

**Monthly Letter Progress Report #2 – April 2016
Study of Brackish Aquifers in Texas – Project No. 3 –
Rustler Aquifer**

TWDB Contract No. 1600011949

Submitted to

**Texas Water Development Board
P.O. Box 13231
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Prepared by:



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1.0 Budget and Expenses

This report summarizes the project costs for the billing period of April 2016. The total expenses through April 2016 are \$43,537. A budget breakdown by tasks is provided in Table 1. A copy of the progress report has been sent to TWDB contracts department along with the monthly invoice.

TASK	DESCRIPTION	Budget	Invoices			Remaining Budget
			Current	Previous	Total	
1	Project Management	\$9,235	\$ 298	\$2,196	\$ 2,494	\$ 6,741
2	Delineate Vertical & Horizontal Extent of Fresh, Brackish & Saline Groundwater	\$97,688	\$ 10,124	\$19,878	\$ 30,003	\$ 67,685
3	Quantify Volume of Fresh, Brackish & Saline Groundwater	\$13,679	\$ -	\$1,303	\$ 1,304	\$ 12,375
4	Delineate Potential Production Areas	\$20,532	\$ 841	\$5,087	\$ 5,928	\$ 14,604
5	Determine Availability	\$23,086	\$ 3,577	\$0	\$ 3,577	\$ 19,509
6	Final Report, Documentation & Technology Transfer	\$35,780	\$ 231	\$0	\$ 231	\$ 35,549
Total		\$200,000	\$ 15,072	\$28,465	\$ 43,537	\$ 156,463

Table 1. Project Budget Versus Expenses

2.0 Progress on Tasks

This report summarizes activities on project tasks through the month of April, 2016 and is the second progress report on this contract

Task 1 Project Management

INTERA Project Management activities have been focused on several items since INTERA was given the notice to proceed in January. Primary activities have included:

- The Project Manager completed execution of the key subcontracts with Dr. Dennis Powers and Dr. Carlos Torres-Verdin (University of Texas). Both of these subcontracts have been submitted for TWDB review and the UT subcontract has been accepted.

- The subcontract with Dr. John (Jack) Sharp was executed on May 12th and was submitted to the TWDB for approval on May 17th. The last subcontract to be executed is with Carollo Engineers. This subcontract has been drafted and is in the hands of Carollo for signing.
- The Project Manager has worked with the TWDB Project Manager to set the date of the Stakeholder Meeting 2 for June 17th in Ft Stockton.

Task 2 Delineate Vertical and Horizontal Extent of Brackish and Saline Groundwater

Task 2 has been subdivided into 6 subtasks. Progress made on the 6 subtasks is as follows:

Task 2.1 – Acquire and Digitize Geophysical Well Logs:

Picks for the various Member Units and subunits of the Rustler Formation were sent to Dr. Dennis Powers as a Petra project. Dr. Powers is reviewing every pick and making a pick for the Los Medanos limestone on each of the applicable logs. Simultaneously, Dr. Powers is developing his conceptual understanding for the occurrence and distribution of the Member Units of the Rustler Formation. This distribution has large implications related to the distribution of water resource. For example, the distribution of logs where no identifiable Rustler Member is picked symbolizes what we are differentiating as the “collapsed zone”.

In addition to acquiring publicly available logs, we have also initiated the process of cataloging the logs into a format that can be imported into the BRACS database.

Task 2.2 – Draft Techniques and Approaches Report and Meeting:

This report is currently being drafted.

Task 2.3 – Evaluate Structure and Lithology:

All of the structure and lithology has been picked and is now in the QA/QC phase with Dr. Powers. We anticipate this being completed May 10th.

Task 2.4 – Generate Surfaces Defining the Member Units of the Rustler:

The initial phase of plotting the wells for each of the Member Units has begun. The distribution of the geophysical picks, in combination with known structural features (mainly faults) is being considered in anticipation of making polygons that can be used to clip structural surfaces to hydrological boundaries.

Task 2.5 – Formation Parameter Sensitivity Analysis:

Dr. Torres-Verdin provided INTERA with the best 25 wells that he could find. These logs were then sent off to WellGreen to be digitized and sent back to Dr. Torres-Verdin. Within a week of having the logs, Dr. Torres-Verdin was able to relay to us that borehole salinity, as interpreted through the reported mud filtrate resistivity, is imparting major effects on the geophysical signatures. Subsequent calculations, specifically using the short normal resistivity curve, will factor this finding in. In addition, Dr. Torres-Verdin’s work has shown that the volume shale in each of the dolomitic units is reducing the resistivity signature and will need to be considered in the analysis. His work is on schedule to be submitted to INTERA for incorporation into the Methods Report.

Task 2.6 – Interpret Water Quality Based on Distribution of Resistivity:

Given our reliance on Dr. Torres-Verdin’s sensitivity analysis for this task, actual calculations have yet to be made. However, significant progress was made on the generation of a final sampled water quality spreadsheet and immediate inferences based on the geographic distribution of the TDS values has been made (Figure 1). It is apparent that the water quality within the Rustler Aquifer extent is less than 10,000 mg/L TDS and in most cases less than 6,000 mg/L. However to the north and west of the Rustler Aquifer extent TDS values goes up by an order of magnitude. It is inferred that water quality data specifically in the Rustler Aquifer extent is going to be the best water quality to try and match the resistivity signatures to. Where the TDS begins to go above 10,000 mg/L, the relative fraction of Na and Cl ions begins to dominate the solution and create a separate model for correlating resistivity. Given the objective of evaluating the brackish groundwater in the Rustler Aquifer extent as defined by the TWDB, we have confined the analysis to that extent aquifer extent which means that we are looking at a groundwater system with TDS between approximately 500 and 10,000 mg/L TDS.

Task 3 Quantify Volume of Fresh, Brackish and Saline Groundwater

The initial phases of creating surfaces has begun. The creation of the surfaces is the bulk of the work for Task 3. In addition, we are also investigating the use of porosity logs (neutron, density and acoustic) in an attempt to better characterize our porosity distributions.

Task 4 Delineate Potential Production Areas

Task 4.1 - Refine Hydrostructural Model and Transmissivity Estimates

No additional progress was made on this task.

Task 4.2 – Map Hydrogeologic Barriers

No additional progress was made on this task.

Task 4.3 – Identify Protected Areas

INTERA has plotted all of the existing groundwater users as reported in the TWDB Groundwater Database and the Submitted Drillers’ Reports Database. Water wells with water quality values less than around 1,000 mg/L TDS have been identified and appear to be clustered in the southern portion of the Rustler outcrop. Additionally, conversations with local GCD’s and review of USGS reports have presented the hypothesis that some areas of the Rustler Aquifer is recharging the Edwards-Trinity Aquifer and, if this area is able to be geographically delineated, might would not be suitable for a PPA.

Task 4.4 – Identify Potential Production Areas

No work was performed on this task in through April.

Task 4.5 – Potential Production Area Meeting with TWDB

No work was performed on this task in through April.

Task 5 Determine Availability of Brackish Groundwater in Potential Production Areas

The developer of the Rustler Groundwater Availability Model reviewed the model to consider how it could be best used to assess the hydraulic impacts of proposed Potential Production Areas.

Task 6 Final Report, Documentation and Technology Transfer

The Project Manager spent an hour reviewing reporting requirements for project deliverables.

3.0 Planned Activities for the Next Month

The project timeline is quite compressed on this project with a draft report due July 31st. The following section will define key expected activities that will be performed or completed in May of 2016.

Task 1 Project Management

In addition to standard project management activities, the following tasks will be performed in April as part of Project Management:

- The subcontract with Carollo Engineers will be fully executed and submitted to the TWDB for their review.
- The INTERA Team will visit with the TWDB to define a date for Stakeholder Meeting 2. to proposed potential production areas.
- The INTERA Project Manager will work to submit the Methods Report by the third week in May.
- The INTERA Project Manager will work continue to work with project staff to get Middle Pecos to provide relevant data on groundwater use in the Rustler. All prior attempts to solicit their data have failed in that we haven't received any data yet.

Task 2 Delineate Vertical and Horizontal Extent of Brackish and Saline Groundwater

Planned activities for task 2 are as follows:

Task 2.1 – Acquire and Digitize Geophysical Well Logs:

Given our current budget, we anticipate digitizing: the gamma curve for all geophysical logs in cross sections, the deep resistivity curve for some adequate distribution of the 93 publicly available

resistivity logs and all curves for the Key Wells that will be sent to Dr. Torres-Verdin for his sensitivity analysis.

We anticipate getting logs sent for digitization for the cross section wells and the majority of the resistivity logs.

Task 2.2 – Draft Techniques and Approaches Report and Meeting:

Work on this report is ongoing and we anticipate having this report complete and submitted by COB on May 20th.

Task 2.3 – Evaluate Structure and Lithology:

The majority of this work has been completed and any future work on this will be in support of Task 2.4. This work will be completed and documented in the month of May

Task 2.4 – Generate Surfaces Defining the Member Units of the Rustler:

This work is ongoing and we anticipate having this task completed by the end of May

Task 2.5 – Formation Parameter Sensitivity Analysis:

Dr. Torres-Verdin has agreed to provide the necessary information to calculate brackish Potential Production Areas (PPAs) by the end of May. In order to provide that information Dr. Torres-Verdin will need to be close to or at completion with his formation parameter sensitivity analysis. Dr. Torres-Verdin provided some insight into his analysis in late April and is supporting the Methods Report.

Task 2.6 – Interpret Water Quality Based on Distribution of Resistivity:

Once Dr. Torres-Verdin provides the results of his formation parameter sensitivity analysis, his recommendations will be used to interpret water quality from resistivity signatures. Given that the structural picks will already be made and the resistivity signatures will be digitized, it is anticipated that implementing his recommendations will be a relatively quick process which can be presented in the Methods Report and use to develop the PPAs.

Task 3 Quantify Volume of Fresh, Brackish and Saline Groundwater

This task will be implemented using three sets of data: 1) water quality sampled from water wells deemed to be producing from the Rustler Formation, 2) water quality calculated from resistivity logs run through the Rustler Formation and 3) structural picks used to confine the sampled/calculated water quality values to the limestones of the Los Medanos Member and the Culebra and Magenta Dolomite Members of the Rustler Formation. Currently the first and third input datasets are almost complete. What remains is to calculate water quality from resistivity logs and interpolate structural surfaces for the various member units. It is anticipated that these tasks will be completed in late May to early June.

Task 4 Delineate Potential Production Areas

This is anticipated to be finished up by late May to mid-June.

Task 5 Determine Availability of Brackish Groundwater in Potential Production Areas

Limited work is expected to occur on this task in May with the bulk of this analysis being performed in June and July.

Task 6 Final Report, Documentation and Technology Transfer

For May, it is anticipated that the information that will go into the Method's Report will also be put into the Final Report.

4.0 Problems/Issues and Actions Required/Taken

No problems or issues were encountered in April.

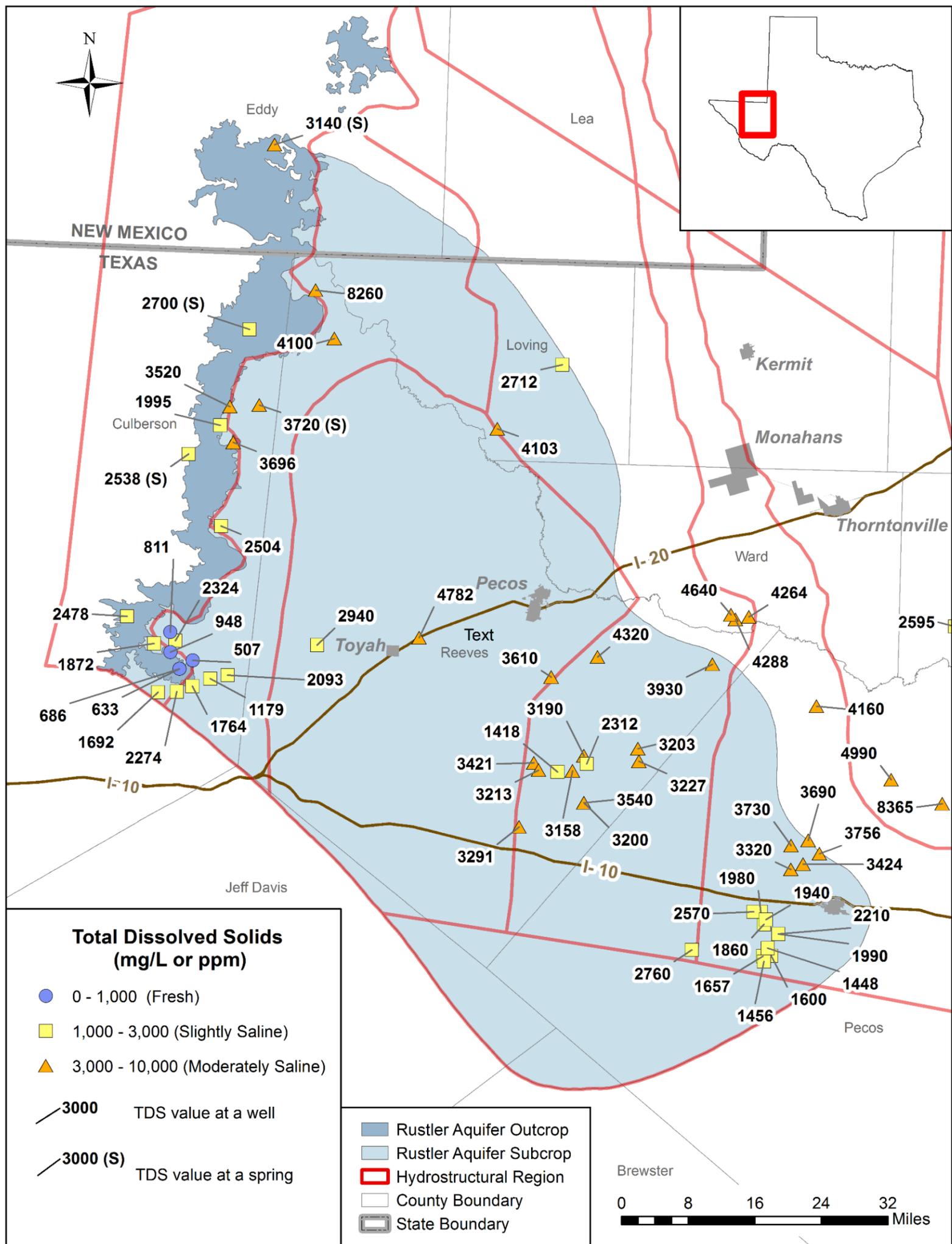


Figure 1 Distribution of water quality samples within the study area.