized potential production area will be organized by salinity classification zone, county, groundwater conservation district, and groundwater management area. All GIS data shall be thoroughly documented with metadata including source, field descriptions, and units (as applicable) and use BRACS program-naming conventions and map Projection parameters. Geologic formation top and bottom raster surfaces, net sand raster maps, salinity classification zone top and bottom raster surfaces, proposed production area top and bottom raster surfaces, well control point files, and Project raster snap grid will be submitted to TWDB. All raster surfaces will share the same map Projection and snap grid attributes. TWDB must be able to replicate the volumes estimated and techniques used to determine the extents of each of the salinity classification zones. All potential production area modeling files will be submitted to TWDB.

J. Training for TWDB staff shall be provided, as needed or requested. Training may include, but not limited to how the volumes were estimated and the techniques used to determine the extents of salinity zones.

K. All draft and final reports shall be delivered in Microsoft Word and PDF formats. Draft deliverables will be submitted for review and comment by TWDB. These comments must be addressed in the Final Report and a copy of the comments must be incorporated into the final deliverables. Acceptance of the Final Report indicates the successful completion of the Project.

L. The BRACS program contract data requirements are available on the TWDB website at http://www.twdb.texas.gov/innovativewater/bracs/projects.asp and include information on GIS data and map Projection standards, BRACS Database standards, well report and geophysical well log file naming and organization standards, and other useful information.

SECTION IV – GENERAL INFORMATION

4.1 SOQ REQUIREMENTS

A. **SUBMISSIONS**: The Respondent shall submit one (1) original and six (6) double-sided, single-spaced copies of their SOQ on and one electronic copy for *each Project*; please indicate the Project No. on each response as listed in Section 2.3. You can submit a response for all or one of the Projects. However, a separate response is required for each Project and MUST indicate the Project No.:

1) ORIGINAL: One (1) complete ORIGINAL response (marked Original) which shall include a copy of the RFQ solicitation document along with the SOQ contents listed in paragraph B, below for each Project. The SOQ pages should be numbered and contain an organized, paginated table of contents corresponding to the section and pages of the response.

2) ELECTRONIC: One Portable Document Format files of the submission on a CD/DVD or USB drive.
3) Response may be tab indexed.
4) Responses must be delivered to the address noted in the RFQ.
5) Responses must be clearly marked **RESPONSE TO RFQ 580-16-RFQ0008**.
6) Responses must be complete and comprehensive.

B. **CONTENTS**: The Respondent shall submit all information listed below, in the order given, separated by labeled and tabbed sheets, as the response to this RFQ. The SOQ will only be considered if all items are submitted as required. Incomplete/late responses to this RFQ will not be considered. NOTE: Since there are six (6) Projects, a separate response for each Project is required and the Project No. MUST be indicated. ***You may make copies of any attachments and/or forms in the RFQ for submission purpose ONLY.***

1) Section 1: Signed/dated Execution of Response to the Request for Qualifications (ATTACHMENT A)
2) Section 2: Company Profile Summary and History, two (2) pages maximum. Response should include the following:
   a. Legal company name, address, phone number, and legal status (corporation, partnership, joint venture, sole proprietorship)
   b. Legal name of each participant/potential user(s), their possible involvement with the Project, their phone number, and email address. Also include the contact person(s) information should questions come up regarding the response.
   c. Name, title, phone number and email address of person submitting the response with the authority to bind the company.
   d. Describe the general nature of previous work, the number of years in business, size and scope of operation.
3) Section 3: Company References - Provide references from a minimum of three (3) customers to whom the Respondent has provided services in the past 36 months similar to the scope of work described in this specification.
4) Section 4: Resumes of Individuals - Submit qualifications and experience of Project staff that will be directly involved, at any level, with this Project. ***PLEASE NOTE: Resumes do not count towards the two page maximum listed in Section 2.***
5) Section 5: Historically Underutilized Businesses Subcontracting Plan and applicable forms.
6) Section 6: Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity submitting the RFQ (if applicable).
7) Section 7: Scope of Work - A detailed Scope of Work (SOW) describing the following:
   a. Each task, a percent of effort per each task, a proposed time schedule for each task, and the amount of time each team member will spend on the Project. This SOW shall not exceed 20 pages, using Times New Roman 12 font.

b. A description of project-monitoring procedures; In addition, the contractor should demonstrate they are able to meet project completion deadlines since there will be no contract extensions.
c. A description of the project deliverables (reports, plans, or other products that the Board will receive;
d. Indicate abilities as listed in Section 2.4(A-L).

4.2 RESPONSE COSTS

Respondents are responsible for all costs in the preparation and delivery of their response to this RFQ to TWDB.

4.3 TRAVEL EXPENSES

This contract may include travel throughout the State of Texas to perform the tasks therein. Any and all travel expenses shall be in accordance with the state travel and per diem allowances detailed at https://fmx.cpa.state.tx.us/fmx/travel/index.php.

4.4 MEETINGS

Any meetings and/or conference calls will be held on regular business days (M - F) during regular business hours (8:00 am – 5:00 pm CT) upon agreed dates and times.

4.5 SCHEDULE OF EVENTS:

The solicitation process for this RFQ will proceed according to the following schedule:

EVENT	DATE (Central Time)
Issue Request for Qualifications	Tuesday, November 10, 2015
Deadline for Submission of SOW	Wednesday, November 25, 2015 12:00 pm
Expected Date of Award of Contract	January, 2016
Expected Contract Start Date	January, 2016

4.6 REVISIONS TO SCHEDULE

TWDB reserves the right to change the dates in the Schedule of Events above upon written notification to prospective Respondent(s) as an addendum posted on the Electronic State Business Daily.

4.7 INQUIRIES

A. All inquiries shall be submitted in writing to the attention of TWDB Contract Administration Staff via e-mail to contracts@twdb.texas.gov.

B. Except as otherwise provided in this Section, upon issuance of this RFQ, other employees and representatives of TWDB will not answer questions or otherwise discuss the contents of this RFQ with any potential Respondent or its representatives. Failure to observe this restriction may result in disqualification of any subsequent RFQ. This restriction does not preclude discussions unrelated to this RFQ.

4.8 RESPONSE SUBMISSION

A. All responses must be received and date stamped by TWDB by the deadline listed in the Schedule of Events above. TWDB will NOT accept late submittals.

B. Responses should be placed in a separate envelope or package and correctly identified with the RFQ number and submittal deadline/RFQ opening date and time. It is Respondent's responsibility to appropriately mark and deliver this response to TWDB by the specified date.

C. Telephone, facsimile or emailed responses will not be accepted.

D. Receipt of all addenda, if applicable, to this response should be acknowledged by returning a signed copy of each addendum with the submitted response**.**

NOTE: Failure to return the required items with the response will result in rejection of your Response. TWDB will not be responsible for locating or securing information that is not included in your Response.

4.9 DELIVERY OF SUBMISSION

Responses may be submitted to TWDB by one of the following methods:

U.S. Postal Service
Texas Water Development Board
Contracting & Purchasing
P.O. Box 13231
Austin, TX 78711-3231

Overnight/Express Mail or Hand Delivery
Texas Water Development Board
1700 North Congress Avenue, 6th Floor
Austin, TX 78701
Hours: 8:00 am to 5:00 pm (CT)

4.10 OPENING

Responses will be opened at 1700 North Congress Avenue, 6th Floor, Austin, TX, at the submittal deadline. Only Respondent's names will be read.

All submitted response's become the property of TWDB after the submittal deadline/opening date. Responses submitted shall constitute an offer for a period of ninety (90) days or until selection is made by TWDB, whichever occurs first.

4.11 EVALUATION AND AWARD

A. TWDB shall award a Contract to the vendor whose response is most qualified to perform the Statement of Work for the State of Texas.

B. A committee will be established by TWDB (including TWDB employees) to evaluate the responses.

C. The evaluation applies to ***each*** Project, which will be evaluated separately. ***TWDB reserves the right to award each Project separately***.

The evaluation committee will determine best value by applying the following criteria:

Points Available	Evaluation Criteria
0 – 70	Qualifications and Experience
0 – 90	Technical Approach
0 – 40	Project Organization and Management
0 – 30	Reports and Deliverables
0 – 20	Feasible Approach
250	**Total Points Possible**

D. TWDB may, at its discretion, elect to have Respondents provide oral presentations and respond to inquiries from the evaluation committee related to their SOQ.

E. Past Performance: A Respondent's past performance will be measured based upon pass/fail criteria, in compliance with applicable provisions of §2155.074, 2155.075, 2156.007, 2157.003, and 2157.125, Gov't Code. Respondents may fail this selection criterion for any of the following conditions:

1) A score of less than 90% in the Vendor Performance System;
2) Currently under a Corrective Action Plan through the CPA;
3) Having repeated negative Vendor Performance Reports for the same reason; or
4) Having purchase orders that have been cancelled in the previous 12 months for non-performance (i.e. late delivery, etc.).

Contractor performance information is located on the CPA web site at: http://comptroller.texas.gov/procurement/prog/vendor_performance/

SECTION V – GENERAL TERMS AND CONDITIONS

5.1 GENERAL TERMS

Any Contract awarded as a result of this RFQ will contain the general terms and conditions provided in this document. Subcontractors must also comply. In addition, any Contract awarded as a result of this RFQ shall be governed, construed, and interpreted under the laws of the State of Texas. The factors listed in Texas Government Code, Title 10, Subtitle D, Section 2155.074, 2155.144, 2156.007, and 2157.003 shall also be considered in making an award when specified. Any legal actions must be filed in Travis County, Texas.

5.2 PATENTS OR COPYRIGHTS

The Contractor agrees to protect the State and TWDB from claims involving infringement of patents or copyrights. TWDB will not consider any RFQ that bears a copyright. RFQ will be subject to the Texas Public Information Act, Texas Government Code, Chapter 552, and may be disclosed to the public upon request. Subject to the Act, Respondents may protect trade and confidential information from public release. Trade secrets or other confidential information,

submitted as part of a RFQ, shall be clearly marked at each page it appears. Such marking shall be in **boldface type at least 14 point font.**

5.3 CONTRACTOR ASSIGNMENTS

Respondent hereby assigns to TWDB any and all claims for overcharges associated with this Contract arising under the antitrust laws of the United States 15 U.S.C.A. Section 1, et seq. (1973), and the antitrust laws of the State of Texas, TEX. Bus. & Comm. Code Ann. Sec. 15.01, et seq. (1967).

5.4 HISTORICALLY UNDERUTILIZED BUSINESSES SUBCONTRACTING PLAN

It is the policy of TWDB to make a good faith effort to achieve the annual program goals by contracting directly with Historically Underutilized Businesses (HUBs) or indirectly through subcontracting opportunities in accordance with the Texas Government Code, Chapter 2161, Subchapter F, and HUB Rules promulgated by the Comptroller of Public Accounts (CPA), 34 TAC, Chapter 20.

HUBs are strongly urged to respond to this RFQ. Under Texas law, state agencies are required to make a good faith effort to assist HUBs in receiving certain percentages of the total value of contract awards. Vendors who meet the qualifications are strongly encouraged to apply for certification as HUBs.

TWDB has determined that subcontracting is probable under any Contract awarded as a result of this RFQ. ALL VENDORS RESPONDING TO THIS RFQ, INCLUDING THOSE THAT ARE HUB CERTIFIED OR THOSE WHO DO NOT PLAN TO SUBCONTRACT, MUST COMPLETE A HUB SUBCONTRACTING PLAN (HSP) IN ACCORDANCE WITH THE STATE'S POLICY ON UTILIZATION OF HUBs. THE HSP MUST BE INCLUDED AS PART OF THE RFQ TO THIS RFQ. FAILURE TO COMPLETE THE HSP AS INSTRUCTED MAY RESULT IN DISQUALIFICATION OF THE RFQ FROM CONSIDERATION. Please review the HSP forms carefully and allow sufficient time to identify and contact HUBs and allow them to respond. Note that Vendors must demonstrate a good faith effort to contract with new HUBs if currently proposed HUBs have performed as subcontractors to the Vendor for more than five (5) years. If the Vendor does not plan to subcontract, Vendor must state that fact in their plan. An original, signed paper copy of the HSP must be submitted in an envelope that is separate from the rest of the RFQ. The completed plan shall become a part of the contract that may be awarded as a result of this RFQ.

5.5 HUB CONTINUING PERFORMANCE

Any Contract(s) awarded as a result of this RFQ shall include reporting responsibilities related to HUB subcontracting. Awarded Vendors may not change any subcontractor without submitting a revised HUB Subcontracting Plan (HSP) to TWDB. Any change to a subcontractor and revised HSP must be approved in writing by TWDB prior to implementation.

5.6 HUB RESOURCES AVAILABLE

A list of certified HUBs is available on the Texas Comptroller of Public Accounts (CPA) Web site at: http://www.window.state.tx.us/procurement/cmbl/hubonly.html. For additional information, contact the CPA's HUB program office at Texas4hubs@cpa.state.tx.us. If Vendors

know of any businesses that may qualify for certification as a HUB, they should encourage those businesses to contact the CPA HUB program office.

5.7 RESPONDENT'S AFFIRMATION

Signing this response (ATTACHMENT A - Execution of Response to the Request for Qualifications) with a false statement is a material breach of Contract and shall void the submitted response or any resulting Contract(s), and the Respondent shall be removed from all bid lists. By signature hereon affixed on ATTACHMENT A, the Respondent hereby certifies that:

A. The Respondent has not given, offered to give, nor intends to give at any time hereafter any economic opportunity, future employment, gift, loan, gratuity, special discount, trip, favor, or service to a public servant in connection with the submitted bid;

B. Neither the Respondent nor the firm, corporation, partnership, or institution represented by the Respondent, or anyone acting for such firm, corporation or institution has violated the antitrust laws of this State or the Federal Antitrust Laws, nor communicated directly or indirectly this RFQ made to any competitor or any other person engaged in such line of business;

C. The Respondent is not a member of the TWDB, a TWDB staff member or a member of their immediate family;

D. Pursuant to Section 2155.004, Government Code, the Respondent has not received compensation for participation in the preparation of the specifications for this RFQ;

E. Pursuant to Section 231.006 (d), Family Code, re: child support, the Respondent certifies that the individual or business entity named in this bid is not ineligible to receive the specified payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate;

F. Under Section 2155.004 Government Code, the Respondent certifies that the individual or business entity named in this RFQ or Contract is not ineligible to receive the specified Contract and acknowledges that this Contract may be terminated and payment withheld if this certification is inaccurate;

G. The Respondent shall defend, indemnify, and hold harmless the State of Texas, all of its officers, agents and employees from and against all claims, actions, suits, demands, proceedings, costs, damages, and liabilities, arising out of, connected with, or resulting from any acts or omissions of Contractor or any agent, employee, subcontractor, or supplier of Respondent in the execution or performance of this contract;

H. Respondent agrees that any payments due under this contract will be applied towards any debt, including but not limited to delinquent taxes and child support that is owed to the State of Texas;

I. Respondent certifies that they are in compliance with Section 669.003 of the Government Code, relating to contracting with executive head of a State agency. If Section 669.003 applies, the Respondent will complete the following information in order for the bid to be evaluated:

Name of Former Executive: _____
Name of State Agency: _____
Date of Separation from State Agency: _____
Position with Respondent: _____

Date of Employment with Respondent: _____

J. Respondent agrees to comply with Government Code Section 2155.4441, pertaining to service contract use of products produced in the State of Texas; and

K. Respondent understands that acceptance of funds under this contract acts as acceptance of the authority of the State Auditor's Office, or any successor agency, to conduct an audit or investigation in connection with those funds. Respondent further agrees to cooperate fully with the State Auditor's Office or its successor in the conducting of the audit or investigation, including providing all records requested. Respondent will ensure that this clause concerning the authority to audit funds received indirectly by subcontractors through Respondent and the requirement to cooperate is included in any subcontract it awards.

5.8 EXECUTIVE ORDER 13224

The TWDB is federally mandated to adhere to the directions provided in the President's Executive Order (EO) 13224, Executive Order on Terrorist Financing – Blocking Property and Prohibiting Transactions with Persons Who Commit, Threaten to Commit, or Support Terrorism, effective 9/24/2001 and any subsequent changes made to it via cross-referencing Respondents/Contractors with the Federal General Services Administration's Excluded Parties List System (EPLS, http://www.sam.gov), which is inclusive of the United States Treasury's Office of Foreign Assets Control (OFAC) Specially Designated National (SDN) list.

5.9 FAMILY CODE REQUIREMENTS

Pursuant to Section 231.006 (c), Family Code, bid must include Names and Social Security Numbers of each person with at least 25% ownership of the business entity submitting the bid. Enter Name & Social Security Numbers for each person.

5.10 ADDITIONAL TERMS

Any terms and conditions attached to this RFQ will not be considered unless specifically referred to on this RFQ and may result in disqualification of this RFQ.

5.11 DISPUTE RESOLUTION

The dispute resolution process provided for in Chapter 2260 of the Texas Government Code must be used by the TWDB and the Respondent to attempt to resolve all disputes arising under this Contract.

5.12 NON-APPROPRIATION OF FUNDS

The State's funds are contingent on the availability of lawful appropriations by the Texas Legislature. If the Texas Legislature fails to continue funding for the payments due under an order referencing this Contract, the order will terminate as of the date that the funding expires, and TWDB will have no further obligation to make any payments.

5.13 PUBLIC INFORMATION ACT

Information, documentation, and other material in connection with this solicitation or any resulting Contract may be subject to public disclosure pursuant to Chapter 552 of the Texas

Government Code (the "Public Information Act"). Any part of the RFQ that is of a confidential or proprietary nature must be clearly and prominently marked as such by the Respondent.

5.14 TECHNOLOGY ACCESS CLAUSE

The Respondent expressly acknowledges that State funds may not be expended in connection with the purchase of an automated information system unless that system meets certain statutory requirements relating to accessibility by persons with visual impairments. Accordingly, the Respondent represents and warrants to the qualified ordering entity that the technology provided to the qualified ordering entity for purchase is capable, either by virtue of features included within the technology or because it is readily adaptable by use with other technology, of:

A. Providing equivalent access for effective use by both visual and non-visual means;
B. Presenting information, including prompts used for interactive communications, in formats intended for both visual and non-visual use; and
C. Being integrated into networks for obtaining, retrieving, and disseminating information used by individuals who are not blind or visually impaired.

For purposes of this clause, the phrase "equivalent access" means a substantially similar ability to communicate with or make use of the technology, either directly by features incorporated within the technology or by other reasonable means such as assistive devices or services that would constitute reasonable accommodations under the Federal Americans with Disabilities Act or similar state or federal laws. Examples of methods by which equivalent access may be provided include, but are not limited to, keyboard alternatives to mouse commands and other means of navigating graphical displays and customizable display appearance.

5.15 ETHICS

Under Section 2155.003, Government Code, an individual who interacts with public purchasers in any capacity is required to adhere to the guidelines established in Section 1.2 of the State of Texas Procurement Manual, which outlines the ethical standards required of public purchasers, employees, and bidders who interact with public purchasers in the conduct of state business, and with any opinions of or rules adopted by the Texas Ethics Commission. Entities who are interested in seeking business opportunities with the State must be mindful of these restrictions when interacting with public purchasers of TWDB or purchasers of other state agencies. Specifically, a TWDB employee may not have an interest in, or in any manner be connected with a contract or bid for a purchase of goods or services by an agency of the state; or in any manner, including by rebate or gift, accept or receive from a person to whom a contract may be awarded, directly or indirectly, anything of value or a promise, obligation, or Contract for future reward or compensation. Entities who are interested in seeking business opportunities with the State must be mindful of these restrictions when interacting with public purchasers of TWDB or purchasers of other State agencies.

5.16 FRAUD STATEMENT

Respondents understand that the TWDB does not tolerate any type of fraud. The TWDB's policy is to promote consistent, legal, and ethical organizational behavior by assigning responsibilities and providing guidelines to enforce controls. Any violations of law, agency policies, or standards of ethical conduct will be investigated, and appropriate actions will be

taken. Providers are expected to report any possible fraudulent or dishonest acts, waste, or abuse to the agency's Internal Audit division at 512-463-7978 or Nicole.Campbell@twdb.texas.gov.

5.17 CONFLICT OF INTERESTS

A RFQ will not be selected if it has a conflict of interest that will or may arise during the performance of its obligations under the Contract. For this reason, the submission in response to this RFQ must disclose all business interest and all relationships that could reasonably be considered to pose possible conflicts of interest in the offer's performance of contract obligations. In addition, Offers must represent and warrant in its response to this RFQ and in the contract that in the performance of services under the contract, (1) Respondent does not have and will not have any actual or potential conflict of interest, and (2) Respondent will take whatever reasonable actions may be necessary and prudent to avoid even the appearance of impropriety.

5.18 CONTRACT ADMINISTRATION

The TWDB shall designate a Project Manager for this Contract. The Project Manager will serve as the point of contact between the TWDB and the selected Contractor. The TWDB's Project Manager shall supervise the TWDB's review of contractor's technical work, deliverables, draft reports, the final report, payment requests, schedules, financial and budget administration, and similar matters. The Project Manager does not have any express or implied authority to vary the terms of the Contract, amend the Contract in any way or waive strict performance of the terms or conditions of the Contract.

5.19 CONTRACT REVISIONS

The contract may only be revised through a contract amendment process.

5.20 VENDOR PERFORMANCE

State agencies shall report a vendor's performance on any purchase of $25,000 or more from contracts administered by the commission or any other purchase made through an agency's delegated authority or a purchase made pursuant to the authority in Government Code, Title 10, Subtitle D or a purchase exemption from CPA/TPASS procurement rules and procedures.

5.21 DEFAULT

If Contractor is found to be in default under any provision of this Contract, TWDB may cancel the Contract without notice and either re-solicit or award the contract to the next best responsive and responsible Respondent. In the event of abandonment or default, Contractor will be responsible for paying damages to TWDB including but not limited to re-procurement costs, and any consequential damages to the State of Texas or TWDB resulting from Contractor's non-performance. The defaulting Contractor will not be considered in the re-solicitation and may not be considered in future solicitations for the same type of work, unless the specification or scope of work is significantly changed.

5.22 FORCE MAJEURE

Neither Contractor nor TWDB shall be liable to the other for any delay in, or failure of performance, of any requirement included in any PO resulting from this RFP caused by force majeure. The existence of such causes of delay or failure shall extend the period of performance until after the causes of delay or failure have been removed provided the non-performing party

exercises all reasonable due diligence to perform. Force majeure is defined as acts of God, war, fires, explosions, hurricanes, floods, failure of transportation, or other causes that are beyond the reasonable control of either party and that by exercise of due foresight such party could not reasonably have been expected to avoid, and which, by the exercise of all reasonable due diligence, such party is unable to overcome. Each party must inform the other in writing, with proof of receipt, within three (3) business days of the existence of such force majeure, or otherwise waive this right as a defense.

5.23 OWNERSHIP/INTELLECTUAL PROPERTY, INCLUDING RIGHTS TO DATA, DOCUMENTS AND COMPUTER SOFTWARE

For the purposes of this Contract, the term "Work" is defined as all reports, statistical analyses, work papers, work products, materials, approaches, designs, specifications, systems, documentation, methodologies, concepts, research, materials, intellectual property or other property developed, produced, or generated in connection with this Contract. All work performed pursuant to this Contract is made the exclusive property of TWDB. All right, title and interest in and to said property shall vest in TWDB upon creation and shall be deemed to be a work for hire and made in the course of the services rendered pursuant to this Contract. To the extent that title to any such work may not, by operation of law, vest in TWDB, or such work may not be considered a work made for hire, all rights, title and interest therein are hereby irrevocably assigned to TWDB. TWDB shall have the right to obtain and to hold in its name any and all patents, copyrights, registrations or such other protection as may be appropriate to the subject matter, and any extensions and renewals thereof. Contractor must give TWDB and/or the State of Texas, as well as any person designated by TWDB and/or the State of Texas, all assistance required to perfect the rights defined herein without any charge or expense beyond those amounts payable to Contractor for the services rendered under this Contract.

Contractor shall maintain and retain supporting fiscal and any other documents relevant to showing that any payments under this Contract funds were expended in accordance with the laws and regulations of the State of Texas, including but not limited to, requirements of the Comptroller of the State of Texas and the State Auditor. Contractor shall maintain all such documents and other records relating to this Contract and the State's property for a period of four (4) years after the date of submission of the final invoices or until a resolution of all billing questions, whichever is later. Contractor shall make available at reasonable times and upon reasonable notice, and for reasonable periods, all documents and other information related to the "Work" as defined in paragraph 11.30 of this Contract. Contractor and the subcontractors shall provide the State Auditor with any information that the State Auditor deems relevant to any investigation or audit. Contractor must retain all work and other supporting documents pertaining to this Contract, for purposes of inspecting, monitoring, auditing, or evaluating by TWDB and any authorized agency of the State of Texas, including an investigation or audit by the State Auditor.

Contractor shall cooperate with any authorized agents of the State of Texas and shall provide them with prompt access to all of such State's work as requested. Contractor's failure to comply with this Section shall constitute a material breach of this Contract and shall authorize the TWDB and the State of Texas to immediately assess appropriate damages for such failure. Pursuant to Government Code, §2262.003 the acceptance of funds by Contractor or any other

entity or person directly under this Contract, or indirectly through a subcontract under this Contract, shall constitute acceptance of the authority of the State Auditor to conduct an audit or investigation in connection with those funds. Contractor acknowledges and understands that the acceptance of funds under this Contract shall constitute consent to an audit by the State Auditor, Comptroller or other agency of the State of Texas. Contractor shall ensure that this paragraph concerning the State's authority to audit funds received indirectly by subcontractors through Contractor and the requirement to cooperate is included in any subcontract it awards. Furthermore, under the direction of the legislative audit committee, an entity that is the subject of an audit or investigation by the State Auditor must provide the State Auditor with access to any information the State Auditor considers relevant to the investigation or audit.

5.24 DRUG FREE WORKPLACE POLICY

The contractor shall comply with the applicable provisions of the Drug-Free Work Place Act of 1988 (Public Law 100-690, Title V, Subtitle D; 41 U.S.C. 701 ET SEQ.) and maintain a drug-free work environment; and the final rule, government-wide requirements for drug-free work place (grants), issued by the Office of Management and Budget and the Department of Defense (32 CFR Part 280, Subpart F) to implement the provisions of the Drug-Free Work Place Act of 1988 is incorporated by reference and the contractor shall comply with the relevant provisions thereof, including any amendments to the final rule that may hereafter be issued.

5.25 INSURANCE

Contractor represents and warrants that it will, within five (5) business days of executing this agreement, provide TWDB with current certificates of insurance or other proof acceptable to TWDB of the following insurance coverage: Standard Workers Compensation Insurance covering all personnel who will provide services under this Contract;

Commercial General Liability Insurance, personal injury and advertising injury with, at a minimum, the following limits: $500,000 minimum each occurrence; $1,000,000 per general aggregate. Contractor represents and warrants that all of the above coverage is with companies licensed in the state of Texas, with "A" rating from Best, and authorized to provide the corresponding coverage. Contractor also represents and warrants that all policies contain endorsements prohibiting cancellation except upon at least thirty (30) days prior written notice to TWDB. Contractor represents and warrants that it shall maintain the above insurance coverage during the term of this Contract, and shall provide TWDB with an executed copy of the policies immediately upon request.

5.26 ORDER PRECEDENCE

In the event of conflicts or inconsistencies between this contract and its exhibits or attachments, such conflicts or inconsistencies shall be resolved by reference to the documents in the following order of priority: Signed Contract (or Notice of Award), Attachments to the Contract (or Notice of Award), Request for Proposals, and Respondent's Response to Request for Proposals.

5.27 PROPRIETY INFORMATION

The TWDB is a government agency subject to the Texas Public Information Act (PIA), Chapter 552, Gov't Code. The Proposal and other information submitted to the TWDB by the Respondent are subject to release as public information. The Proposal and other submitted information shall

be presumed to be subject to disclosure unless a specific exception to disclosure under the PIA applies. If it is necessary for the Respondent to include proprietary or otherwise confidential information in its Proposal or other submitted information, the Respondent must clearly label that proprietary or confidential information and identify the specific exception to disclosure in the PIA. Merely making a blanket claim that the entire Proposal is protected from disclosure because it contains some proprietary information is not acceptable, and shall make the entire Proposal subject to release under the PIA. In order to trigger the process of seeking an Attorney General opinion on the release of proprietary or confidential information, the specific provisions of the Proposal that are considered by the Respondent to be proprietary or confidential must be clearly labeled as described above. Any information which is not clearly identified as proprietary or confidential shall be deemed to be subject to disclosure pursuant to the PIA.

All contracts shall include the following language**:** "**Contractor is required to make any information created or exchanged with the state pursuant to this contract, and not otherwise excepted from disclosure under the Texas Public Information Act, available in a format that is accessible by the public at no additional charge to the state**." In addition to this recommended language, the Comptroller also advises that in order to ***comply with the new statutory requirements***, each state governmental entity should supplement this provision with the additional terms agreed upon by the parties regarding the specific format by which the vendor is required to make the information accessible by the public.

5.28 PUBLIC DISCLOSURE

No public disclosures or news releases pertaining to this contract shall be made without prior written approval of TWDB.

5.29 SUBSTITUTIONS

Substitutions are not permitted without written approval of TWDB.

5.30 TAXES

Contractor represents and warrants that it shall pay all taxes or similar amounts resulting from this Contract, including, but not limited to, any federal, State, or local income, sales or excise taxes of Contractor or its employees. TWDB shall not be liable for any taxes resulting from this Contract.

5.31 ACTS OR OMISSIONS

Vendor shall indemnify and hold harmless the State of Texas and Customers, AND/OR THEIR OFFICERS, AGENTS, EMPLOYEES, REPRESENTATIVES, CONTRACTORS, ASSIGNEES, AND/OR DESIGNEES FROM ANY AND ALL LIABILITY, ACTIONS, CLAIMS, DEMANDS, OR SUITS, AND ALL RELATED COSTS, ATTORNEY FEES, AND EXPENSES arising out of, or resulting from any acts or omissions of the Vendor or its agents, employees, subcontractors, Order Fulfillers, or suppliers of subcontractors in the execution or performance of the Contract and any Purchase Orders issued under the Contract. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE

ATTORNEY GENERAL. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM.

5.32 INFRINGEMENTS

a) Vendor shall indemnify and hold harmless the State of Texas and Customers, AND/OR THEIR EMPLOYEES, AGENTS, REPRESENTATIVES, CONTRACTORS, ASSIGNEES, AND/OR DESIGNEES from any and all third party claims involving infringement of United States patents, copyrights, trade and service marks, and any other intellectual or intangible property rights in connection with the PERFORMANCES OR ACTIONS OF VENDOR PURSUANT TO THIS CONTRACT. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM. VENDOR SHALL BE LIABLE TO PAY ALL COSTS OF DEFENSE INCLUDING ATTORNEYS' FEES. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL.

b) Vendor shall have no liability under this section if the alleged infringement is caused in whole or in part by: (i) use of the product or service for a purpose or in a manner for which the product or service was not designed, (ii) any modification made to the product without Vendor's written approval, (iii) any modifications made to the product by the Vendor pursuant to Customer's specific instructions, (iv) any intellectual property right owned by or licensed to Customer, or (v) any use of the product or service by Customer that is not in conformity with the terms of any applicable license agreement.

c) If Vendor becomes aware of an actual or potential claim, or Customer provides Vendor with notice of an actual or potential claim, Vendor may (or in the case of an injunction against Customer, shall), at Vendor's sole option and expense; (i) procure for the Customer the right to continue to use the affected portion of the product or service, or
(ii) modify or replace the affected portion of the product or service with functionally equivalent or superior product or service so that Customer's use is non-infringing.

5.33 TAXES/WORKERS' COMPENSATION/UNEMPLOYMENT INSURANCE – INCLUDING INDEMNITY

1) VENDOR AGREES AND ACKNOWLEDGES THAT DURING THE EXISTENCE OF THIS CONTRACT, VENDOR SHALL BE ENTIRELY RESPONSIBLE FOR THE LIABILITY AND PAYMENT OF VENDOR'S AND VENDOR'S EMPLOYEES' TAXES OF WHATEVER KIND, ARISING OUT OF THE PERFORMANCES IN THIS CONTRACT. VENDOR AGREES TO COMPLY WITH ALL STATE AND FEDERAL LAWS APPLICABLE TO ANY SUCH PERSONS, INCLUDING LAWS REGARDING WAGES, TAXES, INSURANCE, AND WORKERS' COMPENSATION. THE CUSTOMER AND/OR THE STATE SHALL NOT BE LIABLE TO THE VENDOR, ITS EMPLOYEES, AGENTS, OR OTHERS FOR THE PAYMENT OF TAXES OR THE PROVISION OF UNEMPLOYMENT INSURANCE AND/OR WORKERS'

COMPENSATION OR ANY BENEFIT AVAILABLE TO A STATE EMPLOYEE OR EMPLOYEE OF ANOTHER GOVERNMENTAL ENTITY CUSTOMER.

2) VENDOR AGREES TO INDEMNIFY AND HOLD HARMLESS CUSTOMERS, THE STATE OF TEXAS AND/OR THEIR EMPLOYEES, AGENTS, REPRESENTATIVES, CONTRACTORS, AND/OR ASSIGNEES FROM ANY AND ALL LIABILITY, ACTIONS, CLAIMS, DEMANDS, OR SUITS, AND ALL RELATED COSTS, ATTORNEYS' FEES, AND EXPENSES, RELATING TO TAX LIABILITY, UNEMPLOYMENT INSURANCE AND/OR WORKERS'
COMPENSATION IN ITS PERFORMANCE UNDER THIS CONTRACT. VENDOR SHALL BE LIABLE TO PAY ALL COSTS OF DEFENSE INCLUDING ATTORNEYS' FEES. THE DEFENSE SHALL BE COORDINATED BY VENDOR WITH THE OFFICE OF THE ATTORNEY GENERAL WHEN TEXAS STATE AGENCIES ARE NAMED DEFENDANTS IN ANY LAWSUIT AND VENDOR MAY NOT AGREE TO ANY SETTLEMENT WITHOUT FIRST OBTAINING THE CONCURRENCE FROM THE OFFICE OF THE ATTORNEY GENERAL. VENDOR AND THE CUSTOMER AGREE TO FURNISH TIMELY WRITTEN NOTICE TO EACH OTHER OF ANY SUCH CLAIM.

ATTACHMENT A
EXECUTION OF RESPONSE
FOR PROJECT NO. _____

Company Name: _____

Address: _____

_____

_____

Phone Number: _____

I, _____, am the above-referenced company's representative and I am authorized to submit this response and sign future contract documents. By signing, vendor certifies that if a Texas address is shown as the address, the vendor qualifies as a Texas Resident Bidder as defined in Texas Administrative Code, Title 34, Part 1, Chapter 20.

_____ _____
Authorized Signature Date

SECTION 2
COMPANY PROFILE SUMMARY AND HISTORY
FOR PROJECT NO. _____

(To be provided by Respondent)

SECTION 3

COMPANY REFERENCES
FOR PROJECT NO. _____

REFERENCE #1

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3

COMPANY REFERENCES
FOR PROJECT NO. _____

REFERENCE #2

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 3

COMPANY REFERENCES
FOR PROJECT NO. _____

REFERENCE #3

Name of Organization:			
Business Address:			
Business City:			
Business State:		**Zip:**	
Contact Person Name:			
Contact Person Title:			
Phone Number:		**Fax:**	
Client Comments:			

THIS PAGE OR A REASONABLE FACSIMILE SHALL BE RETURNED WITH THE RESPONSE. FAILURE TO RETURN THIS PAGE OR A REASONABLE FACSIMILE WILL RESULT IN THE RESPONSE BEING CONSIDERED NON-RESPONSIVE. ANY NEGATIVE RESPONSE(S) MAY RESULT IN DISQUALIFICATION OF THE RESPONSE.

SECTION 4
RESUMES OF INDIVIDUALS
FOR PROJECT NO. _____

(To be provided by Respondent)

SECTION 5

Historically Underutilized Businesses Subcontracting Plan

FOR PROJECT NO. _____

Please see SECTION IV, GENERAL INFORMATION, No. 4.1-B5

All HUB Subcontracting Plan Forms must be completed and submitted with the Response.

The forms are entitled and can be found at:

HUB Subcontracting Plan Form
HUB Subcontracting Plan Form, SECTION 2 continuation sheet
HUB Subcontracting Plan Good Faith Effort - Method A (Attachment A)
HUB Subcontracting Plan Good Faith Effort - Method B (Attachment B)
HUB Subcontracting Opportunity Notification Form

http://comptroller.texas.gov/procurement/prog/hub/hub-subcontracting-plan/

SECTION 7
(if applicable)
FOR PROJECT NO. _____

Name(s) and Social Security Number(s) of Each Person with at least 25 Percent Ownership of the Business Entity Submitting the RFQ

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

_____
Name

_____
Social Security Number

SECTION 7
SCOPE OF WORK
FOR PROJECT NO. _____

(To be provided by Respondent)