

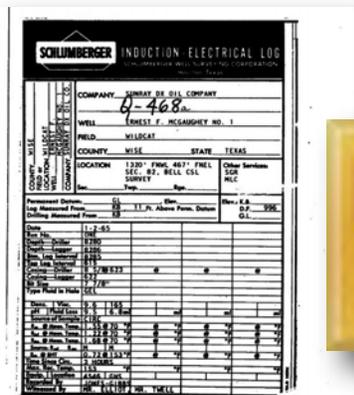
# Locating, Scanning, and Delivering Digital Geophysical Well Logs and Associated Data for Brackish Resources Aquifer Characterization System (BRACS)

by

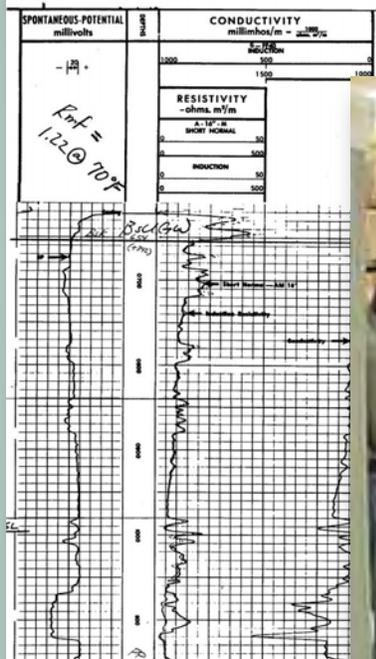
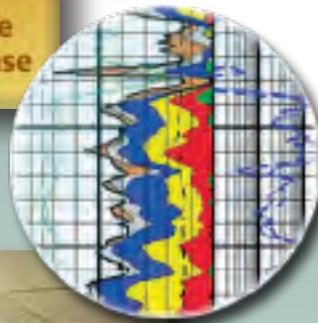
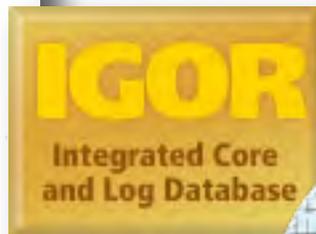
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Report prepared for  
Texas Water Development Board  
under Contract No. 1100011198



Schlumberger Induction Electrical Log form. Fields include: COMPANY: SURVEY BY OIL COMPANY, WELL: WEST F. McARDREY NO. 1, FIELD: WILDCAT, COUNTY: WISSE, STATE: TEXAS, LOCATION: 12301 FINE, 4817 FINE, SEC. 42, BECK C&L, SURVEY: 1, DATE: 11-2-85. It also contains a table for Log Measured From and Logging Interval From.



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June 2012

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WELL LOGS AND ASSOCIATED DATA FOR BRACKISH RESOURCES  
AQUIFER CHARACTERIZATION SYSTEM (BRACS)

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December 2011  
Revised June 2012



## INTRODUCTION

In January 2011, staff at the Bureau of Economic Geology (Bureau), The University of Texas at Austin, began an effort sponsored by the Texas Water Development Board (TWDB) to identify, determine locations, and scan geophysical logs that could be used to help characterize brackish groundwater resources of Texas, enter key attributes of those geophysical logs in a database designed by TWDB, and deliver the scans and database to 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) itself, 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.

## LOG SELECTION AND SCANNING CRITERIA

The guiding principles for identifying geophysical logs that would be most useful to the BRACS project were stipulated in the original Request for Qualifications issued in 2010. These included identifying logs (at a density of one per 2.5-minute grid cell across the state) that reached within 200 ft of the surface (this depth requirement was relaxed to 300 to 400 ft in consultation with TWDB staff during the project) that were acquired with electrical tools (including induction, resistivity, and spontaneous potential). In consultation with TWDB staff, the log type preference was relaxed to include gamma logs in areas where availability of electrical logs was limited. Preference was given for logs having full 10-digit American Petroleum Institute (API) numbers, either already known or identified from log header information. Logs meeting the TWDB criteria were scanned at 300 to 400 pixels per inch in gray scale or color, depending on size and quality of the original document. Logs obtained from other digital collections were imported at their original scanned resolution and type (black and white, gray scale, or color).

## APPROACH

The Geophysical Log Facility (GLF) at the Bureau houses the largest public collection of paper and digital geophysical logs in Texas, but only a minority of the more than 1 million logs in the collection have been cataloged and entered into the IGOR core and log database. As of December 2011, the IGOR database contained 326,945 entries, of which about 62,000 reach within 200 ft of the surface, one of the principal selection criteria for inclusion in the BRACS database.

Our approach to maximizing the number and geographic distribution of geophysical logs to be included in BRACS was to (1) identify candidate logs from the vast collection of uncataloged paper logs donated to the Bureau from many public and private sources; (2) identify scanned and unscanned logs from the IGOR database that match the BRACS criteria; (3) acquire and process scanned logs from several public and private sources; and (4) incorporate logs in unfilled cells from those acquired from the surface casing collection maintained by the RRC (before September 1, 2011, this collection was maintained at the Texas Commission on Environmental Quality).

### Bureau Collections (Paper Archives and IGOR)

The extensive and labor-intensive effort to identify criteria-matching logs from the unprocessed and uncataloged paper collection at the Bureau's 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. These criteria-matching logs were placed in a queue for determining API numbers and geographic coordinates, scanning if the logs were located in an unfilled cell, and data entry. In addition, the IGOR database was queried to identify BRACS criteria-matching candidate logs from the 326,945 entries in that database that fell within unfilled 2.5-minute grid cells. Lists of logs potentially matching the BRACS criteria were sorted by grid cell; paper or scanned logs were then examined to ensure that they met the criteria before scan-

ning and inclusion into the BRACS database. Previously unscanned logs that met the BRACS criteria were scanned to project specifications for eventual delivery.

#### TCEQ and RRC Surface Casing Logs

Geophysical logs from the RRC (formerly TCEQ) Surface Casing Collection include 28,608 logs scanned for the Bureau's multiyear, TCEQ- and RRC-funded Surface Casing Estimator project (at the resolution required for that project) as well as 7,539 newly scanned images from the TCEQ and RRC collection acquired as part of this project in an attempt to increase the log density in counties with sparse log coverage. Data entry was completed for some of the newly scanned logs in low-density counties; these logs are included in the database and scanned-log collection. As a supplemental resource, all other logs scanned from the surface casing collection are also being provided to TWDB as scans without data entries.

#### University Lands Donation

Staff from University Lands, part of The University of Texas System, provided 40,146 electronic log images to the Bureau for possible inclusion in the BRACS database. Of these, 2,238 images fit the BRACS criteria and were distributed among 318 cells in the Permian Basin. These logs were sorted by cell and examined until a criteria-matching log was found, which was then added to the BRACS database. The majority of the logs in this collection were either too deep, were located within an already-filled cell, or were logs acquired using tools other than the preferred induction or resistivity, SP, or gamma. All University Lands log images, including those entered into the BRACS database, are provided to TWDB as a supplemental resource.

#### The University of Texas at El Paso Collection

The University of Texas at El Paso donated about 22,000 paper geophysical logs to the GLF in 2009. Petralogos subsequently scanned these logs and provided copies to the GLF. Criteria-matching logs from this collection were evaluated for inclusion in the BRACS database. A few

additional logs (68) from this collection, beyond those captured in BRACS, are provided to TWDB.

#### Private Donation

Two months before the end of the project, the GLF received a donation of 27,882 scanned images from a private donor. The project ended before the logs could be integrated into the Bureau's collection. Furthermore, some of them are proprietary and cannot be released to the public. Locations of these logs were compared to open grid cells, yielding lists of logs that are candidates for inclusion in the BRACS database. This effort was in progress at the close of the project, yielding 80 log images that were included in the database. Additional logs from this collection could be added to the BRACS collection with additional effort. GIS shapefiles that include well locations within unfilled cells have been provided to TWDB to aid future searches for logs from this collection that might be useful for BRACS.

#### WELL LOCATION SOURCES AND DISTRIBUTION LIMITATIONS

Bureau staff obtained geographic coordinates for wells from public databases such as those maintained by the RRC or the Bureau's IGOR where possible. Many of the logs from older paper collections, which are often the best sources for shallow information, had no entry in RRC or IGOR. Lack of locational information necessitated the use of proprietary sources to quickly assign API numbers, determine latitude and longitude coordinates, establish whether the log was from a well that occupied a previously unfilled cell, optimize log scanning, and conduct data entry. For these logs, well header information was used to identify API numbers and latitude and longitude values from the IHS database, to which the Bureau has been granted limited access licenses. Bureau staff member Beverly DeJarnett requested permission from IHS to use and deliver IHS-derived locations to TWDB. In September 2011, the Bureau received permission from IHS to allow internal Bureau and TWDB use of IHS-derived locations with the stipulation that these locations not be released into a public database. These data are delivered TWDB with the

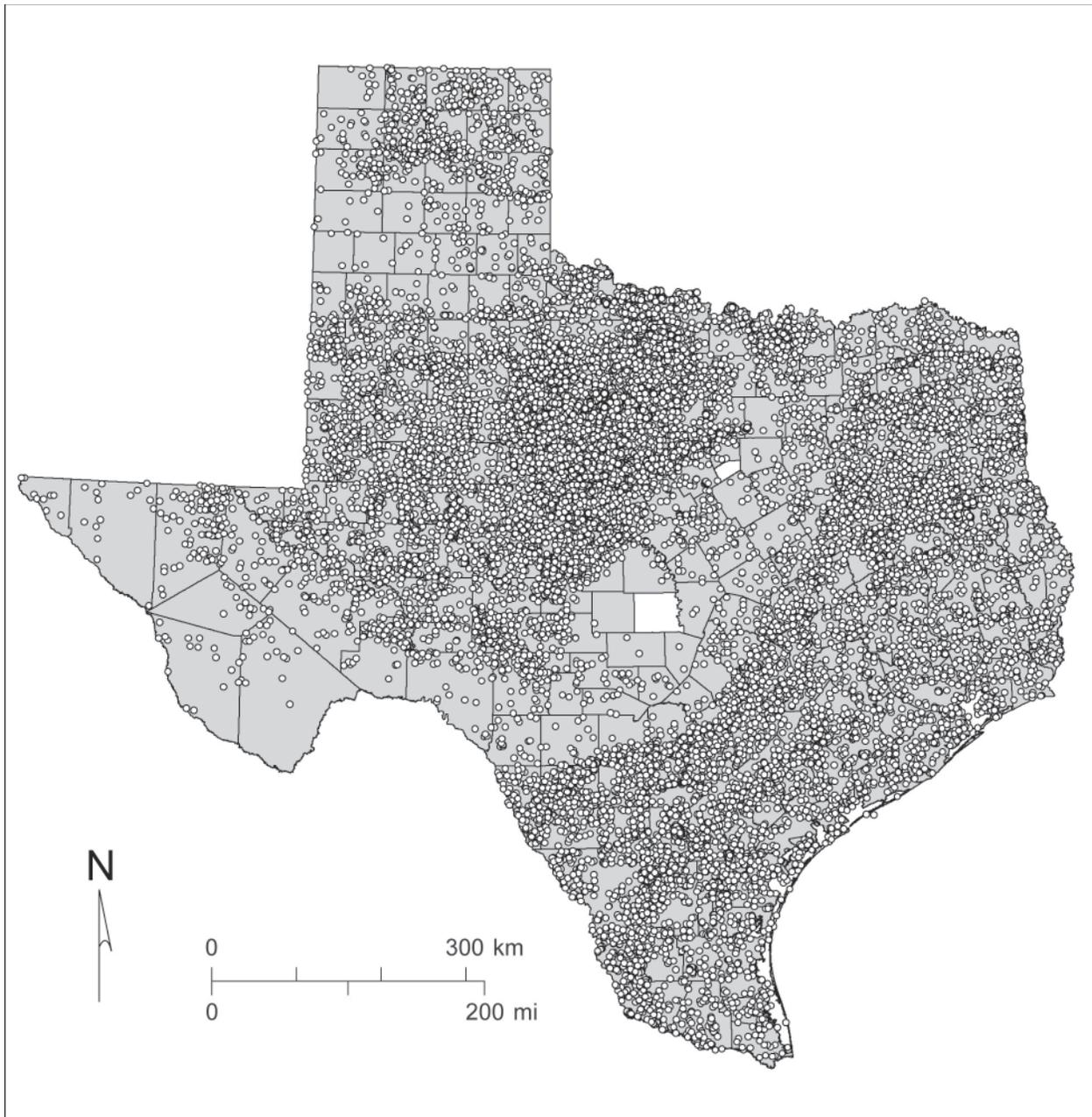


Figure 1. Locations of 19,727 geophysical well logs with entries in the BRACS well-log database. These locations are contained within 12,491 unique 2.5-minute grid cells and 252 of Texas' 254 counties. Shaded counties contain entries in the BRACS database.

understanding that the IHS-derived locational coordinates not be made available to the public. To assist TWDB staff in this effort, a field was added to the Access database to indicate whether the location was obtained from a proprietary source (IHS). Of the 19,727 well entries in the database (fig. 1), 6,800 were obtained from IHS exclusively (these entries have the proprietary flag set to true) and 12,927 are available from other public sources including RRC and IGOR (these entries have the proprietary flag set to false).

## DELIVERABLES

Several hardware, software, and electronic items constitute the deliverables for this project.

These include:

- Two (2) Neurolog log scanners (NeuraScanner II Turbo 12” Color, serial nos. 2621 and 2622), associated software (NeuraView for PC Windows), and extended warranties (through 1/20/2013) purchased by the Bureau with project funds and used by project staff to scan logs at the Bureau and at remote sites such as TCEQ and RRC. Ownership of hardware and associated software has been transferred to TWDB with the vendor.
- One (1) 1 terabyte external hard drive (Seagate FreeAgent GoFlex, part no. 9ZF2A5-500 1 TB, serial no. NA0BHK39).
- Microsoft Access database populated with 19,727 well entries, 20,480 scanned log headers, and 40,539 individual geophysical log traces following the field format prescribed by TWDB, with the addition of a bit field to designate proprietary latitude and longitude coordinates. The majority of the traces are electrical logs, including 11,980 spontaneous potential, 9,665 conductivity (induction), 8,706 resistivity, and 1,646 “generic” electrical logs. More than 7,700 gamma-ray logs are also included.
- Scanned log images associated with Access database entries, sorted into folders named according to Texas county codes (delivered to TWDB in December 2011). Additional images have been transferred to TWDB by ftp transfer since December.

- Scanned log images obtained from public-domain sources (TCEQ, RRC, University Lands, and University of Texas at El Paso) that include logs that have not been entered into the Access database. Many of these logs do not fit the strict log type and depth criteria desired for this project, but may be useful where other coverage is poor.
- ArcMAP-compatible shape files that include (1) well locations from Access database entries (bracsWells\_20120628\_twdb); (2) locations of 25,001 logs that were donated to the Bureau just before the project ended and fall within empty cells, but are not included in the Access database or among the delivered scanned images because they are not yet processed (donatedLogsInUnfilledCells\_20120628\_twdb); and (3) 2.5-minute grid cells that are unfilled from other sources but have logs that are included in the recently donated collection (unfilledCells HavingDonatedLogs\_20120628\_twdb). These GIS files are not among the scheduled deliverables, but are provided as a supplement to assist TWDB staff in identifying logs that may be useful in future studies. The same public distribution limitations for IHS-obtained locations apply to the BRACS log entries shapefile as for the Access database deliverable.
- This report, which summarizes project activities and deliverables.

## FUTURE CONSIDERATIONS

This project enabled the Bureau and TWDB staff to identify cataloged and uncataloged geophysical logs acquired at the Bureau and residing in other public-domain collections that would be useful in statewide aquifer characterization activities. Initial efforts over the limited time available for this project focused on inventorying and identifying criteria-matching logs from the Bureau's uncataloged historic log collection, which yielded much broader statewide coverage than was available from the inventoried and cataloged collections. Nevertheless, there are significant gaps in geophysical log coverage for the state, largely reflective of uneven distribution of oil and gas activity and lack of criteria-matching logs. Improvement in statewide coverage could be obtained by continued efforts locating and scanning logs from the Bureau's uncataloged archives

and the RRC surface casing log collection. In addition, the Bureau has recently received other substantial and uninventoried log donations currently residing at the Houston Core Repository that could yield criteria-matching logs in 2.5-minute grid cells that are currently unfilled. Further, the Bureau continues to receive geophysical logs from the RRC as the designated log repository, as well as significant donations of paper or digital logs from companies and individuals that could also supplement current coverage.

#### ACKNOWLEDGMENTS

This project was funded by the Texas Water Development Board (TWDB) under contract no. 1100011198 to the Bureau of Economic Geology, The University of Texas at Austin. Jeffrey G. Paine served as the principal investigator. Sanjeev Kalaswad (TWDB) served as project manager. TWDB staff who participated in meetings and project design included John Meyer, Matthew Wise, Jorge Arroyo, and David Carter. Numerous Bureau of Economic Geology permanent, temporary, and student staff participated in log processing, selection, scanning, and data entry activities that were overseen by Daniel Ortuño, including Suzanne Bennett, Dennis Campa, Heidi Clausen, Tyler Davis, Dylan Davis, Enrique Deolloz, Elizabeth Doubleday, Lindsey German, Alexandra Gilmore, Douglas James, Berkley Johnson, Alexandra Lewis, Henry Marcus, Bill Molthen, Luis Ramirez, Jeremy Ortuño, Heath Rogers, Rhiannon Roman, Andrew Smith, and Lisa Telles. Aaron Averett designed web applications to streamline data entry and facilitate identification of criteria-matching logs in unfilled cells. Dean Williams at IHS permitted Bureau staff to obtain locations for wells in the IHS database and to provide those locations to TWDB for internal use. David Sunderland at University Lands, The University of Texas System, provided geophysical log images from the University Lands collection. Mark Robinson at Petralogos scanned images from paper logs donated in 2009 by The University of Texas at El Paso to the Bureau. TCEQ and RRC allowed access to their geophysical log library for selective scanning.